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THE SIGNIFICANCE OF CALCIUM FOR HIGHER GREEN PLANTS[1]

In view of the time limit reasonably set for this paper, I shall not attempt to review the very extensive literature that in one way or another deals with the relation of calcium to the plant world, but shall content myself with pointing out certain of the land marks that occur at certain intervals along this oft-traveled road. And, at the beginning, I may as well give Jost's summing up of the situation as he saw it in 1906, [2]when he says, "We are bound to admit that its function has not yet been discovered."

To Salm-Horstmar[3] seems to belong the credit of proving in 1856 that calcium is necessary for phanerogams and is distinctly not replaceable by magnesium.

Almost simultaneously in 1869 Adolph Mayer[4] and Raulin[5] showed that this rule was not of general application since certain non-chlorophyllose types were found to thrive without it.

Mayer grew yeast normally in media from which calcium was lacking and Raulin did the same with Aspergillus. It remained for Molisch[6] in 1895 to demonstrate that not all green plants require calcium by cultivating

[1]Address of the Vice-President and Chairman of Section G, Botanical Sciences, American Association for the Advancement of Science, Toronto, December, 1921.

[2]Jost, Ludwig, "Lectures on Plant Physiology," Gibson's transl. Oxford, 1907: 85.

[3]Salm-Horstmar, "Versuche und Resultate über die Nahrung der Pflanzen, Braunschweig." 1856.

[4]Mayer, Adolph, "Untersuchungen über Alkoholgährung." 1869: 44.

[5]Raulin, *Ann. d. Sci. Nat.*, V, Ser. I, 11: 224, 1869.

[6] Molisch, *Stizb. d. Wien. Akad.*, Abt. I, 104: 733. 1895.

certain algæ in media from which this element was absent.

In the meantime the distilled water problem had arisen to vex all physiologists and in their attempt to deal with it the zoologists had thrown some light on the calcium problem as well. Perhaps fundamental to all was the work of the English physiologist, Sydney Ringer, who, as a by-product of a long series of experiments, developed the generally-used normal saline solution known by his name. While working on the characteristic effects produced by various salts in prolonging the life of organisms in water cultures, he noted the favorable action of calcium salts.[7] He observed that in distilled water calcium and other salts were extracted from fish placed in it, and records that epithelial and mucous cells seemed to become detached from the gills. In later experiments carried out on Tubifex, a freshwater worm, he noted that a far more striking change took place. After a time spent in water from which calcium salts were excluded, the worms disintegrated. When to distilled water a calcium salt was added the worms not only lived but behaved very much as they did in river water.[8]

His explanation of the fundamental causes here operating was couched in rather general language, but one gathers that he conceived them to be of a physico-chemical nature, and the seat of operation was thought to be in the cells of the animals. There is much in Ringer's work to repay the student of general physiology.

The fundamental features observed by him were confirmed by Herbst in 1900[9], when he showed that in certain sea-urchin larvæ grown in sea water from which Ca was lacking, the epithelial tissues dissolved into their component cells. When these dissociated, but still living, elements were returned to calcium-containing sea water, they adhered again to each other at their points of contact. Herbst assumed that a *Verbindungsmembran* exists between the cells when Ca is present, that this membrane is dissolved when Ca is lacking in the external medium, thus releasing the cells of the complex. When Ca is restored, this membrane is reconstituted and again cements the cells at their points of contact.

It is interesting to note in connection with these observations of Herbst those of Knüdson,[10] who found that in Pfeffer's solution the root cap cells of corn and Canada field peas are sometimes sloughed and remain in the medium isolated but living for as long a period as seventy days or more. While it does not appear that a Ca shortage existed in these root cap cells, the possibility of such a shortage would be well worth investigating.

In 1905 and 1906, while engaged in a study of the physiological properties of distilled water, the author, with the kindly aid of his colleague, Dr. Lyman G. Briggs, applied the method of electrical conductivity to the investigation of ion changes in solutions in which seedlings were growing. It was observed that the conducting capacity of distilled water in which seedlings were grown increased, due, it was believed, chiefly to the leaching of ions from the cells of the seedlings. It was noted furthermore that this leaching was checked when a small quantity of a Ca salt was added to the distilled water.[11]

The use of the conductivity method was extended by H. H. Bartlett and the author [12] to a study of ion changes taking place in distilled water and in solutions of calcium nitrate and magnesium nitrate planted with pea seedlings. Owing to the fact that the method as applied to this type of work had not then been carefully studied, more attention was given here to the method. The conclusion was reached that equilibrium concentrations of Ca and NO_3 ions in one case and of Mg and NO_3 ions in the other instance existed for peas below which the roots would leach ions into

[7] Ringer, Sydney, *Journ. of Physiol.* 4: IV. 1883.

[8] Ringer, Sydney, and Sainsbury, H., *Journ. of Physiol.*, 16:4. 1894.

[9] Herbst, C., *Arch. Entwicklungsmech* 9: 424. 1900.

[10] Knüdson, L., *Am. Journ. Bot.*, 6: 309. 1919.

[11] True, Rodney H., *Am. Journ. Bot.*, 1: 255-273. 1914.

[12] True, Rodney H., and Bartlett, Harley Harris, Bureau of Plant Industry, U. S. Dept. of Agri. Bull., 231: 1-36. 1912.

either solution, or into solutions containing both salts mixed in various proportions and above which the roots would absorb ions. It was shown that Ca differed essentially from Mg ions in being harmless in concentrations that proved fatal in the case of magnesium.

The conductivity method was next applied to the problem of absorption by phanerogamic seedlings from solutions of the ordinary nutrient salts; these being studied singly in various concentrations[13] and mixed in a variety of proportions and concentrations.[14] I will not try to deal here with the results gained beyond presenting a brief summary of such points as bear on the question now in hand. As a result of the study of several sorts of seedlings grown in solutions of single salts it may be said that in solutions of potassium and sodium salts no concentration was observed in which the seedlings were able to carry on sustained absorption, in the end yielding markedly more ions to the medium than they were able at any time to appropriate.

In solutions of Ca and Mg salts there was a well defined equilibrium concentration below which the roots were not able to absorb and in these sub-minimal solutions ions leached out into the medium. In solutions stronger than this equilibrium concentration, absorption took place in greater or less measure. It appeared that Ca was more favorable generally than Mg. At no concentration tried, the strongest being about 900×10^{-6} gram norm. per liter, was there any evidence of injury. Where the concentration of Mg was raised in order to ascertain the maximum quantity of absorption, characteristic injury appeared and death more or less promptly thereafter. A similar injury appeared tardily in weaker solutions on longer duration.

In mixtures again, absorption or leach depended on the presence of Ca or Mg ions. Again Ca in high proportion never brought injury. Mg injury appeared less often than in simple solutions. There was little evidence that any such thing as a very definite Ca-Mg ratio exists. In mixtures containing Ca and other nutrient ions, especially when all or a large proportion of the required ions were present, the total quantity of ions absorbed far exceeded the quantity of Ca ions present. This indicated that in such mixtures Ca ions in some way secured conditions that bring about the absorption of ions, that, offered in unmixed solutions, would be unabsorbed, or would cause an active leach of other ions from the plant cells.

Thus we may fairly say that the presence of Ca ions in some way makes those absorbable that would otherwise be unabsorbable and enables the plant to retain ions that it would otherwise be unable to retain. The Ca ions may be truly said to make the others *physiologically available* to the plant. Stating this in terms of the soil, we may say that when the required minimum of Ca ions is not present in the soil solution other nutrient ions present are largely out of reach and such a deficient soil solution may finally leach mobilized nutrients from seedlings. If the required minimum of Ca ions is not present, other nutrient ions may be present in abundance but be *physiologically unavailable* because of the inability of the plant to appropriate them.

Having thus far established the relation between Ca ions and the ability of the roots of the seedlings studied to retain ions gained by the mobilization of their reserves and to absorb others from the nutrient medium outside them, let us turn to a somewhat more detailed study of this phase of calcium action.

Analytical data have long since indicated a close chemical relation between the calcium-content of higher plants and the cell wall. The calcium content is relatively low in young meristematic tissue and increases greatly in those parts characterized by mature cell walls.

A more critical study of cell walls by Fremy, Mangin, Bertrand and others has shown that these are by no means homogeneous structures, either chemically or structurally speaking, but consist characteristically of an outermost layer lying on the boundary line between adjoining cells and other layers lying between it and the

[13] True, Rodney H., and Bartlett, Harley Harris, *Am. Journ. Bot.*, 2: 255-278. 1915.

[14] True, Rodney H., and Bartlett, Harley Harris, *Am. Journ. Bot.*, 2: 311-323. 1915.

[15] True, Rodney H., and Bartlett, Harley Harris, *Am. Journ. Bot.*, 3: 47-57. 1916.

plasma membranes. This outermost boundary layer consists of a calcium salt of a weak organic acid known since work of Mangin as pectic acid. Not only is this structure Ca pectate, but in cases other layers of similar chemical character occur in the thickening materials laid down in the more interior parts of the wall. This Ca pectate has been shown to be a stiff adhesive colloid that is formed when pectic acid meets Ca ions. According to authors from Fremy to Bertrand this acid appears when the neutral mother substance pectin is acted on by the enzyme pectase.

Now in view of the observations of Mangin, Bertrand, and others, and latterly those of Sampson[16] there seems to be considerable freedom in the shifting of cell wall materials into and out of the pectic acid condition, and when Ca ions are present, with the consequent appearance of calcium pectate layers. These chemical shifts are frequently explicable only by relaying them back to internal irritable causes. They appear then in cases to be self-regulated chemical responses to stimuli, perhaps due in the first instance to external conditions, but in their immediate application, to internal causes. Thus Sampson finds in the abscission tissue of coleus leaves following the shock due to inflicted injury a change of more or less of the cellulose of cell wall tissues to pectic acid with a disappearance of calcium ions from the cells of the abscission layers and from their walls. Sampson favors the view that the change of cellulose into pectic acid arising from the irritation that sets in motion the train of abscission phenomena is responsible for the disappearance of Ca. Pectic acid being present greatly in excess of the quantity of Ca ions present can not be converted by these ions into the firm colloid, calcium pectate, but creates a thin, mechanically weak colloidal medium which mutually interdiffuses with the Ca ions and in proportion as the pectic acid exceeds the Ca dilutes and removes it from its original seat.

In this connection it should be noted as a general observation that the conversion of cellulose into pectose is a usual feature in aging cell walls (Sampson: 48). The shift from pectose to pectic acid follows easily.

The change in firmness of fruits and vegetables seen to follow the action of parasitic or of saprophytic fungi seems to be a related phenomenon. Here some form of Wiesner's theory of the generation of organic acids which take possession of the Ca tied up in health in the Ca pectate layers seems likely to apply. With the removal of the Ca by acids formed directly or indirectly by fungi, the pectate layers become pectic acid or something closely akin. Since these substances lack mechanical strength, a slump of the tissues follows.

It was my good fortune to be able during the winter of 1919-20 to associate Dr. Sophia H. Eckerson of the University of Chicago with our work on this calcium problem, then being carried on in the U. S. Department of Agriculture and with her permission I beg to refer here to some of her findings. She grew seedlings of wheat, maize and white lupine in series of solutions closely paralleling others that were receiving attention, or had received attention in conductivity experiments. Dr. Eckerson applied the methods of microchemistry to the study of seedlings grown in potassium solutions in which Bartlett and the author had found a leaching of ions from the seedlings into the solution. She observed (1) that ions readily entered the cells of the roots, (2) that within twenty-four hours Ca ions began to diffuse out of the calcium pectate middle lamella, (3) *K* pectate was formed instead of the Ca salt and this substance being relatively soluble in water soon dissolved, (4) at this stage, *sugars, amino-acids,* and *salts,* chiefly Mg, diffused rapidly out of the roots. Thus we find Dr. Eckerson's microchemical evidence giving us the stages of an event already found to exist by means of our grosser conductivity work. It was established beyond doubt that not only was the cell wall modified and in part dissolved by the replacement of Ca ions by K ions in the solution, but it was shown that the damage goes far more deeply into the cell. Analyses of the leach into distilled water by lupine roots has already demonstrated to us that no less than two thirds of

[16]Sampson, Homer C., *Bot Gaz.*, 66: 32-53. 1918.

the materials yielded were organic and perhaps in large part non-electrolytes. Dr. Eckerson finds that the leach into K solutions are largely organic and non-electrolytic. These solutions must have come in considerable part from the cell contents. The permeability of the cell walls had been greatly modified, also the osmotic properties of the plasma membranes.

These modifications were seen in the passing of materials from within outward. Dr. Eckerson tested the permeability in the opposite direction. Corn seedlings after five days in a KNO_3 solution were placed in a 1 per cent solution of copper sulphate. In one hour the Cu ions had penetrated all of the root tissue. Similar seedlings after five days in a $Ca(NO_3)_2$ solution showed the penetration of Cu ions only after twenty-four hours in a similar copper solution. This seems to make it clear that permeability for ingoing ions is also greatly increased by the changes that we have described.

Experimental work on Mg solutions showed that Mg pectate replaced Ca pectate in solutions of Mg salts. It is known that while Mg pectate is not soluble like K pectate and is less permeable it is slightly more permeable than the firmer Ca pectate.

Dr. Eckerson found in addition to this that the fatal result repeatedly seen in our other work to come after a longer or shorter time to seedlings grown in Mg solutions of more than minimal concentration did not occur until the Ca of the middle lamella had been wholly replaced by Mg. When this had come to pass the cells died. We could perhaps imagine that sufficient uncaptured Mg ions were then free to penetrate the deeper structures of the cell to bring about the fatal upset.

The conclusion seems well founded that the integrity of the calcium pectate forming the middle lamella was maintained when a sufficient quantity of Ca ions was present in the culture solution and with it the normal retention of its contents by the cell. When according to the laws of mass action this quantity of Ca ions fell below the equilibrium concentration, other kations present replaced the Ca in the colloid compound forming the middle lamella. As a result of a long series of experiments in various culture solutions, it may be said that no kation other than Ca has been found that can replace it in this relation without an injurious or fatal change seen in permeability relations, or without the appearance sooner or later of other toxic response. Mg comes most nearly to replacing Ca, but fails, partly because of the greater permeability of its pectate, chiefly because of the ultimately toxic action of the Mg ions when they reach the deeper lying structures.

In view of what has been said, what are we justified in thinking concerning the phenomena that lie deeper than cell walls, what about the living content of the cell? I think we are justified in regarding the cell wall and the plasmal membranes that secrete it, and in closest contact with which it lies, as standing in the closest relation. Cell walls, except in specialized locations, are seldom decisive in determining what ions pass through them. They influence, as we have seen, up to a certain quantity the ions that pass into them, through the chemical changes which take place in the walls themselves and thus far may be regarded as having a certain quasi-determining influence. Beyond that, after chemical demands in the walls have been satisfied, more deeply lying equilibria are concerned. As an ion-containing structure, the cell wall maintains ion-equilibria subject to the laws of equilibria in colloids, with the living membranes with which it stands in most intimate chemical and biological contact. When ion equilibria in the wall are disturbed, this disturbance is transmitted to the equilibria of the protoplast that lays it down, modifies it and remains in closest relation to it. Hence it is not surprising that a drastic change in the very chemical composition of parts of the wall itself if continued should work through and perhaps profoundly affect the equilibria of the protoplasm.

This close relation of protoplasm and cell wall has already been seen in the cases of wall change initiated from within in response to irritation. When cells are melted apart by self-regulatory processes it seems hardly necessary to argue the intimate relation of wall change to protoplasm change. In response to the formative laws governing the organism a dozen or more layers of cells surrounding the embryo of the wheat or maize are completely absorbed and in the end the innermost remaining walls of the ovary are literally cemented to the outer unabsorbed layer of the inner integument.[17] Here is emphatic control of cell walls by the life inhabiting them, control exerted chiefly through the agency of the Ca-ion-equilibria of the tissues concerned. Finally this control in the wheat as in Herbst's sea urchin embryos is shown by the fusing together of *outer surfaces of cell walls.* Here we seem to have clean cut instances to show how in the formative processes the living material is able to command the structure it forms about itself. The outer walls of cells originally located far from each other are brought together by the solution of intervening structures. The substances necessary for the formation of the cementing layer seem to be extruded from the protoplasm through the wall to the outside surfaces where they unite to form the coagulum seen. Perhaps the Ca ions and the pectase thrust through from the interior of the cell meet at its frontier the pectin which under enzyme action yields pectic acid in the presence of the Ca ions. The product of such an occurrence would be seen in the cementing layer formed on the outside of each of the now neighboring cells.

In conclusion, I should like to refer briefly to some of the more practical results that seem to flow from the considerations that have been here set forth.

It appears that a certain quantity of Ca ions must be present in the medium for the maintenance of the chemical and functional integrity of the cell wall, as well as the chemical and functional integrity of the deeper lying living parts of the cells of absorbing roots of higher green plants. When this is so maintained, absorption takes place in the manner we are accustomed to call normal. When this necessary minimal supply of Ca ions in the medium is lacking, be it in soil solution, water culture, or sand culture, the function of absorption is upset and a more or less marked leaching of ions from the plant follows. In the absence of this necessary minimum of Ca ions, the soil solution or culture solution may be rich in all other required ions, but these are useless to the plant. They are unabsorbable. This brings us face to face with a condition of affairs in plant nutrition that has not been recognized and therefore has not been characterized. We may fairly say that Ca ions make *physiologically available* other equally indispensable nutrient ions. The practical consequences that follow from this way of looking at the fertilizer problem have not thus far been realized. We learn why from earliest times civilizations have grown up on soils rich in limestone dèbris. We learn why agriculture has readily succeeded in some regions, not in others. We understand why, by the use of lime, lands have been rendered capable of supporting largely increased populations. We are now able to correlate these broad facts with those of cell physiology and to suggest perhaps not *the calcium function* sought by Jost, but one way perhaps of many in which higher green plants find calcium necessary.

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[17] True, R. H., *Bot Gaz.*, 18: 212-226. 1983.

THE METHOD OF SCIENCE IN AGRICULTURE[1]

To be practical has been the great goal of agricultural investigation from the beginning. It was entered upon with a practical purpose, and in a large degree practical results early came to the expectation of the farming people. Here was a type of science which was not working in the clouds for its own sake, but down in the dirt where the problems of farming lay.

It is fortunate that this has been so—that this close sympathy and this urge to meet the needs of the art have been felt so keenly. It has given life as well as purpose to our branch of science, and the wide extent to which its

[1] Address of the Vice-president and Chairman of Section O—Agriculture, American Association for the Advancement of Science, Toronto, 1921.

findings have been embraced and woven into the warp and woof of intelligent practice has been a constant source of stimulation. It makes even more imperative the call for steady progress, not only in getting practical results for immediate use, but in securing deeper insight and larger intelligence about the common things of agriculture.

The problems of agricultural science have become increasingly difficult. As the simpler things lying near the surface are gradually solved the underlying problems are seen to be more complex and difficult, taxing knowledge, skill, and imagination to increasing extent. Almost have they come to call for that rare perspicacity of the colored preacher who claimed to be able "to explain the unexplainable, to make known the unknowable, and to unscrew the inscrutable."

At all events, there is no more exacting field of experimental inquiry at the present time, and success in it is largely a matter of methods. It calls for a clear conception of the nature of problems and means for deriving the needed data for their solution. Steady advancement in some of the oldest and most common lines of agricultural inquiry rests more largely on the development of methods than on additional experiments or the accumulation of data on the conventional basis. It is the largest problem in agricultural investigation at the present time, and it is so important that in a large degree it determines the progress of science.

Fundamentally the method of science is the same, of course, in agriculture as in the simple sciences. It makes no difference whether the subject is cornmeal or a chemical compound, the response of the growing plant or the law of falling bodies, the experimental method and requirements for the same grade of inquiry are the same. But in practice different types of effort are represented which vary with respect to their aim and the extent to which they require application of the scientific method. The difference is perhaps chiefly a quantitative one, of degree rather than kind, in conception of the end of inquiry rather than in general essentials which must be met.

In the simpler form of agricultural work, consisting of observations, tests and trials, the object may be a quite superficial one—the attempt merely to get a bit of information but one step removed from ordinary experience, such as the profit from use of a fertilizer, the larger crop from spraying, or the advantage of fall plowing. The information may be quite sufficient for the practical purposes of the time and place, but it can not be said to be very scientific, even if made with every care, for the work involves no study of exact relationships or tracing of the effect of conditions. In other cases observations, tests and trials may have a deeper purpose and form a step in investigation. Similarly, experiments may be purely comparative, as showing the relative value of different fertilizers, or feeding stuffs or methods of tillage, without touching any basic fact; or they may be the means of securing scientific facts in a piece of fundamental research.

In the early stages of agricultural experimentation, before the problems had been organized to show their nature and content, the work was naturally elementary, based largely on observations, comparative trials, and simple experiments which did not attempt to determine the underlying conditions or establish definite relationships. These types of work have given results which although largely empirical have been extremely useful. They have supplied a great fund of information on which to develop practical systems and to base further experimental inquiry. Although sufficient for one stage, they may be a poor means of progress in another. Hence they need to be replaced by more rigorous methods and by investigation which goes to the heart of the problems.

It has been a somewhat prevalent mistake to assume that a complex agricultural problem could be solved in its practical aspects without a study of the principles and factors underlying it. This has led to the attempt to secure quick results by short cuts, and has bred overconfidence in the competence of simple comparative experiments. Reliance upon such time-honored procedure in certain classes of work has resulted in the effort to refine them without going outside of them or bringing to their support more abstract types of inquiry which the changing status of the problems made necessary.

This is not to overlook or to minimize in the least the increasing extent to which agricultural research has advanced into new fields or stages of inquiry, has developed improved methods and means of progress, and has been rewarded with results comparable with those in any line of investigation. Such effort has well illustrated the truth that in this branch of research as in other walks of life "we build the ladder by which we rise"; and it argues for a type of experimental work which is critical of its methods and conclusions, seeking means for strengthening them and avoiding error or uncertainty. But certain types of work have not been marked by such growth of vision and method, with the result that they have become doubtful means of scientific progress at the present time. They continue to perpetuate their possible errors or inherent limitations after these have been disclosed. They are not fulfilling the expectations originally placed upon them; and while they have been useful up to a certain point, they are accumulating data after they have ceased to shed new light.

The aim of science is simplicity, the dissolution of complexities, and development of simple facts and statements easily comprehended. Its method begins with a simplifying process, the analysis of problems to get at their real nature and content, the resolution of complex questions into parts which are sufficiently simple and self-contained to be capable of study. Often this can be only partially done at the outset, but as the investigation proceeds and the real nature of the problem is disclosed, the segregating process becomes easier.

In agricultural investigation this is difficult because of the many factors embraced, and in the more common types of work with plants and animals it has been followed to only a limited extent. More often the problem has been an involved and complex one from the start, embracing a wide range of phenomena, and instead of being simplified and reduced to smaller definite units as the work progressed, it has gathered bulk as it went, like a snow ball, until it has become such a complicated aggregation as to be well-nigh unworkable. Too large for any intimate study, the mechanics and routine of it have occupied the full time, and it has often degenerated into the broad accumulation of data.

In constructive research data are secured for use, not for themselves. They are designed for a definite purpose—to solve a concrete problem, to prove or disprove a conception or an idea, to disclose scientific facts. The undirected collection of facts, whether they be observations, results of experiments, or what not, leads to complexity, to an aggregation of data which must first be classified before being used in molding a scientific explanation or a principle, or developing even practical information. Unless there is a clear objective and an idea to guide in the acquiring of data, it may be a waste of time, an aimless, hopeless, dead effort. Its results may be chaotic, impossible of developing a leading principle or an illuminating fact.

There is still a quite prevalent idea that the ends of research may be satisfied by the accumulation of data. It is a common expression in connection with the status of long-continued experiments that data are being accumulated. This is especially apt to be the case where such complex conditions and factors are involved that the results from year to year are confusing, and it is assumed that these uncontrolled variables may be eliminated by long repetition. In such cases there is apt to be lack of a critical attitude toward both the method and the data themselves, and hence the test of adequacy or competence is not applied. Data add to the accumulated fund of information when they are accurate, systematic and orderly, and so capable of enabling deductions or fitting into other supplies which may be so used. Unless they respond to such a test it may well be questioned whether their accumulation is profitable at this stage, when there is already such a large background.

Simplification and definiteness of purpose give direction to the making of records and the gathering of data. All experimental inquiry turns upon securing proof which is both accurate and adequate to the purpose. The method of science is the process of securing accuracy and precision in purposeful observation, and the interpretation of the product. As has been said, it is "only a perfected application of our human resources of observation and reflection."

The method is not a fixed thing but is continually changing as progress makes possible. Science strives constantly after new ways of acquiring and proving facts which would otherwise not be known or but imperfectly so, and at the same time eliminating the personal factor. Apparatus and appliances are designed primarily to make possible the taking of observations which would otherwise not be feasible, or with equal accuracy. They therefore enlarge the field of observation and increase precision.

This applies of course to facilities and methods for agricultural inquiry such as field plats and cylinders, feeding appliances, special apparatus and other means for securing experimental data; and there is the same need of critical examination of these from time to time that there is of other facilities, to determine whether they are supplying proof which is accurate and sufficient, or to assess correctly what can and what can not be shown by such methods.

The question is forcing itself upon the minds of many as to the adequacy of certain types of field experiments, as ordinarily conducted, to answer fundamental questions in plant nutrition and soil management. Large reliance has been placed on such experiments in the past, and data have been accumulated from them over long periods. The oldest series of fertilizer and rotation plats in this country runs back over forty years; several others have been under way from twenty-five to thirty-five years. One station has some two thousand plats.

These experiments have brought highly important practical results, and have marked a definite step in agricultural inquiry. They have furnished a rich background of material and suggestion for more definitely directed studies. The question is whether they have reached their maximum and how far they are to be depended upon in making further advances.

It is now realized that many of these experiments contain inherent difficulties dating back to their beginning, which introduce a strong element of doubt in interpreting results. For one thing, most of the published reports fail to describe the soil except in the most general way, and lack information as to the condition and previous treatment of the field, indications of irregularity, etc. Again, the number of check plats is usually too small, and the same is true of the amount of replication of treatment. This may account for the different interpretations made by different persons from the same series of experiments. In few cases has the necessary number of checks and duplicates been worked out mathematically for such experiments, and where there is considerable variation in different parts of a field, averages may furnish a doubtful basis for measuring the effect of treatments.

The number of questions "put to the soil and the plant" in a given plat experiment has usually been far too large. For example, the customary rotation-fertilizer experiment has often covered practically the whole range of soil fertility and plant nutrition. This wide range has limited the amount of replication practicable, and it has failed to reflect the discrimination in gathering data and the simplification of the problem dictated by the method of science.

Such experiments have relied quite largely on what the field results themselves were interpreted to show, primarily the crop returns. True, most of the later experiments have embodied plans for chemical, bacteriological, and other laboratory studies, but only to a limited extent have these been developed with the progress of the work so as to shed new light. The chemical studies have often become of a routine nature—analyses of the crops and of the soils at stated intervals, and the bacteriological studies by the technique developed have largely failed to meet expectations in establishing correlations between soil treatment and bacterial flora. Such bacteriological observations have now almost ceased in connection with long continued field experiments.

Reduced to such a simple collection of experimental data, the conduct of these extensive field experiments has often become largely a matter of routine. The niceties of plat work are observed, but the element of actual inquiry is deferred until many years have supplied their data. When that time is reached the publication is more often a summary of field and and laboratory records than a critical analysis of the data and their actual meaning. At best the product is quite apt to consist of empirical observations rather than definite contributions to fundamental principles. We have not yet learned how to interpret, except superficially, the answer which the soil and the plant give as to just what has happened or what the apparent effects are due to. We have not yet learned how to examine a plot of soil so as to determine the changes occurring from time to time or brought about by a long continued system of treatment, or how to connect these changes with the response of the crop in a given season or period. Indeed, relatively little study is now given in such experiments to the soil itself, and only to a limited extent are underlying questions suggested by such experiments being given intensive study.

In a word, the indications are that in the majority of cases the use is not being made of such long-time field experiments that ought to be made at this stage. They are rarely being simplified as time goes on, with a narrowing down to specific problems for intensive research, and they are not being increasingly supplemented by definitely directed laboratory study. They ought themselves to be progressive both in method and outlook. They ought to be used as the source of problems and material with which to make further and more profound inquiries.

We can hardly fail to recognize the changed status at the present time, both as to practical requirements and the stage which has been reached in research and its problems. What is especially needed at this stage is the study of factors and their relationships rather than gross comparisons of one complex of conditions with other complexes. This will call for the kind of team work which has been applied to the Rothamsted experiments,—the association of the chemist and the bacteriologist with the agronomist and soil expert, and the guidance of the statistician in both planning and interpretation.

In many of the feeding experiments, also, the unchecked sources of possible error are too great for safety. The small number of animals in the lots gives large chances for the influence of individual variation. The conditions and frequency of weighing may also give misleading indications. Some of the results of such experiments can be measured quite accurately, while others can only be described. Some are not strictly experimental because they embody so many factors not under experimental control and whose probable variation can not be estimated. This is true, as Dr. H. H. Mitchell has recently shown, of the cost or financial returns in feeding. Such results lack permanent value, and are likely to be given a prominence and an application which they are not entitled to.

Experiments of this practical type have been useful in the past and there will be need for them in future. It is important that they occupy their proper place; but in the scheme for investigation they should not take the place of nutrition studies based on more permanent factors than prices and food combinations, or reliance rest too largely on them at this stage.

Many important advancements have been made in animal nutrition which will find application in feeding practice and in showing the reason back of it. These disclose more clearly the functions to be discharged by food, the inherent qualities which account for the observed value or special properties of feeds, and the means of measuring the response of the animal with a high degree of accuracy. Such fundamental investigations ought assuredly to be encouraged, not to the exclusion of but along with the type of feeding experiments which seek a more immediately practical end.

There is still need to cultivate intelligent public appreciation of research conducted in accordance with the spirit and the method of science. It has been far easier to get funds for types of work which promise early contributions to practice than those which dig deep and lay solid foundations to make the whole superstructure sure. The dependence of the former upon the latter needs to be recognized.

The magnificent work of Armsby and his associates has been the admiration of the scientific world, but in spite of its ultimate practical value, and especially in furthering investigation, it had not within itself the elements of publicity, and was only vaguely understood. It never had an assured permanent income, and in that sense was obliged to live from hand to mouth. The loss this entailed is realized too late; and now the future of the work he so admirably started is under discussion. It would be a calamity if it were allowed to fall to the ground.

The large amount of attention now being given to fundamental and searching inquiry on the soil, the conditions of plant growth, and related subjects, should not fail of mention in this connection, for it illustrates the development of insight into these problems. At no period has there been anything comparable to it. The results which are following from these intensive studies amply justify the expectations of them as constructive means of progress.

With all the facts clearly in mind, it is very important to take an account of stock in the more conventional lines of experiment; to study seriously the long list of the better experiments in order to determine what they have actually shown, what they are competent to show, and the lessons they teach in methods. By all means, let us garner in all the teachings of these field and other common types of experiment; let us profit by both the good and the bad experience, but let not the negative results be overlooked in searching for the more positive ones. Such experiments represent large annual expenditures, and they occupy the time of a large body of workers. They express a confidence on which men are staking their efforts and their prospects. It is important to know the place which such experiments should occupy in future study and the manner in which they need to be supplemented. This may be one of the fundamental lessons to be drawn from them, and may indicate that their most useful field is in supplementing laboratory studies, rather than the reverse as at present.

In a public supported enterprise like agricultural investigation there must necessarily be a happy combination of effort representing different grades of intensity. Some problems or stages of them call more urgently for the full measure of the method of science than others, and it will be for the investigator to govern himself accordingly. But he can not fail to exercise a critical attitude toward all his work and his methods, or to exemplify in them the element of real progress.

E. W. ALLEN

U. S. DEPARTMENT
OF AGRICULTURE

THE CONCILIUM BIBLIOGRAPHICUM

IN the issue of *Science* of December 2, I called attention to the critical situation in which I found the Concilium Bibliographicum this summer, when I made a special trip to Zurich to investigate this situation for the National Research Council and the Rockefeller Foundation.

On the occasion of this visit I proposed, after conferences with Mrs. Field (widow of the late Dr. H. H. Field), her business advisers, the chief of the technical staff of the Concilium, and official representatives of the Swiss Natural Science Association, which becomes under Dr. Field's will the legatee, under certain conditions, of Dr. Field's financial interests in the Concilium, a plan for an immediate temporary reorganization of the Concilium to last until January 1, 1922, and a further plan for a provisional permanent reorganization to go into effect as from that date.

The plan for temporary reorganization was put into effect immediately with Professor J. Strohl, of the Zoological Institute of the University of Zurich, as acting director, without salary. The proposed provisional permanent reorganization—by "provisional permanent" I mean a well considered and fully supported organization to run on until international matters may indicate a desirable change—required, for putting into effect, the approval and definite action of the Field estate, the Swiss Natural Science Association, the National Research Council, and the Rockefeller Foundation. I obtained the formal agreement of the Field estate and Swiss Association before leaving Zurich and now the Research Council and the Rockefeller Foundation have signified formal approval and taken the necessary definite action.

This arrangement, which would require too much space to set out in detail here, provides for the control of the Concilium, until some later arrangement for control by a satisfactory international board can be made, by a special Commission set up by the Swiss Natural Science Association on which there shall be an official representative of the National Research Council whose acquiescence must be obtained for any major activity or expenditure of funds proposed by the commission. In addition, the National Research Council sets up a special committee on Concilium matters to advise and instruct the Council representative on the Swiss Commission. This committee of the Research Council is composed of Drs. R. M. Yerkes and L. R. Jones, and myself as chairman. I am also appointed as the Council's representative on the Swiss Commission.

To clear up the current obligations of the Concilium and help maintain it during the next five years the Rockefeller Foundation has appriated and pledged to the National Research Council the following sums: Appropriated: to meet outstanding obligations, $15,000, and for maintenance during 1922, $20,000; pledged: for maintenance during 1923, $20,000; during 1924, $15,000; 1925, $10,000; 1926, $5,000, after which the Foundation assumes no further financial obligation for the Concilium. This means that the Concilium must arrive at a self-sustaining condition by January 1, 1927, or have found by then other philanthropic assistance.

It is proposed that a staff composed of a director, a competent secretary-bookkeeper, three trained technical assistants, three untrained assistants, and the needed stenographers and messengers, be arranged for at once. To maintain this staff and provide the necessary office expenses (postage, telegraph, telephone, fuel, lighting, etc.) the Concilium has not only the Rockefeller Foundation subvention but an annual subsidy of 5,000 francs (Swiss) a year from the Swiss Government and one of 1,000 francs (Swiss) from the Canton of Zurich. It has also whatever income can be derived from sale of its bibliographic cards and books. It has a building of its own, well suited and fairly well equipped for its work.

Thus the Concilium has, thanks to the generous action of the Rockefeller Foundation, a new lease of life and Dr. Field's noble and self-sacrificing work and his plans for increasing the Concilium's usefulness are not to go unregarded. Plans for extending the bibliographic work to other fields not now covered by it, and for a possible development of an abstracting system in addition to the present subject, title and author references, are under consideration. In this connection the managing board of the Concilium will need and will welcome all the advice that can be given it.

There should be, also, a greatly increased list of subscribers to the cards and books issued by the Concilium. The National Research Council will undertake a campaign to add to the list of American subscribers, and the Director (in Zurich) will institute a similar campaign in Europe. So I shall have occasion to ask the editor of *Science* for space in the near future for still another note about the Concilium.

VERNON KELLOGG

THE NATIONAL RESEARCH COUNCIL

HENRY TURNER EDDY

THE death of Henry Turner Eddy occurred at his home in Minneapolis on December 11, 1921, due to an acute attack of pneumonia, after only a few days' illness.

Dr. Eddy was born at Stoughton, Mass., on June 9, 1844. He was the son of Henry Eddy, Yale '32, Congregational minister, and Sarah Hayward (Torrey) Eddy, a graduate and teacher of mathematics at Mt. Holyoke Seminary.

Dr. Eddy graduated from Yale A.B. '67, Ph.B. '68, A.M. '70, Hon. Sc.D. 1912; Cornell, C.E. '70, Ph.D. '72; and Centre College (Ky.) LL.D. He also studied at the University of Berlin and at the Sorbonne, Paris. He was instructor in Latin and mathematics at the University of Tennessee, 1868-9; assistant professor of mathematics and civil engineering, Cornell, 1869-73; adjutor professor mathematics, Princeton, 1873-4; professor of mathematics and astronomy and civil engineering, 1874-90, and dean of the academic faculty, 1874-7, at the University of Cincinnati, and was its president-elect in 1890. The following year he went to Rose Polytechnic Institute, Terre Haute, Indiana, as its president and remained there until 1894, when he resigned and went to the University of Minnesota as professor of engineering and mechanics, in the College of Engineering. In 1906 he was elected dean of the Graduate School, which position he held until his retirement from university work in 1912 as professor and dean emeritus.

After his retirement from teaching at 68 years of age, Dr. Eddy formed an association with Mr. C. A. P. Turner, consulting engineer, of Minneapolis, and spent several happy years in mathematical researches concerning the properties and stresses in reinforced concrete floor slabs, the results of which he published in collaboration with Mr. Turner. Dr. Eddy was one of the first to take up the subject of graphical statics and in 1878 he published his well-known "Researches in Graphical Statics"; this was followed in 1879 by a treatise on "Thermodynamics"; previously to this he had published a mathematical text on "Analytical Geometry."

Dr. Eddy was a member of numerous scientific societies of varied interest, including the American Association for the Advancement of Science, of which he was one of the vice-presidents in 1884; the American Philosophical Society, the American Mathematical Society, the American Physical Society, and the Society for the Promotion of Engineering Education, of which he was an honored past president. He was a man of versatile attainments, as shown by his many valuable contributions to the various societies to which he belonged.

Dr. Eddy was a man of quiet, scholarly tastes, genial in his intercourse and always an inspiration to his associates. He was married in 1870 to Sebella Elizabeth Taylor, of New Haven, Conn., who died on September 5, 1921, only three months prior to the death of her husband. The surviving children are: Horace T. Eddy, Omaha; Mrs. Charles F. Keyes, Minneapolis; Mrs. Clive Hastings, Atchison, Kan.; Mrs. Charles H. Patek, Minneapolis, and Mrs. J. B. Frear, Buffalo, N. Y.

The faculty of the Graduate School of the University of Minnesota has placed on its records the following tribute:

Henry Turner Eddy, Ph.D., LL.D., died on December 11, 1921, at the age of 77 years. In his death the faculty of the University has lost one of its most eminent and honored members.

As professor of mathematics and mechanics from 1894 to 1905, as the first dean of the Graduate School from 1906 to 1912, and as professor emeritus since 1912, Dr. Eddy was a distinguished associate whom the faculty was proud to own as a colleague. His ability as a mathematician won him an international reputation and his high general scholarship and Christian character endeared him to all with whom he came in contact. He was an educator of the highest type, an inspiration to his students and intimate associates, and a wise, sympathetic counsellor in the faculty conferences.

This faculty would express its heartfelt sympathy with the family, in the faith that God has given the departed a rich reward; and the assurance that it cherishes the memory of a noble life that has left a precious and imperishable heritage.

J. J. F.

SCIENTIFIC EVENTS

THE STERLING HALL OF MEDICINE OF YALE UNIVERSITY

THE Yale Corporation and the Sterling Trustees will appropriate from the Sterling funds the amount of $1,320,000 for the erection of a new and modern building to be known as the Sterling Hall of Medicine. With this purpose in view the university has recently acquired most of the city block bounded by Cedar, Broad, Palmer and Rose streets where the dispensary now stands, opposite the New Haven Hospital.

The Sterling Hall of Medicine will have a central entrance and building at the corner of Broad and Cedar streets containing a library of approximately 12,000 volumes, an amphitheater with a seating capacity of about 250, the administrative offices of the dean and registrar, a room for faculty use, students' common room, and on the third and fourth floors single rooms and suites for unmarried instructors in the pre-clinical subjects. Extending along Broad street a wing will provide space and laboratories on the first and second floors for the department of physical physiology, with like provision on the third and fourth floors for the department of pharmacology and toxicology. A similar wing facing the Brady Laboratory and the administration building of the New Haven Hospital on Cedar street will provide on the first and second floors space for the department of chemical physiology, the two upper floors being given over to laboratory space for anatomy. Beyond the central structure will be an animal house where various types of domestic animals will be kept for experimentation and observation, these being available for all departments of the university located in the vicinity of the hospital. The power house, designed on the unit basis with stack and bunkers of sufficient capacity for future requirements of the hospital and the school, will be situated at the corner opposite to the central building.

Day & Klauder, of Philadelphia, are the architects of the Sterling Hall of Medicine. One of the features of this building will be the provision for future expansion as the needs of the School of Medicine require and its finances permit. This means the ultimate completion of the quadrangle.

One of the features of the expansion of the Yale School of Medicine has been its closer affiliation with the New Haven Hospital and the Dispensary. In addition the finances of the hospital have been placed on a stronger footing and the physical rehabilitation has been begun.

Placing the faculty of the Medical School on a university basis of full time organization in the clinical service has been an important step in the consolidation of the work of the Medical School and the New Haven Hospital. With the beginning of the fall term of the present year all four of the clinical departments of the School of Medicine have been placed on such a basis.

THE CROP PROTECTION INSTITUTE

The first annual meeting of the Crop Protection Institute will be held at Rochester, N. Y., in connection with the New York Horticultural Society's meeting. A dinner will be provided on January 12 at the Rochester Chamber of Commerce.

Among those taking part on the program will be Professor W. C. O'Kane of the New Hampshire Agricultural Experiment Station, and chairman of the board of governors of the Crop Protection Institute, who will speak on the ideals of the institute; Dr. L. R. Jones, chairman of the Division of Biology and Agriculture of the National Research Council, whose theme will be the "Relation of Environment to Disease and Disease Resistance of Plants"; Dr. R. W. Thatcher, director of the New York Agricultural Experiment Station, who will speak informally on the "Need for Investigations in the Chemistry of Insecticides and Fungicides." From the standpoint of industry, Mr. G. R. Cushman, of the General Chemical Company, will speak briefly. Professor P. J. Parrott, of the New York Agricultural Experiment Station, will also probably speak on "Paradichlorobenzene."

The Crop Protection Institute, which has a membership of about three hundred and fifty prominent entomologists, plant pathologists, agricultural chemists and manufacturers of insecticides and fungicides and others interested in the protection of all kinds of crops, was organized only a year ago, under the auspices of the National Research Council of Washington, D. C. The purpose of the institute is not to duplicate the work of individuals or other organizations, but to bring about closer cooperation of effort, to strengthen the weak places and develop needed investigations that are not being pursued by other agencies.

Those interested, though not members, are invited to attend.

PUBLIC HEALTH WORK IN THE PHILIPPINES

The Rockefeller Foundation announces that the International Health Board has accepted an invitation to cooperate in carrying out the general scheme of reorganization of the public health activities of the Philippine Islands, which was recently made public by the president of the Senate, Manuel Queson.

The participation of the board will consist in lending the services of certain members of its staff for a limited period and providing specialists as consultants and assists to Philippine government officials in various lines of public-health work. The broad program which the government has adopted for improving health conditions includes the ultimate consolidation of all health functions in a single department of health to correspond with the ministry of health in other countries.

Among the persons whose services will be furnished by the Rockefeller Foundation is an assistant to the dean of the College of Medicine and Surgery of the University of the Philippines, who will assist in developing the medical school and will give particular attention to the problem of providing post-graduate instruction in public health, so that the health workers so urgently needed in the Philippine Islands may be trained locally.

Fellowships for advanced study in the United States will be offered by the board to exceptionally promising and well-qualified young Filipinos, to fit them for the more important administrative and technical positions in the public-health service and for positions as instructors in the College of Medicine and Surgery and as teachers of nursing. Existing facilities for the training of nurses are said to be inadequate to meet the demand for hospital and private service. The nursing situation will therefore be studied and special attention given to training women in public-health nursing.

An assistant will be provided for the director of the Bureau of Science, who will be expected to advise in the further development of that bureau. The Biological Laboratory, which is one department of the Bureau of Science, is to be expanded in order to serve as the central public-health laboratory of the Philippines, with local laboratories in the provinces.

Dr. Victor G. Heiser, director for the East of the International Health Board, and formerly director of health for the Philippine Islands, who is now in New York, will go to Manila in February to assist in carrying out the program.

SCIENTIFIC NOTES AND NEWS

The meeting of the American Association for the Advancement of Science and of the associated scientific societies held at Toronto from December 27 to 31 was notable both for the scientific programs and for the admirable arrangements made for the entertainment of members. The total registration was over 1,800, which is about twice the number anticipated. Large audiences were present at the general sessions at which Dr. L. O. Howard gave the address of the retiring president and Professor William Bateson spoke. The University of Toronto conferred its honorary doctorate of science on Professor Bateson, Dr. Howard and Professor E. H. Moore, the president of the association. We hope to publish the permanent secretary's report of the meeting in the next issue of Science. Officers were elected as follows:

President

J. Playfair McMurrich, professor of anatomy in the University of Toronto.

Vice-presidents and Chairmen of the Sections

Section A (Mathematics): G. A. Miller, University of Illinois.

Section B (Physics): Frederick A. Saunders, Harvard University.

Section C (Chemistry): W. Lash Miller, University of Toronto.

Section E (Geology and Geography): Charles P. Berkey, Columbia University.

Section F (Zoological Sciences): Maynard M. Metcalf, Oberlin College.

Section G (Botany): Francis E. Lloyd, McGill University.

Section I (Psychology): Raymond Dodge, Wesleyan University.

Section K (Social and Economic Sciences): Henry S. Graves, Washington, D. C.

Section L (Historical and Philological Sciences): William A. Locy, Northwestern University.

Section M (Engineering): George F. Sivain, Harvard University.

Section N (Medical Sciences): Francis W. Peabody, Harvard Medical School.

Section O (Agriculture): R. W. Thatcher, University of Minnesota.

Professor W. M. Wheeler, of the Bussey Institution, Harvard University, was elected president of the American Society of Naturalists at its meeting held last week at Toronto.

Professor Henry B. Ward, of the University of Illinois, who for twenty-seven years has been secretary of the Society of Sigma Xi, and has been in large measure responsible for its development during this period, was elected president at the meeting held at Toronto during Christmas week. Professor Edward Ellery, professor of chemistry and dean of the faculty at Union College, was elected to succeed Professor Ward as secretary.

At the meeting of the Geological Society of America and the affiliated societies held last week at Amherst, a silver loving cup was presented to Professor B. K. Emerson, who became head of the department of geology at Amherst College in 1870. The presentation was made by Dr. John M. Clarke, whose address we hope to print.

Dr. W. W. Keen, of Philadelphia, has been elected a foreign associate of the French Academy of Medicine.

Dr. C. Lloyd Morgan, D.Sc., F.R.S., late principal and emeritus professor of the University of Bristol, was presented on December 2 with his portrait, a gift from friends, colleagues and students, both past and present. The portrait was painted by Mr. Anning-Bell.

Dr. J. G. Adami, lately professor of pathology in McGill University Medical School and now vice-chancellor of Liverpool University, has been admitted to the freedom of the City of London.

Mr. Alfred D. Flinn, secretary of the United Engineering Society and Engineering Foundation and chairman of the Division of Engineering, National Research Council, gave an address on "Engineering, research and vicarious tests" at the meeting of the American Philosophical Society on January 6.

Dr. Allen K. Krause, associate professor of medicine, Johns Hopkins University, will deliver the fifth Harvey Society Lecture at the New York Academy of Medicine on Saturday evening, January 21. His subject will be "Experimental Studies on Tuberculous Infection."

Dr. Charles Moureu, professor of chemistry at the Collège de France, who is now in this country as technical adviser to the French Mission for Disarmament, delivered an address on "Natural gases, with special reference to the rare gases" at Columbia University on December 20.

An International Society of Medical Hydrology was founded at a meeting of the Royal Society of Medicine on December 9, with a preliminary membership of 71 medical men from 13 countries. Dr. Fortescue Fox was elected president.

The third congress of the International Society of the History of Medicine will be held in London from July 17 to 22 under the presidency of Sir Norman Moore.

Dr. Adolf Lorenz, the Vienna orthopedic surgeon, has been granted a license to practice medicine in the State of New York. The Board of Regents of the University of the State of New York at a recent meeting voted unanimously to indorse the copy of a license issued to Dr. Lorenz in October, 1902, by the Illinois State Board of Health.

On Tuesday afternoons, beginning on January 17, the following lectures will be given before the Royal Institution: Two lectures by Dr. F. H. A. Marshall on "Physiology as applied to agriculture"; three by Professor H. H. Turner on "Variable stars"; five by Sir Arthur Keith on "Anthropological problems of the British Empire," and two by Dr. J. W. Evans on "Earth movements."

We learn from *The Observatory* that the Royal Astronomical Observatory, Arcetri, Florence, Italy, will henceforth devote its activities to astrophysics, and it will therefore in future be called the Royal Astrophysical Observatory. Professor Antonio Abetti retired from the acting directorship last June on account of age, and has been succeeded by his son, Professor Giorgio Abetti.

Albert W. Smith, formerly dean of Sibley College and recently acting-president of Cornell University, is now consulting engineer with the firm of Henry R. Kent & Co. of New York and Boston.

Morse B. Pringle, chief engineer for the Eastman Kodak Company, has been appointed city manager of Smyrna, Fla.

Dr. Karl Landsteiner, formerly of Vienna and now of The Hague, has been appointed on the scientific staff of the Rockefeller Institute for Medical Research, New York.

Dr. Howard S. Reed, professor of plant physiology at the Graduate School of Tropical Agriculture and Citrus Experiment Station, University of California, is spending part of his sabbatical year in Mexico, Central America and the West Indies. He will return about March 1.

Dr. W. J. Humphreys, professor of meteorological physics, United States Weather Bureau, lectured on "Fogs and Clouds" before the Franklin Institute, Philadelphia, on January 5.

Professor George C. Whipple's book on "Vital Statistics," published in 1919, has been translated into Japanese and is published in Tokyo.

The American Astronomical Society will hold its next meeting at Yerkes Observatory, Williams Bay, Wis., the week following next Labor Day. The next winter meeting will be held at Vassar College, Poughkeepsie, N. Y., and the summer meeting of 1923 probably at the Mount Wilson Observatory, near Pasadena, Cal.

The Washington Academy of Sciences has compiled a tentative list of one hundred popular books in science. The list, which was edited by Dr. R. B. Sosman, corresponding secretary, was compiled at the request of Dr. George F. Bowerman, librarian of the Public Library of the District of Columbia. The standard set up for the books is that they must be both readable and scientifically accurate. The subjects covered are anthropology and physiology, heredity, botany, animals, birds and insects, geology, meteorology, minerals, astronomy, chemistry, physics, mathematics and history of science.

The faculty of Mercer University on December 14, 1921, passed the following resolutions:

Resolved, That the Faculty of Mercer University favor the plan of placing the scientific bureaus of the United States government under the jurisdiction of a board of governors, with the view of unifying all governmental science and developing it to the highest possible efficiency, by affording scientific workers permanent tenure of office, greater freedom in investigation, non-interference through politics, and adequate salaries.

Resolved, That a majority, at least, of the said board of governors be appointed by the American Association for the Advancement of Science, in order that the most able executives in the various fields of science may be appointed to such an important governing board, and that its personnel be free from political influences.

We learn from the *Journal* of the American Medical Association that Senator Wadsworth, of New York, has presented a bill in congress providing for an appropriation of $143,032 to meet the increased cost of land needed adjoining the Walter Reed General Hospital in Washington. On this real estate it is proposed to erect buildings for the medical museum and library and the Army medical school. At the request of Surgeon General Ireland, Congress appropriated two years ago the sum of $350,000 for the purchase of this land, but since the negotiations for the taking over of the property have been under way it has been discovered that it could not be bought at this figure. A request for more money from Congress, therefore, was necessary. Immediate purchase is urged both by Senator Wadsworth, chairman of the Senate committee on military affairs, and Surgeon General Ireland, because it is believed that the land will increase in price in the future and the government should act now as a matter of economy.

The Army medical school is to be the first building erected at a cost of $500,000.

The returns of the British registrar-general for the quarter ending September, 1921, have been issued. They show that in England and Wales there were 214,850 births, which were 15,017 fewer than in the third quarter of 1920. The rate was 22.5 a year for each thousand of population. The deaths numbered 99,134, and were 9,937 fewer than in the preceding quarter, but 5,444 more than in the third quarter of 1920. The rate was 10.4 per thousand. The infant mortality was 83 per thousand births, being 15 below the average of the ten preceding third quarters.

UNIVERSITY AND EDUCATIONAL NOTES

An endowment of $110,000 for the department of art as applied to medicine has been given to the Johns Hopkins Medical School. The gift, by an anonymous donor, was transmitted to the trustees through Dr. Thomas S. Cullen. This department has been established since 1911, with Max Brodel at its head, the same anonymous donor having provided funds for its maintenance.

Work has begun at Pomona College, Claremont, California, on a new chemistry building to cost nearly $250,000. The building will be of reinforced concrete with tile roof and massive tower to conform with the accepted architecture of the college campus. It will provide facilities in undergraduate and research work for 600 students.

Dartmouth College has received a bequest of $5,000 from the late Judge Ira A. Abbott for the increase of the salaries of professors.

At a meeting held on December 9, the board of regents of the University of Michigan voted to merge the homeopathic medical school with the medical school of the university. The expense for the maintenance of the homeopathic school was $47,000 last year and there were seven graduates.

Dr. George J. Heuer, associate professor of surgery at the Johns Hopkins Medical School, has accepted the professorship of surgery in the Medical College of the University of Cincinnati. By accepting the post, he will automatically become chief of the surgical service of the Cincinnati General Hospital.

Professor Henry Jordan has recently been made head of the department of electrical engineering at Colorado Agricultural College at Fort Collins.

DISCUSSION AND CORRESPONDENCE

PUBLIC HEALTH AND MEDICAL PRACTICE

The article "Education in Relation to Public Health and Medical Practice, by Professor S. J. Holmes, which appears in the issue of Science of November 25, 1921, is a highly interesting presentation of a subject which will merit discussion. Its author, however, falls into the common error of those criticizing another profession than their own, of somewhat overstating the case and taking a too pessimistic view of a situation which is constantly being bettered, as, for instance, when he states that "a large part of the time of well-trained medical men is simply wasted in a kind of desultory practice from which their patients secure no permanent benefit," and that "humanity comes very far short of getting out of the medical profession the aid which it is capable of furnishing." As a matter of fact, there are 106,000,000 persons in this country the vast majority of whom are perfectly well cared for medically. The death rate in our larger cities is constantly falling and there are increasing numbers of organizations devoted exclusively to the study and promulgation of public sanitation which are maintained by physicians who furnish gratuitous time and energy without stint. The laboratory tests which the author enumerates are, for the most part, now taught to every third year medical student and the more elaborate tests of this order are not required by more than four or five per cent. of all patients.

The author further comments upon the ignorance of sanitation among our immigrants (which, of course, is deplorable) and writes that the "uninstructed foreigner" "fails to get competent aid when he is ill."

New York City has admittedly the largest and most varied immigrant population of the country. It has, however, many competent foreign born physicians who care for their own kind, besides many hospitals devoted to the care of special foreign groups, like the Italian, French and Lenox Hill (formerly the German Hospitals, besides several others devoted to Yiddish patients. The Health Board of the city is most active and efficient, together with many other agencies, both public and private, in raising the health standards among the foreign born, and special health lectures are given in different languages in the public schools. The infant mortality of the entire city has never been so low as in the past few years and is a source of amazement to distinguished foreign members of the medical profession who come here. The comments of the author upon the fraudulent medical cults with which the country abounds are well made and nowhere to be better ilustrated than in his own quack-beridden state of California, but it is unfair to shift any of the burden of this upon an assumed negligence of the medical profession, which wages constant warfare against it in its county, state, and national associations, only to be defeated time and again by lay legislators. There are too many other operative factors, notably the sensational press, the general restlessness of the times, and indeed the multiplicity of experimental medical tests themselves, which lead patients to compare experiences with one another and seek all manner of examinations whether they need them or not, in order to get their money's worth out of what the author characterizes as "our commercialized system of private practice"—which remark leads one to wonder whether he knows the average income of the legitimate medical practitioner.

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New York City

NOTE ON INHERITANCE IN SWINE

The Berkshire pig is distinguished by the following characters: (1) erect ears, (2) uniform black coat with the exception of "six white points" which occur on the head, on each foot and on the tail, (3) a short "dished" nose, and (4) a somewhat short and broad body. The Large Black pig is distinguished by (1) "flop" ears, (2) uniform black coat without any white, (3) nose not "dished" and of moderate length, and (4) a long body, somewhat narrower than that of the Berkshire. On a farm near Oxford, pure-bred Large Black boars have for some years been crossed with pure-bred Berkshire sows. About a dozen litters have come under the observation of the author of this note and the F^1 generation has invariably shown (1) erect ears, (2) uniform black coat without any white, and (3 & 4) intermediate features as regards nose and shape of body. Latterly, the reciprocal cross has been made (Berkshire boar and Large Black sow) and the F^1 generation shows (1) erect ears and (3 & 4) intermediate characters. But as regards (2) there has appeared a gradation from pure black to spotted pigs in which the whole coat is fairly evenly divided into black and white patches. At present the numbers are small, but it would appear that the gradation is not uniform between the pure black and the spotted condition. There appear to be three classes—pure black, black with the six Berkshire points and spotted. Further it is noticeable that the true spotted pigs have hitherto all been boars, though pure black boars have also appeared.

It may be suggested that erect ear is a simple dominant. The coat color and other features clearly require considerable analysis. It may be that sex linkage is in some way concerned in coloration.

A. M. Carr-Saunders

Department of Comparative Anatomy,
Oxford

ON SUMMARIES OF RECENT ADVANCES IN PHYSICS

The National Research Council has recently issued two valuable pamphlets on the Quantum theory (The Quantum Theory, E. P. Adams, 1920, No. 5; Atomic Structure, David L. Webster, Leigh Page, 1921, No. 14). Similar contributions on other live topics have come, from time to time, from the Bureau of Standards. I wish to express my personal appreciation of this admirable work and hope that more is in store for us.

We, who are about to be shelved, used to live in this country, peacefully under the constitution and we were quite happy in our simplicity. One day a man by the name of Einstein came along and mixed that constitution up. We were told that it had long been an antiquated document anyway. There were difficulties, but eventually we managed to fit in; for they had left us, at least, with the doctrine of energy. Now, I read that the classical law of the conservation of energy must also go, that at best it is only statistical like the second law of thermodynamics. Truly these young bloods are Balkanizing the whole of physics and our ancient constitution has gone the way of the mark.

Carl Barus

Brown University

SCIENTIFIC BOOKS

Trees of Indiana. *By* Charles C. Deam, State Forester of Indiana. First revised edition. 317 pages; 137 plates. Publication 13 of the Department of Conservation, State of Indiana. April, 1921.

The forerunner of the present work, under the same title and by the same author, was issued in 1911. So great was the demand for that book that the edition of 10,000 copies lasted only three years, while a second edition, printed in 1919, was exhausted within five days of publication. The present "first revised edition" is fundamentally a new work, with new illustrations and completely rewritten text.

During the past decade numerous "tree books" have been issued by various state organizations, but it is doubtful if any of these contain more original matter than the present work. Certainly none of them contain more local color. The botanical descriptions are based on Indiana material, and the illustrations are photographed from Indiana specimens, while the distributional peculiarities in Indiana of the various species are treated in gratifying detail. It is in this latter particular, perhaps more than any other, that the book will prove of service to the general botanical public. In the course of his studies of the flora of Indiana, the author, within the last ten years, has traveled more than 27,000 miles, by auto, and has visited every county and traversed practically every township in the state. As a result he is able to present, at first hand, a wealth of detail in regard to local tree distribution, not to mention various other observations which bespeak intimate familiarity with the tree flora of the state. The attention given to the ecological relations of the different species is especially worthy of note, and this feature alone will recommend the work to a wide circle of readers.

George E. Nichols

NOTES ON METEOROLOGY AND CLIMATOLOGY

SKY BRIGHTNESS AND DAYLIGHT ILLUMINATION

What is the relation between sky brightness and the electric light load carried by the central lighting plant? How much sky-light will be cut off by a row of buildings on the opposite side of the street These questions and many others may be solved by studies of the brightness of the sky and daylight illumination such as have been carried out by Dr. H. H. Kimball, of the Weather Bureau at Washington. The practical utility of such investigations is attested by the interest shown by illuminating engineers, architects and electrical engineers. A paper, recently appearing in the *Monthly Weather Review*,[1] summarizes with considerable detail a report submitted to the Illuminating Engineering Society, of whose committee on sky brightness Dr. Kimball is chairman.

The observational program which has been followed in making the measurements has been to make photometric readings with a Sharp-Millar photometer at elevations of 2°, 15°, 30°, 45°, 60°, 75° and 90° above the horizon on vertical circles at azimuth intervals of 45° beginning with the sun's vertical and proceeding half-way around the horizon. Only half the sky is measured because it is assumed that the

1 Kimball, H. H., and Hand, I. R.: Sky brightness and daylight illumination measurements. Sept., 1921, pp. 481-488.

brightness distribution is symmetrical about a vertical semicircle passing through the sun. Such measurements were made on days that were (1) perfectly clear, (2) overcast with thin clouds or dense haze, (3) completely overcast with clouds or dense fog, so that neither sun nor blue sky could be seen, (4) overcast with clouds from which rain or snow was falling, and (5) partly overcast, in an irregular manner.

On clear days it was found that the sky brightness at Washington has somewhat the following distribution: The brightest part of the sky is, of course, that close about the sun. The darkest part is that in the solar vertical about 90° distant from the sun. In general, the sky increases in brightness toward the horizon, although there is a "dark valley" extending from the dark point in the solar vertical to a point about midway between the sun and the horizon. This distribution agrees closely with that observed by Dorno at Davos, Switzerland, except that the Swiss sky is brighter than that at Washington. This difference in brightness is probably the result of secondary reflection of light from the Alpine snows. In comparison with observations made at Chicago University and on the roof of the Federal Building in "Loop" district of Chicago, it was found that the distribution there is much the same, except that the horizon opposite the sun is darker at Chicago than at Washington. This is attributed to smoke, from which the Washington atmosphere is particularly free.

The brightest type of sky measured at Washington is that completely overcast with thin clouds or dense haze. With clouds from which rain is falling, the distribution is about the same as with thin clouds, but its intensity is only half as great.

Measurements of the illumination on horizontal and vertical surfaces were made at Washington and at the two Chicago stations mentioned above. It was found with respect to the variations with change of solar altitude that the illumination on horizontal surfaces increased markedly with increase of solar altitude; but in the case of illumination on vertical surfaces the difference between a surface facing the sun and one oppositely directed grows less with increase of solar altitude. Moreover,

> The daylight illumination on a vertical surface facing opposite the sun, and with an unobstructed exposure to the sky, in the Loop district of Chicago under summer conditions as regards smoke, averages only about two thirds as intense as illumination on a similarly exposed surface at Washington under similar sky conditions with respect to clouds, except when the sun is more than 40° above the horizon and the sky is clear.

The equation,

$$\text{Tan }\theta = h/w\sqrt{1/(1+\tan^2 x)},$$

is given for computing the shading effect of buildings on the opposite side of the street. θ is the angular height of a building as seen from the center of a window across the street, the width of the street being w. The horizontal angle between a normal to the window and a line joining a point p on the building opposite is x, and h is the height of the obstructing building above the point p. The author gives a table showing the relation between x and θ for various values of h/w. Attention is directed to the fact that the horizon is the most effective illuminating agent for vertical surfaces, hence buildings and other objects on the horizon are the most serious obstacles in the question of illuminating rooms through vertically placed windows, especially with a clear sky.

Two interesting examples of the relation between electric light load and sky brightness are given. At Washington, on July 15 and 29, 1921, there occurred thunderstorms about 2:30 p.m. and noon, respectively. On the former occasion, the daylight intensity fell rather quickly to about one foot-candle and the sudden increase in electric light load caused by the nearly simultaneous turning on of thousands of electric lights was sufficient to put the power plant out of commission. The statistician for the company states that

> During the day in the business section a sudden increase in current consumption occurs when the day light illumination intensity falls below 1,500 foot-candles. The lower the intensity, the higher the current consumption, but fluctuations in intensity above 1,800 foot-candles have only a negligible effect.

It appears that some arrangement whereby power companies supplying large cities could have recourse to observations of daylight illumination, especially during the thunderstorm season, would be of decided benefit to them, for the falling off of this illumination would afford an index as to the proper time to prepare to supply additional current.

This sketch is sufficient to indicate the character of the important work being done by Dr. Kimball and to suggest some of the industrial benefits to be derived from the study of daylight under various types of cloudy and smoky sky.

C. LE ROY MEISINGER

WASHINGTON, D. C.

ON STEREOTROPISM AS A CAUSE OF CELL DEGENERATION AND DEATH, AND ON MEANS TO PROLONG THE LIFE OF CELLS

IN former investigations we have shown [1, 2] that amoebocytes of Limulus have the tendency to move and to spread out in contact with solid bodies. We thus found another instance of a reaction which is common to many kinds of cells and which we observed and analyzed in 1897 and subsequent years and which we designated as stereotropism of tissue cells [3].

We further found that the blood cells of Limulus, as a result of this stereotropic response and the concomitant spreading out of their protoplasm along the surface of the solid body, underwent degenerative changes; they lost their granules, became hyaline and gradually motionless and then died. There was some indication that this spreading out of the cells was accompanied by a taking up of fluid from the surrounding medium and that this led to processes of solution which initiated the retrogressive changes. [1, 2, 4]

In order to prolong the life of these cells it was therefore necessary to retard this exaggerated stereotropic response which led to a spreading out of the cell in contact with the solid body. We found previously that this can be done not only by keeping the cells at a lower temperature, which retards other activities as well as the stereotropic reactions and is therefore not specific, but in a specific manner by enabling the cells to rest on a surface previously covered with a thin film of paraffine or vaseline. [4] In contact with such a surface the spreading out of the cells is considerably retarded and the life of the cells and the duration of their amoeboid movement is prolonged. In carrying out these experiments, we make use of the experimental cell fibrin (amoebocyte) tissue, a small piece of which we place on the prepared surface and surround with the desired kind of fluid.

Last summer at the Woods Hole Marine Biological Laboratory we continued these experiments with the cooperation of Mr. K. C. Blanchard [5] and found an additional method of preventing the extension of the cells and thus to prolong their life and activities. This can be accomplished by making the medium into which the cells enter from the piece of tissue very slightly acid, an observation which agrees with our previous finding according to which the cells perish in a neutral solution of isotonic sodium chloride, but are preserved in such solutions after addition of a very small amount of either acid of alkali.[2]

In our recent experiments we found that in such slightly acid media the cells leave the tissue in dense masses and continue to move for a considerable period of time; they are preserved, their spreading out is much retarded and their motor activity in consequence much prolonged. In alkali the cells are likewise preserved for some time, but they begin to spread out and become dissolved much earlier than in acid.

It is possible to grade the effect of acid upon the cells. If the acid used is too strong and

[1] Leo Loeb, *Journal Medical Research*, 1902, II 145. *Virchow's Archiv.* 1903, Vol. 173, 35.

[2] Leo Loeb, *Folia Haematologica* 1907, IV 313. *Pflüger's Archiv.* 1910 Vol. 131, 465.

[3] Leo Loeb, *Archiv. f. Entwickelungsmech.* 1898 VI 297. *Anatomical Record* 1912, VI 109.

[4] Leo Loeb, *Washington University Studies* 1920 VIII 3. *American Journ. Physiol.* 1921, Vol. 56 140.

[5] These experiments will be more fully described by the writer and Mr. K. C. Blanchard elsewhere.

consequently the consistency of the cell too great, their motility is diminished. If it is used in too weak a concentration, the spreading out and solution processes are not sufficiently delayed. In an intermediate concentration of the acid, the consistency is such that the migration of the cells out of the piece is readily possible and at the same time the cells are preserved and the stereotropic reaction is retarded. But ultimately the cells begin to spread out and now retrogressive changes set in even in these favorable media. However, it may be possible to keep the cells active for six days or longer even at room temperature, at which under ordinary conditions the cells spread out and become hyaline on the first or second day.

In this case we recognize thus as the principal cause of cell death an extreme degree of reactivity of the cells in contact with solid surfaces. There is good reason for assuming that this reaction leads to an increased permeability of the surface of the cell which reaches a degree which is injurious and is thus responsible for the subsequent degenerative processes.

Conditions which prevent this extreme stereotropic reaction tend therefore to prolong the life of the cells. Acid acts in this way apparently by increasing the consistency of the cells, at least of its outer layer.

As we have shown elsewhere [4] there exists a striking analogy between the behavior of the amoebocytes and ordinary tissue cells. Through agglutination the amoebocytes produce sheets of a tissue-like material. After an incision in such a tissue cells migrate from the cut edge into the defect, in a way similar to tissue cells adjoining a wound. In both cases two factors determine the direction of migration: (a) The stereotropic reaction, (b) a tendency towards centrifugal movement.

During the process of movement the amoebocytes spread out and thus produce structures totally unlike the original amoebocytes, but closely resembling various tissues. A similar change from agglutinated round cells to cells spreading out in contact with a solid or viscous substratum underlies the embryonic tissue formation. Under the influence of mechanical factors a system of fibrillation can be produced in this experimental amoebocyte tissue which indicates the direction in which the mechanical factors act. In an analogous way we know that certain mechanical effects determine the fibrillation in certain higher tissues. In both cases the tissue formation leads to the production of an elastic tension under which the tissues are held, which latter retract after an incision had been made. The processes of tissue formation had led to the production of potential energy stored in the tissues.

The transformations which we observe in the amoebocytes in the case of tissue formation are, as far as our evidence shows at present, due mainly to two factors: (a) changes in consistency primarily in the outer layer of the cells; this depends in all probability upon a taking up of fluid from the surrounding medium and a different distribution of fluid within the cell, and (b) an increased permeability of the outer layer of the cell. These changes may lead to degenerative processes in the cell.

In some respects the differentiation and specialization of tissue cells in higher organisms has likewise the aspect of retrogressive changes; it may diminish the power of resistance of these differentiating cells. This suggests very strongly that changes of a similar character, although perhaps quantitatively weaker, may take place in the higher tissue cells during the process of tissue formation.

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THE AMERICAN CHEMICAL SOCIETY

(Continued)

DIVISION OF CHEMISTRY OF MEDICINAL PRODUCTS
CHARLES E. CASPARI, chairman.
EDGAR B. CARTER, secretary.

Arsphenamine and neoarsphenamine: GEORGE W. RAIZISS, JOSEPH GAVRON AND M. FALKOV. Arsphenamine and neoarsphenamine are indispensable in the treatment of spirochaetic infections. The elimination of the alarming symptoms or "reactions" attendant upon the use of these drugs is a problem of increasing importance. These have been attributed to chemical impurities which the authors have tried to identify. Incidentally, samples, of unusually high chemotherapeutic indices have been obtained. Methyl alcohol and crystallization have been found in two of the American made products. Experiments show that this does not exert any untoward effect upon the drug. A study of the colloidal properties and the relationship to toxicity has also been undertaken in order to explain the above "reactions."

Hydrogen peroxide, its manufacture and preservation: Paul Poetschke. The quality of the chemicals needed and the equipment required for manufacturing the product and a detailed account of the various stages of the process are given. Briefly, the process consists in hydrating barium peroxide with distilled water and adding this mixture to a dilute solution of phosphoric acid which forms barium phosphate and hydrogen peroxide. Sulphuric acid is then added which regenerates the phosphoric acid converting the barium phosphate into barium sulphate and phosphoric acid. In this way the phosphoric acid is used over and over again. The insoluble barium sulphate and phosphate is then removed by filtration and the filtered hydrogen peroxide purified and adjusted to the proper strength. Experiments with quinine sulphate show that this substance has many advantages over acetanilid as a preservative, particularly in that only 1/10th the amount is required and it does not cause any foreign odor or discoloration. A mixture of benzoic acid and salicylic acid is also effective. Storage in glass bottles of suitable quality, and exclusion of light, are far more effective in restraining decomposition than any of the preservatives studied.

Developments in mercurial antiseptics: Edwin C. White and Justina H. Hill.

The preparation of certain arsenic-free reagents: G. D. Beal and K. E. Sparks.

The preparation of pure fatty acids: G. D. Beal and J. B. Brown.

The preparation of cholesterol esters of fatty acids: G. D. Beal and J. B. Brown.

The determination of aldehydes in essential oils: Francis D. Dodge. The use of bisulfite solutions in the technical determination of aldehydes is sometimes inconvenient, owing to the relative insolubility of the bisulfite compounds. The writer has found the solution of lithium bisulfite quite useful in such cases, the lithium compounds being in general more soluble than the sodium or potassium derivatives. A serious error arises, however, when unsaturated alcohols such as geraniol, linallol, or terpineol are present. The latter react slowly with bisulfite, yielding soluble sulfonic compounds and the aldehyde determination becomes quite inaccurate. Details are also given of experimental work with some other aldehyde reagents.

Crystalline ethyldihydrocupreine (optochin) base: Michael Heidelberger and Walter A. Jacobs. Hitherto only crystalline salts of ethyldihydrocupreine (optochin) have been reported. Having found that dihydroquinine could be advantageously recrystallized from toluene, we dissolved ethyldihydrocupreine in this solvent and allowed the solution to evaporate spontaneously, crystals forming after several days. On seeding a concentrated solution and letting stand the base separated as irregular leaflets containing toluene of crystallization, a portion of which was retained on air-drying, but could be removed by heating *in vacuo*. The base so obtained has approximately the properties of the purest commercial samples of the substance.

Crystalline ethyldihydrocupreine (optochin) base: Michael Heidelberger and Walter A. Jacobs.

The purification of tuberculin and the preparation of ophthalmic tuberculin discs: M. Dorset and J. A. Emery.

Food as a medicine: Harvey A. Wiley.

The need for an improved formula for infusion of digitalis, U. S. P.: A. Richard Bliss, Jr. In response to the complaints of clinicians concerning the unreliability, lack of uniformity, etc., of the Infusion of Digitalis of the U. S. Pharmacopoeia, a pharmacodynamic study of twenty samples of the Infusion was made. Fifteen of the samples were collected at random from retail drug stores, and five of the samples were prepared in the laboratory according to the unofficial method advocated by Hatcher and Eggleston. The method of pharmacodynamic assay employed was that known as the Hatcher and Brody Cat Method, a total of seventy-four estimations being made by this method. Ten of the drug store samples, prepared by the method of the U. S. P. IX, showed an average activity of but 38.1 per cent. of the theoretical activity; five of the drug store samples, prepared by diluting the fluid extract, showed an average activity of but 62.6 per cent. of the theoretical activity; and the five samples, prepared according to the method of Hatcher and Eggleston, showed an average activity of 95 per cent. of the theoretic activity. The dropping of the infusion as prepared by the present U. S. P. method, or the substitution of an improved formula, such as that of Hatcher and Eggleston, is recommended by the author.

The toxicity of Benzyl alcohol and its homologues: OLIVER KAMM. The acute toxicities towards paramecia of homologues of benzyl alcohol agree well with the values predicted on the basis of experimental results obtained with aliphatic alcohols. Given the experimental value for one straight-chain aliphatic alcohol, the toxicities of the remaining members may be calculated by means of the "rule of thirds." The common branched-chain members also fit into the prediction scheme, two methyl groups in the form of side-chains being equivalent to one additional carbon atom in a straight-chain. To predict toxicities in the benzyl series it is simply necessary to apply in addition the previous presented "molecular volume relationship." Illustrative examples are presented.

Pharmacological examination of isopropyl alcohol: DAVID I. MACHT. Acute toxicity of isopropyl alcohol on intravenous injection in cats is greater than that of isopropyl alcohol; but is somewhat less than that of the normal propyl alcohol. The toxicity by mouth gives figures which run parallel to those for intravenous injection. Administration of small doses of isopropyl alcohol (2 cc per kilo) through stomach tube to dogs produced no marked permanent deleterious effects even when continued repeatedly over a number of days. Rats exposed to the fumes of isopropyl alcohol for a series of days showed no signs of poisoning. A large number of experiments performed for the purpose of ascertaining whether isopropyl alcohol would produce toxic symptoms after repeated applications to the skin yielded negative results. In common with other alcohols of the fatty acid series both normal and isopropyl alcohols are toxic for the isolated heart and excised muscle tissues. The effect on circulation is not much depressant in the *intact* animal when the drug is administered in smaller doses. Death after lethal doses is due in most cases to paralysis of the respiratory center but smaller doses produce no dangerous depression of the respiration.

SECTION OF SUGAR CHEMISTRY

C. A. BROWNE, chairman.

FREDERICK BATES, secretary.

Modified sulfate methods for ash in sugar and molasses: E. H. ADKINS AND J. R. WITHROW.

Some studies on decolorizing chars: C. E. COATES. A study was made of the possibility of making a decolorizing char for use in the cane industry from cane bagasse. The material was charred boiled with caustic soda and washed with hydrochloric acid and heated to 850 degrees. An excellent carbon was obtained by this method. Certain observations are given concerning methods for color comparisons with various types of tintometers and colorimeters.

The comparison of various carbons upon the American market: CHR. E. G. PORST AND JOHN M. KRNO. The decolorizing value of various carbons on the market was determined. By the use of steam activation and leaching and other means, carbons were produced from lignite, sawdust, spent boneblack and other materials. These were equal, and in some cases superior, as regards their decolorizing value, to those on the market. A method of grading the carbon was suggested.

Absorption isotherms of some decolorizing carbons: F. W. ZERBAN AND S. BYALL. Isotherms have been determined for the decolorization by six different decolorizing carbons of molasses solutions of varying concentration, and it has been found that, while for one carbon and one concentration the logarithmic curves closely approximate straight lines, there is a marked difference in the constants of the adsorption formula for one carbon at varying initial concentrations of molasses solution, and for the same initial concentration, using different carbons.

Mechanical clarification of cane sugar liquors: A. S. ELSENBAST. Cane sugar liquors are clarified and filtered without the use of chemical defecants by means of the specially prepared filtering medium, Filter-Cel. Details are given for operating with plantation white sugar, plantation white sugar by lime sulphur process, cane and sorghum syrups, raw sugar and standard granulated white sugar in cane sugar refineries.

Decolorizing carbons: H. H. PETERS AND F. P. PHELPS. Twenty different carbons have been used, under identical conditions, for the decolorization of one quality raw sugar, and some of them on the affined sugar and the raw wash resulting from the affination process. The effect is shown on the basis of spectrophotometric analysis which establishes new standards for a correct judgment, far more rigorous than at present accepted by technical colorimetric methods. The names of the carbons are withheld at this time. Not only does the quality of some carbons vary, but new equipment had to be ordered for a systematic and complete inquiry into the nature of the coloring bodies.

Comparison of the various corn product starches: CHR. E. G. PORST AND M. MOSKOWITZ. The Bingham-Green Plastometer is adapted to the examination of various corn starch pastes, alkali, acid and thin boiling (Herschel and Bergquist, Journal of Ind. & Eng. Chem., Vol 13, 703). A short review of the derivation of the formulas required is given. Type curves and tabulated data on the various starches investigated are included. The effect of the temperature of cooking on the properties of the pastes is noted and the need of more accurate formulas suggested.

An inquiry into fundamentals of sugar colorimetry: H. H. PETERS AND F. P. PHELPS. The spectrophotometric investigation of impure sugar products is continued, and the asbestos method of colorimetric clarification and filtration, which was reported in a previous paper, is further critically examined. Beer's Law is valid for concentrated impure sugar liquors (50 Brix), but dilution with water changes the degree of dispersion and colorimetric value of the colloidal nonsugars, invalidating Beer's Law. A new method, using concentrated granulated syrup of known spectral transmissivity for the dilution of heavily colored, concentrated syrups in place of water is presented.

The testing of quartz control plates: F. P. PHELPS. Quartz control plates are used in precise sugar work to eliminate all errors due to variations in the polariscope itself. All quartz plates sent to the Bureau of Standards are subjected to the following tests: (1) Examination of the mounting. (2) Homogeneity of the quartz. (3) Planeness of the faces. (4) Parallelism of the faces. (5) "Axis Error." (6) The precise measurement of the rotation from which the sugar value is calculated. A tentative set of specifications for quartz control plates has been drawn up as an aid in the production of plates of uniformly good quality. It is very important that all quartz control plates be standardized at some central agency such as the Bureau of Standards. The maker's value, which is stamped upon the mounting, can not be relied upon, in fact, plates have been tested at this bureau whose true sugar value differed from the maker's value by approximate 0.°2 of a sugar degree.

The origin and development of the cane sugar industry in America: C. A. BROWNE. The history of plantation cane sugar manufacture in America is briefly sketched with help of lantern slides and old engravings from 1493 down to the present day. The evolution of the mill, evaporator and other machinery is traced with descriptions of such curiosities as Stuart's steam mill and Bessemer's crusher. The methods of white sugar manufacture in Cuba by means of bone black between 1850 and 1860 are described. In conclusion the origin and development of the modern central system are discussed with particular reference to the future growth of the industry.

Enzyme method for determination of raffinose in beet sugar-house products: H. S. PAINE AND F. W. REYNOLDS. The method of Hudson and Harding, which depends on the hydrolysis of raffinose by invertase with formation of melibiose and fructose, and subsequent hydrolysis of melibiose by means of the enzyme melibiase, was adapted for the examination of beet molasses and other sugar-house products. The molasses solution is clarified with basic lead acetate and a small amount of norit, and, after suitable adjustment of the acidity, top yeast extract, containing the enzyme invertase, and bottom yeast extract, containing the enzymes invertase and melibiase, are added to equal portions of the clarified molasses. The difference in the polarizations is a measure of the amount of raffinose present. The success of the method depends upon the use of highly purified and concentrated enzyme preparations.

Rôle of fermentation in the deterioration of cane sugar products: C. A. BROWNE, C. A. GAMBLE, G. H. HARDIN AND M. H. WILEY. The average quality of the raw cane sugar manufactured in the tropics has shown but little improvement during the past five years. Only about 35 per cent. of the Cuban factories make good-keeping sugar of low moisture content. Sugars during deterioration become more hygroscopic, owing to the invert sugar that is formed, and the additional moisture absorbed from the atmosphere accelerates the activity of the destructive microorganisms. The chief requirements for making a good-keeping sugar are: (1) Cleanliness in the factory to prevent infection; (2) A moisture content sufficiently low to retard the growth of yeasts, moulds and bacteria; (3) Bagging the sugar after it has cooled to prevent sweating; (4) Storage in clean, dry warehouses in piles that are not high enough to burst the bags. The deterioration of soft refined sugars is less rapid than that of raw cane sugars of the same polarization. Sugar cane molasses also undergoes deterioration during storage with destruction of both sucrose and invert sugar.

The manufacture of chemically pure dextrose: C. E. G. PORST AND N. V. S. MUMFORD. The development of a method of manufacturing chemically pure dextrose using crystallization from water only is described. The first method used necessitated an alcohol wash and a crystallization from alcohol. This method had to be abandoned owing to excessive cost and another method developed. This method used "Cerelose" as a raw material and "Eponite" as a decolorizing agent. This method had to be abandoned to allow an increase in capacity. Boneblack is now used for decolorizing and the raw material is "Refined Cerelose" made by the Porst and Newkirk method. Difficulties encountered and methods of overcoming them are described.

The purification and concentration of enzyme solutions for the rapid analysis of sugars by enzymotic hydrolysis: F. W. REYNOLDS. Preparations of the enzymes invertase and melibiase were purified by dialysis followed by treatment with a very small proportion of acetic acid, which caused flocculation of impurities. Substances which stabilize the impurities flocculated by acetic acid are apparently removed by dialysis. This treatment is fully as efficient as clarification with neutral lead acetate and does not cause loss of enzymic activity. The filtrate may then be concentrated to practically any desired extent by ultra-filtration, using collodion filters of special composition. Highly active and brilliantly clear solutions of invertase and melibiase of great stability were thus obtained. This method of purification and concentration permits the use of these enzymes as analytical reagents, for rapid analysis of sucrose and raffinose. The construction of a suitable ultra-filter from materials generally available is described.

The estimation of raffinose and sucrose in beet products: R. F. JACKSON. A modification of the enzyme method permits an accurate determination of true raffinose without the difficulty of measuring small changes in polarization in the presence of large amounts of invert sugar. After sterilization of the molasses, the greater part of the invert sugar is removed by fermentation with bakers' yeast. The solution containing the melibiose is filtered, evaporated and divided into two aliquots, which are diluted one tenth, one with water, the other with the invertase-melibiase solution extracted from brewers' yeast. After hydrolysis, both are analyzed for reducing sugar. The difference between them is a measure of raffinose. The method is not standardized against pure raffinose. By the above method analyses were made of samples of Colorado beet molasses. True raffinose was found to be sometimes less and sometimes greater than that indicated by Clerget. From the true raffinose and true sucrose, the direct polarization of the sugars was computed. The difference between the calculated and observed direct polarizations give the rotation of the non-sugars. In every case these proved to be negatively rotating.

A simple diffusion battery for laboratory and lecture room experiments: M. J. PROFFITT. Each cell of the battery consists of a friction top tin can to the inner walls of which near the bottom is soldered a circular woven wire screen molded to a concave shape. A suitably bent copper tube is soldered with a perforation in the side of the can below the screen, and it extends on the outside above the top of the can, to connect with the juice line. It may be provided with a steam jacket for a colorisator. Two short copper tubes are soldered into perforations in the lid of the can, one for an air-vent and the other for connecting to the water-line. The juice, water and cross-over lines consist of glass T-tubes with rubber connections and pinch-cocks. A 14-cell battery without colorisators requires 14 friction top cans, enough wire screen to make the screens, depending upon the size of the cans used, about 60 pinch-cocks, 60 glass T-tubes, 20 feet of copper tubing, some solder, and 50 feet of thin-walled rubber tubing. At current prices, it will cost about $30 and require one day's time to set up. It serves for experiments on water extractions and for familiarizing students with the actual operation of the diffusion process as carried out in the manufacture of beet sugar.

Precipitation of gum from beet molasses: H. S. PAINE AND C. F. WALTON, JR. In order to permit a study of the properties of the gums present in beet molasses, and the effect of such gums on the analytical control and certain phases of the factory process, the following method of preparation was evolved. It is considered more rapid than the dialysis method previously described. Each kilogram of molasses is diluted with 10 liters of water, and to this solution are added 1.4 liters of ammoniacal lead acetate and 0.4 liter of strong ammonium hydroxide. After filtration of the precipitate, it is suspended in water and decomposed with 1:4 H_2SO_4 in carefully regulated amount. The filtrate is neutralized with solid barium hydroxide in the cold, concentrated in vacuo and dialyzed against running tap water.

This solution is clarified with neutral lead acetate, and after removing excess lead with H_2S the dialysis is completed against distilled water. The specific rotation of the gum obtained, on the basis of total solids in the purified solution, was $-38.°8$.

Chemical properties of the gum from cane affected by Cobb's gumming disease and its influence in the sugar-house: C. F. Walton, Jr., and O. S. Keener. Observations were made in Porto Rico of the effect of a gum similar to that from Cobb's gumming disease on factory operations. A somewhat concentrated solution of the gum purified by filtration and dialysis was found to polarize $-0.°6$ V. in a 2-decimeter tube. After hydrolysis with 1 per cent. hydrochloric acid this rotation changed to $+0.°1$ V. The solution after hydrolysis reduced Fehling's solution strongly but gave no test for pentose. Total solids by the Westphal balance corresponded closely to the amount found present by drying. Although the substance was found to be optically active, it was completely precipitated by basic lead acetate as in the usual method of analysis. On the basis of these and other experiments, it is believed that the presence of this gum in cane juice does not interfere with the laboratory analyses.

The dietetic value of sugar: W. D. Horne. The extremely high food value of sugar is not adequately realized. As a producer of heat and energy in the body it is cheaper than almost any other food. With its high calorific efficiency, quick digestibility and present low price, it should logically be used in much larger quantities in old world countries where food and money are scarce. Europe averaged 37 pounds per capita per annum before the war. The United States now averages 86, and New Zealand in 1911 averaged 130. The United States could increase her consumption 20 to 30 per cent. advantageously and Europe much more.

Organic and inorganic composition of corn: C. E. G. Porst and Miss J. F. Mohring.

Some new processes in the sorghum syrup industry: J. J. Willaman. The sorghum syrup industry is being given a new impetus by certain developments in its process of manufacture in a Minnesota factory. The principal ones are: (1) A cleaning machine, which does away with hand labor entirely in the harvesting and cleaning of the cane. (2) Instead of the wasteful settling process of clarification, the whole juice, after defecation with heat and lime, is filtered, infusorial earth being an ideal filtering medium. (3) Treatment of the filtered juice with activated charcoal produces a light colored, mildly flavored product. (4) Evaporation in a vacuum. (5) The seed heads are dried and constitute a valuable by-product. (6) The leaves and bagasse are continuously fed into the fire-boxes, and constitute 85 per cent. of the fuel. (7) The cleaner has reduced the labor hour cost per gallon of syrup from 1.3 hours to 0.7 hour. (8) The cheapening of the processes, the improvement of chemical control, and the breeding of pedigreed and improved cane, have inaugurated a new era in sorghum syrup manufacture.

Note on the first uses of the polariscope in the United States for sugar testing: C. A. Browne. A search of available records indicates that one of Biot's early polariscopes was used in the sugar refinery of J. S. Lovering & Co. in Philadelphia as early in 1843. Two Ventzke polariscopes were imported about the same time, one by the chemical firm of Booth & Boye of Philadelphia, and one by Professor R. S. McCulloh, of Jefferson College, for his research upon sugar and hydrometers for the U. S. government. Information is lacking as to the date of the importation of the first Soleil saccharimeter. An old Soleil instrument used by Valcour Aime of Louisiana and now in the Louisiana State Museum is probably of about the date 1850.

Preparation of fructose from invert sugar: T. Swann Harding. Fructose was prepared by fractional crystallization from invert sugar obtained by the hydrolysis of sucrose by invertase. It was found necessary to recover by the first crystallization 36 to 37½ per cent. of the weight of sucrose taken as glucose. The yield of fructose subsequently crystallized amounted to 23.5 to 28 per cent. of the weight of sucrose taken. The sirups were mixed with glacial acetic acid before setting aside to crystallize. The fructose was recrystallized from alcohol. The effect is discussed of various factors, such as acidity and temperature, on the crystallization of fructose.

Analyses of mixtures of reducing sugars and sucrose with Quisumbing's Fehling solution method. A. W. Thomas. Analyses of known sugar mixtures containing sucrose give more nearly correct results when using the new Fehling reduction method than has been possible by any of the older reduction methods.

Charles L. Parsons,
Secretary

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OBSERVATION VERSUS EXPERIMENTATION[1]

IN gatherings of scientific men such as this one, it is customary to have a number of non-technical addresses, which often take the form of general surveys of certain fields of science, with summaries of what is known in various directions, and with indications of problems which await solution. The topic which I have chosen, however, would indicate that for the moment it seems to me worth while to stop and discuss somewhat the methods of science rather than the results. No doubt all of us look upon both observation and experimentation as necessary evils, the means to arrive at ends or results which are much more important and attractive in themselves than are the processes of obtaining them.

Before a company of astronomers the contest between observation and experimentation might be anticipated to mean a discussion of the relative merits of the old and new astronomy, the astronomy of position, or of precision as its devotees often call it, and the newer field of astrophysics. Or the contest might be between the whole field of astronomy on the one side and the domain of physics and other experimental sciences on the other, for we astronomers have the reputation of being precise and painstaking observers, while the experimenters have, to our minds at least, the habit of spending most of their energies in getting ready to be precise, and then when they are prepared to take what we would call observations, their aim is achieved and they pass on to something else. But my purpose is rather to consider somewhat the struggle which often goes on in the mind of the investigator himself, whether he shall after a certain amount of

[1] Address of the retiring vice-president and chairman of Section D—Astronomy, American Association for the Advancement of Science, Toronto, December, 1921.

preparation begin observing, or whether he shall consider that his conditions are not yet favorable for exact work. Likewise the question may come up in any long series of observations: When is it better to stop and try to improve things rather than to go on in a routine? A similar choice may come to an individual even in deciding his preference for one science or another, and in the fundamental sense this same choice runs through much of our lives, the attraction of the old versus the new.

While we may take up certain considerations from the limited point of view of astronomers, there are undoubtedly applications of these same ideas in many fields of science. Of course we are all interested in improvements, and no one of us would care to admit that he has not the patience and concentration to keep at a task until he has mastered it and can do it well. There are, however, differences in individuals, and as time goes on these are accentuated, and each worker naturally tends to gravitate into the field where he works best and feels at home. The skillful observer is usually an orderly person who keeps his surroundings and apparatus neat and tidy. His instinct is to maintain constant conditions, and if his instrument or apparatus is working perfectly, to let everything remains undisturbed. There is good reason for this, since experience often shows that variation of conditions introduces unsuspected errors. The experimenter, on the other hand, seems to take delight in being surrounded by the débris of his work. Order and system are not part of his creed. He has no hesitancy in dissecting any fine new instrument if some of its pieces will fit in with what he wants, probably much to the consternation of his colleague who is responsible for the equipment. Whenever the observer sees or does anything, he writes down a note, but writing is the last thing of which the experimenter thinks. The observer takes apparatus as it comes to him, the experimenter improves apparatus or devises something new. The observer keeps all or almost all his work, the experimenter has no scruples in throwing away anything which he thinks he can improve upon.

I remember visiting a laboratory in company with a prominent astronomer, where we were shown some spectrum photographs. The physicist in charge showed us a negative which he had just taken, and then threw it aside. My companion promptly asked if there could not be something of value on that plate, if it should not be kept. The experimenter answered that he had dozens equally poor, and that he could reproduce it at will. To the observer even a poor photograph may represent an opportunity which will never return.

It is much easier to teach large classes of students to observe, after a fashion, than to experiment. In a laboratory section, the student will consider favorably a system which enables him to come in and sit down at his table, and without delay to begin and simply take readings. We hear a great deal about teaching the scientific method, but it would be quite impracticable to inflict upon elementary students the real methods of science, the trials and waste of time which any one must undergo before he can determine what he needs, and then find and assemble his apparatus.

There is one direction in which an observer sometimes feels that he has the advantage over the experimenter, and that is in this matter of waste of time. An hour's work for the observer brings an hour's results, whereas the experimenter often puts in a great deal of effort with apparently no return. A safe program of observation brings in sure returns; but is not any one mistaken in assuming that he can avoid waste of effort? It is the fate of most scientific work to be superseded, and the most accurate observations are likely to be quite out of date even in the lifetime of an individual. Bradley's star places have been and are still of great importance as a basis for proper motions of stars, but the time will come when the so-called modern observations will be of the same order of antiquity as those of a century and a half ago, and Bradley's observations will gradually lose their importance. On the other hand, there are many results from positions and proper motions of stars determined from current measures which are obviously of permanent value. Such a case is Boss's cluster in Taurus, a group of stars now widely dispersed, but which as time goes on will gradually condense and become more and more conspicuous as an illustration of what can be predicted from precise data.

Photographic parallax determinations seem to be relegating all previous results to the discard, but parallax observers might as well hurry and get these results while they are still valuable, as the spectroscopic method though at present dependent upon the trigonometric results for a basis need not always remain so, and the mere possibility of interferometer measures of parallaxes should be enough to dampen one's enthusiasm for undertaking too large a program of safe and sane trigonometric determinations.

One of the striking differences between observers and experimenters is their use of the method of least squares. I have heard a young physicist state that he had been advised against taking a course in least squares, because he would never have occasion to use that subject in physics. The answer is that both he and his adviser have probably used the method a great deal, without being aware of it. Experimenters as a rule do not repeat measures enough to get many residuals—one astronomer has said that he wants at least fifty observations to determine a reliable probable error—but the method of least squares is by no means as limited in its usefulness as might be imagined. It is striking in how many fields of exact science the discussion of measurements takes the directions of a graphical exhibition of the results. The experimenter gets some measures which he puts on a graph exhibiting, say, the dependence of one variable upon another. Through a series of plotted points he proceeds to draw a curve; but how does he draw this curve Just what does he try to do when he makes a smooth line pass through a series of points Even for the simplest case of a straight line if you ask a student what he does, he may say that he tries to draw the line as "near as possible to all of the points," whatever they may mean, or he may try to have as many points on one side as on the other side of the line. It is very doubtful if by intuition he will draw that line which makes the sum of the squares of the residuals a minimum, and it is difficult to see how he is to fit any curve to observations without using some of the principles of the method of least squares.

In passing it might be noted that some authors still persist in publishing curves without representing the observed points on which these curves are based. Such a suppression of evidence should not be countenanced. especially as the graph of the original observations gives any one else such a convenience test of the reliability of the curves.

An application of the method of least squares which is of the utmost importance to the experimenter is in the law of propagation of error. The well known relation

$$R^2 = \left(\frac{dX}{dx_1}\right)^2 r_1^2 + \left(\frac{dX}{dx_2}\right)^2 r_2^2 + \; - \; -$$

where R is the probable error of X, a function of several measured quantities, X_1, X_2, ..., is not only useful for determining the probable error of a result, but is even more important in planning a program of observation or of experimentation. Where several quantities enter into a determination there is no object in spending time or effort in the wrong place, and one wonders at the tremendous amount of misdirected effort which is constantly being wasted because of investigators measuring and being careful about the wrong thing, when an elementary acquaintance with this formula would show them which of the various sources of error was contributing most to the inaccuracy of the result. Another advantage of the method of least squares is that it enables a number of unknown quantities to be disentangled from a mass of data where it has been impossible for the experimenter to differentiate with respect to one variable at a time. In astronomical practice this is too elementary even to mention, but it is amazing how physicists and others can get along without knowing how to proceed when the conditions are such that they can make only indirect observations on several quantities. It is, of course, the safest practice to measure directly the quantity sought, and to vary but one thing at a time when that is possible, but an experimenter may find advantage in knowing how to derive several unknowns simultaneously.

However, with all of the advantages of the method of least squares, it is not so seldom that its devotees may go too far with it. How often it occurs that the accuracy of a series of measures as indicated by the probable error is illusory In almost every field of exact measurement we have the presence of both accidental and systematic errors, and he is an optimist indeed who deals with only the former. It is here that the experimenter is at an advantage, as he naturally is constantly seeking to eliminate undesirable factors, and by constantly changing conditions may vary or eliminate what may be called the systematic errors.

It has been said that a worker in exact science usually goes through three stages of attitude toward his work. He starts out by considering every small or unexpected discrepancy as due to a physical reality; after being deceived a sufficient number of times, he has a reaction, and nothing is proved until it is really proved; he then gradually grows back into a state where he is neither too exultant at the first prospect of a discovery, nor too pessimistic over the insufficiency of the evidence for a result which he hopes to establish. We may quote from Langley, who in the discussion of small irregularities of his bolometer records of the solar spectrum said, "When we approach the limits of vision or audition, or of perception by any other of the human senses, no matter how these may be fortified by instrumental aid, we finally perceive, and always must perceive a condition, a condition still beyond, where certitude becomes incertitude, although we may not be able to designate precisely where one ceases and the other begins. This is always the case, it would seem, on the boundaries of our knowledge in every department, and it is so here."

In the estimate of the precision of a given result there is not yet adherence to the logical use of the probable error as a measure of precision or accordance; astronomers long ago adopted this usage, but others seem to get along without it. Only recently I heard in a public address the statement that a certain measure could be made "with an error of one part in a thousand." Just what was meant by this would be difficult to determine, especially as the speaker afterwards said that the "range did not exceed one part in a thousand." These loose statements did not come from a beginner but from a master in the art of exact measurement. Still another example is found in a recent number of a standard journal: "The maximum error is .1 per cent." This is presumably some sort of estimate of the possible systematic error of the result, but one would think that physicists would come to some common ground in describing their errors, so that they could understand each other. One suspects that here we have simply an illustration of the difference between the observer and the experimenter; the former stays with his measures long enough to have a real basis for computing a probable error, the latter has a few measures, and even if he used the formula for the probable error he would be doubtful of its value. Experimenters boast when they have achieved "astronomical precision" in the number of significant figures in their results, but they might equally well cultivate some astronomical accuracy of statement when it comes to describing the reliability or accordance of their results.

The term "astronomical" precision brings to mind the prediction of some years ago that most new discoveries in physics would be in the sixth place of decimals. Whatever else may be said concerning the advances in that science, it will not be maintained that so many significant figures have been necessary to establish the important results. Intelligent lay opinion might be somewhat shocked to learn by what methods astronomers are measuring or estimating distances of stars. A mere guess at the mass of a stellar system may give its distance with far greater accuracy than could possibly be secured by the method of exact measurement. The new things in science continue to be not in the last place but often in the first place of decimals. We should be quite happy to have one significant figure correct in a measure of the size of the visible universe.

There is one particular field in astronomy where the technique of observing as at present practiced is a constant reminder to the observer that either he or some one else had better do some experimenting, and that is in astronomical photography. Many an observer during the tedious hours of long exposure must have felt that some of his time might better be devoted to increasing the sensitivity of the photographic plate, rather than to be continuing the drudgery of keeping a telescope accurately on a star for hours at a time. However, the astronomer knows well that the plate makers themselves are fully alive to the desirability of faster plates, which would have such an enormous commercial value that the astronomical applications would seem trivial in comparison. Nevertheless, one can not but speculate on the field which would be opened to small telescopes if the photographic plate were increased say tenfold in sensitivity, not to mention the power which would then come to large instruments.

There is little need of discussing the relative advantages of large and small telescopes, one might as well discuss the possibilities of abundant and meager resources; but there is at least the consolation to a possessor of a small instrument that he does not need to use it all the time simply to justify the capital expenditure in his equipment. He is therefore much freer to try out new ideas, and even to waste a great deal of time, without the immediate necessity of producing results in proportion to his facilities. The large and well equipped institutions have by no means a monopoly on revolutionary improvements or discoveries.

The choice of an individual between joining a large or a small institution may or may not be the same as the choice between observation and experimentation. In some large places he may become simply a cog in the machine, and easily sink into a narrow routine. On the other hand, the resources of a large place may make it possible for him to try out various schemes which would be quite impossible if he were off by himself. On the whole, one must balance the advantages of each type of institution, but he is a fortunate individual if he has free choice in which direction he will work. There is one resource, however, which is necessary to all scientific investigation, and this is the item of time. You may deprive the investigator of much of his physical equipment and resources, and with plenty of free time he can go on, almost with bare hands as it were; but take away the opportunity to make continued effort, and he will cease to produce. As an illustration of what may be done with almost no equipment we may cite the case of the late Simon Newcomb, who while visiting at a summer resort made a determination of the fundamental quantity, the total light of all the stars. His apparatus comprised only several spectacle lenses, but he succeeded in obtaining a result, and any possessor of a large telescope would be satisfied if he could with all his means occasionally produce something as valuable as that work of Professor Newcomb.

But after all, both the experimenter and observer need to discuss their work, and this entails a certain amount of computation. As a rule the observer becomes more adept in the art of computation simply because he has more of it to do, but either observer or experimenter will probably look upon long computations simply as necessary evils. It has been said of a certain astronomer that his dream of heaven is a sky full of comets and a room full of computers to work out their orbits for him. This reminds us that most important of all is theorization; all of the routine of scientific work, experimentation, observation, and computation are simply a means to an end. The real joy consists in sitting at one's desk and making discoveries which come out of previous work, either from one's own or from that of others. Perhaps the ideal case is where a single individual is able to partake in all phases of investigation, from the preliminary securing of data up to the final discussion of the theoretical bearing of the results. In the old days this was more easy to do than now, for as science becomes more and more complex it is increasingly difficult for one person to master the technique of all the processes involved in a single problem, and with the growth of cooperative research it is possible for several workers to join hands and accomplish what would be far beyond the powers of any one of them. But in any cooperative scheme it should be borne in mind that what is wanted is real cooperation on a democratic basis, and not a direction of individuals by a so-called master mind. Efficient as an autocratic system may be, in science as in other fields it ultimately fails in the question of morale, for when young scientific workers see that however attractive may be the places of the men at the top, the chances for any individual are that he will become only a part of an efficient machine, then a man of ambition will choose some machine where the material rewards are greater than in science.

One great disadvantage in the arrangement of separating the observer and the computer is that a realization of attainable accuracy is likely to be lost. It sometimes seems that the farther the computer is removed in time and place from the original observations, the greater is the accuracy which these observations take on. A good illustration is in some modern computations of results based upon old observations of variable stars. The method of Argelander, of simply looking first at one star and then at another, and estimating the difference of brightness, is still of the utmost value, but errors as great as ten or twenty per cent, in the ratio of the light of two stars are not uncommon. We can make the accuracy seem greater by expressing the estimate in stellar magnitude, when the errors are only one or two tenths of a magnitude, but the fact remains that the discordances are a large fraction of the quantities sought. Some computers taking results of such estimates have managed to derive elements of variable stars where some of the derived quantities are expressed to five significant figures, although the original data were often wrong in the second figure. This fictitious accuracy seems to come from a state of mind where the more you compute the more figures you get, and the investigator needs the restraining influence of experience in securing observational data. Of course, the computer, if he goes about it in the right way, can really show the observer just how accurate the measures are, but in his anxiety to establish some fine theory the computer sometimes loses his own sense of proportion.

And so it goes; the observer does not know how to observe unless he realizes the value of experiment; the experimenter loses a great deal if he has not acquired the technique of observation; neither the experimenter nor the observer can work to the best advantage unless he has the proper theoretical background; and the pure theorist may be saved from various grotesque mistakes if he becomes acquainted with some of the methods and difficulties of securing the facts of physical science.

We may, therefore, best dwell not on the differences among experimenters, observers, and theorists, but rather on their strength when united and working together. No matter how well rounded an individual may become, his capabilities may be easily surpassed by a group of cooperating workers. If it be objected that new ideas will not originate in a committee, the answer is that any one of us has plenty of ideas, many of them fundamental and important, but what we lack is the ability and power to put our ideas into execution. It is here that to my mind lies the great advantage of the policy of the National Research Council in bringing together in committee workers from all over the country so that they can form plans of joint attack on various problems. In our universities and other institutions there is great opportunity for cooperative effort between colleagues, but even in the same institution or department the interests may be so divergent that a worker may find little help of just the kind that he needs, whereas in some other parts of the country may be one or more competitors who, if they can be got together to talk things over, will turn out to be only hearty collaborators.

Astronomy is called the oldest of the sciences; our friends in other fields say that it has been in the lead in America, and especially that astronomers were the first to organize cooperation in research. Let us not fail to continue to deserve this good name, and to set the example in so far as we can of free trade and mutual good will in the solving of our problems.

Joel Stebbins
University of Illinois Observatory

GENERAL FEATURES OF THE TORONTO MEETING

The second Toronto meeting of the American Association for the Advancement of Science and of the associated scientific societies, which was held during the last week of the year just ended, was the seventy-fourth meeting of the association. It was successful in every way and must go on record as the most satisfactory meeting thus far held, aside from the greater, four-yearly meetings. Some of these greater meetings—as the last Chicago meeting, for example—have surpassed it in the number of those in attendance, and in the number of societies meeting with the association, but it is safe to say that the second Toronto meeting was at least equal to any previous meeting in other respects. Fourteen sections of the association were represented, and twenty-six associated societies. The general program,[1] of 95 pages, showed the programs of all sections and societies. About nine hundred addresses and contributed papers were presented, representing nearly all branches of science. If these were printed together they would make four large volumes.

The total number of those in attendance was 1,832, geographically distributed as shown below:

SUMMARY:

United States, including Hawaii and the Philippine Islands	867
Canada	953
England, Belgium and Japan	12
Total	1,832

BY REGIONS:

City of Toronto	686
Ontario outside of Toronto	186
Quebec	34
New Brunswick, Nova Scotia and Prince Edward Island	15
New York State	199
Maine, Vermont, New Hampshire and Rhode Island	34
Massachusetts	48
Connecticut	19
Pennsylvania	68
New Jersey	28
District of Columbia	57
West Virginia, Virginia, Delaware and Maryland	39
Ohio	59
Michigan	48
Indiana, Kentucky and Tennessee	34
Wisconsin	30
Illinois	77
Minnesota, Iowa and Missouri	54
North Dakota, South Dakota, Nebraska and Kansas	19
Saskatchewan and Manitoba	22
Montana, Wyoming and Colorado	13
British Columbia and Alberta	10
Washington, Oregon, California, Idaho, Nevada and Utah	11
North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana and Arkansas	16
Arizona, New Mexico, Texas and Oklahoma	12
England	5
Belgium	3
Hawaii	1
Philippine Islands	1
Japan	4

On the afternoon of Monday, December 26, the day before the official opening, the secretaries of the sections met with the general secretary and the permanent secretary to discuss some of the general problems of the association. They dined together and continued their conference in the evening. On Tuesday afternoon Dr. F. R. Moulton, professor of astronomy in the University of Chicago, showed some very fine motion pictures on scientific subjects, illustrating the use of motion pictures in education. The films were furnished by the Society for Visual Education of Chicago.

This meeting of the association and the associated societies was held in Toronto on invitation of the University of Toronto and of the Royal Canadian Institute. The sessions were held in the buildings of the university, which are excellently adapted for such purposes, while the majority of those in attendance were very conveniently housed in the university dormitories. Meals were served in the university dining halls. These arrangements proved to be unusually convenient and satisfactory for all, and especially for those

[1] Fifteen hundred copies of the general program were printed, but this number proved to be inadequate, and many of those who registered late in the meeting did not receive copies. A few copies are now available in the permanent secretary's Washington office, and these may be had by members on request, as long as the supply lasts.

who roomed at the university. For these there was comparatively little need for going back and forth between the university grounds and the down-town section of the city. The hospitality of the University of Toronto and of the Toronto friends of science was greatly appreciated.

The meeting was formally opened on the evening of Tuesday, December 27, in Convocation Hall, the University of Toronto, under the able presidency of Dr. E. H. Moore, professor of mathematics in the University of Chicago, who was introduced by the retiring president, Dr. L. O. Howard, chief of the Bureau of Entomology of the U. S. Department of Agriculture, who was permanent secretary of the association for many years. Sir Robert Falconer, president of the university, delivered an admirable address of welcome, calling attention especially to the close and friendly relations that have so long obtained between Canada and the United States. This was followed by the address of the retiring president. Among many other interesting things, Dr. Howard called attention to the fact that the average age of the presidents of the British and of the American Association since 1895 is about the same—61 years and 11 months for the British and 61 years and 5 months for the American. The second part of Dr. Howard's address dealt with the topic. The War against the Insects. He considered the unceasing warfare that must be waged by mankind against the almost countless and omnipresent forms of insect life which threaten the very existence of the human race. Dr. Howard's address has been printed in full in Science, for December 30, 1921. The opening sessions were followed by a reception in the room behind Convocation Hall, where members and their friends had opportunity to meet one another and to examine the exhibits of scientific apparatus and products brought together under the auspices of the association for this meeting.

On Wednesday afternoon many members of the association and their friends visited the Royal Ontario Museum, on special invitation, and enjoyed the opportunity of seeing the exceptionally fine collections of the museum.

The Wednesday evening session, in Convocation Hall, was of a twofold character. Professor William Bateson, director of the John Innes Horticultural Institution, Merton Park, Surrey, England, who was present at Toronto by joint invitation of the American Association and the American Society of Zoologists, delivered a stimulating address on "Evolutionary Faith and Modern Doubts." He clearly emphasized the point that students of evolution harbor no doubts as to the *fact* of evolution, but the exact *mode* of evolution remains still an unsolved problem. Professor Bateson's address will be printed in Science.

At the close of this address the session was transformed into a convocation of the University of Toronto, Sir Robert Falconer presiding, at which the degree of Doctor of Science *honoris causa* was conferred on Professor Bateson, Retiring President Howard and President Moore. A reception followed the convocation.

Sir Adam Beck, chairman of the Hydro-Electric Commission of Ontario, addressed a general session, on Thursday afternoon, under the auspices of Section M (Engineering). His subject was "Hydro-Electric Developments in Ontario." After pointing out how these developments have been due to the men of pure science, as well as to those of applied science—the electric and the hydraulic engineers—Sir Adam traced briefly the history of the hydro-electric enterprises of Ontario, showing how the commission is able to deliver electric power from Niagara Falls in Windsor (254 miles away) at a price only about one third as great as that of steam-generated electricity in Detroit, across the river. Electricity for the common home is supplied at minimum cost. Sir Adam showed a series of moving pictures, illustrating the various hydro-electric projects in Ontario.

The Thursday evening conversazione in Hart House was one of the greatest social functions ever held in Toronto and was unique in the history of the association. For three hours the two thousand guests of the university and the Royal Canadian Institute enjoyed the entertainment facilities of the magnificent students' social center in Queen's Park. The theater beneath the quadrangle of the big building was filled three times during the evening; Mr. J. Campbell McInnis rendered three very fine song programs, Irish, Scotch and English. The string quartette in the music room was a center of attraction. The band of the 48th Highlanders played near the Great Hall, and the pipers promenaded the corridors. An exhibition in the sketch room attracted those interested in art and architecture. Many athletic features were enjoyed, including water polo in the natatorium, indoor base-ball, basket ball, squash in the squash courts, boxing, wrestling and fencing. Supper was served in the Great Hall, in the dining hall of the Faculty Union and in the Graduate Commons. The conversazione will be long remembered by all who were present; it not only furnished entertainment and a very pleasant social evening, but it also provided opportunity to renew friendships and to form new ones and to exchange views regarding the work and plans of those in attendance.

To give visitors a sample of Canadian winter sports, "A Half Hour with the Toronto Skating Club" was provided on Friday afternoon, in the Arena, with artificial ice. An exhibition of artistic figure-skating was followed by a hockey match between the Varsity Intermediates and the St. Helen's Intermediates.

A most interesting showing of scientific apparatus and products was open throughout the meeting, in the room behind Convocation Hall. The arrangements for this exhibition were in charge of the Subcommittee on Exhibits, of which Professor E. F. Burton was chairman, and the work of the subcommittee was greatly appreciated. A British firm exhibited various articles of fused silica ("vitreosil"), exceedingly resistant to acids and alkalis and capable of withstanding very high temperatures and rapid temperature changes. Dr. MacKenzie's ink polygraph, which makes simultaneous tracings of the beats of the pulse, heart and jugular vein, was among the instruments shown. There was an interesting exhibit of the action of Stoechel's tube. A collection of books showing the extension courses given by the University of Toronto, and another on the question of an international auxiliary language were interesting parts of the exhibition.

A collection of Canadian paintings was on exhibition during the meeting, under the auspices of the Royal Canadian Academy, in the Art Gallery of Toronto. A collection of fine water-color paintings of mountain and glacier subjects, the work of Professor A. P. Coleman, formed a part of the exhibition in the Convocation Hall building; also an extraordinary collection of artistic photographs, exhibited by the Toronto Camera Club.

A women's reception room was maintained throughout the meeting, in the library building, and tea was served here every afternoon.

The Toronto meeting was especially international in character. It emphasized the point that the American Association is an international organization. Although the majority of its members are residents of the United States, it was clearly visualized at Toronto how much the future of the association depends upon Canadians. The meeting was an occasion for a pronounced increase in the Canadian membership, and it is hoped that the time will soon come when Canadian scientists will all regard the association as theirs. A wonderfully fine spirit of international good-fellowship and understanding prevailed throughout the second Toronto meeting and hovered benignly over the multitudinous and varied sessions.

The weather throughout the meeting was fine indeed—cold enough to be stimulating and with almost unclouded sky. The use of artificial ice for winter sports in Toronto furnished an agreeable surprise to those who had anticipated arctic cold.

Many well-attended dinners were held during the meeting, by the various groups of scientists. A list of these follows: (1) For mathematicians, physicists and astronomers; (2) for geologists and engineers; (3) for zoologists; (4) for entomologists; (5) for naturalists; (6) for ecologists; (7) for botanists; (8) for phytopathologists; (9) for psychologists; (10) for agriculturists; (11) for foresters; (12) the annual metric dinner; (13) the Sigma Xi dinner; (14) the Gamma Alpha dinner; (15) the Phi Kappa Phi dinner. Besides these, there was the biological smoker. An important feature of the meeting was the

Women's Dinner, held in the Great Hall of Hart House on Friday evening. Those attending dinners held in the university buildings on Friday evening enjoyed several entertaining surprise features introduced by the Local Committee, including selections by the bagpipers and the choristers, and several other musical numbers. At most of the dinners toasts were proposed and responded to, with many inspiring after-dinner speeches.

The programs of the sections and of the societies associated with them were generally extensive, and all were interesting and important. The vice-presidential and presidential addresses will be noted in a later issue of Science, as will also the various symposia of these programs. Special mention should be made here of the program of Section M (Engineering) (which presented no program at the recent Chicago meeting), and of the symposium on "An International Auxiliary Language," which was arranged for Toronto under the auspices of Section K (Social and Economic Sciences).

The Engineering program was unusually excellent in many ways. Arrangements for this were due to the very efficient work of Mr. J. B. Tyrrell, of Toronto, vice-president of Section M. The Society for the Promotion of Engineering Education met with the section. The engineering program began on Tuesday forenoon, with an address on the "Natural Resources of Canada" by the Honorable Sir Clifford Sifton, K.C.M.G., etc., formerly minister of the interior, and head of the Conservation Commission of the Dominion of Canada. The program continued through Thursday afternoon, with two sessions each day, many of the papers being illustrated by motion pictures. It was concluded by Sir Adam Beck's address on "Hydro-Electric Developments in Ontario," given at the Thursday afternoon general session of the association as a whole, the engineering section furnishing this important feature of the general sessions. The two engineering sessions on Friday were under the auspices of the Society for the Promotion of Engineering Education. A very enjoyable dinner of engineers and geologists was held in the Music Room of Hart House on Friday evening, at which a number of inspiring speakers were heard. The president of the university and the general secretary and the permanent secretary of the association were among the guests.

The social and economic sciences (Section K) had no separate program at the Toronto meeting, but a new symposium topic of very broad interest was introduced under the auspices of this section. Through the enthusiastic and efficient work of Dr. F. G. Cottrell, of the U. S. National Research Council, this symposium was arranged, on "An International Auxiliary Language." It was held at a joint session on Friday afternoon, of Sections K and Q (Education). The symposium was preceded by the delivery of the address of the retiring vice-president of Section K, Dr. Frederick L. Hoffman, of the Prudential Life Insurance Company of America, on "The Organization of Knowledge." Dr. Hoffman emphasized the imperative need for better methods in the classification of knowledge, so that what science has already accomplished may become much more easily available. He presented an improved scheme of classification that promises to be very valuable in this important and fundamental field of scientific endeavor. Related to Section K was the program of the American Metric Association, which held two sessions on Thursday and a dinner on Thursday evening, with papers and addresses favoring the more general use of the metric system of weights and measures.

A program of great general and cultural interest was presented by the Committee on the History of Science, in a session held on Thursday forenoon. Among others, Dr. J. Playfair McMurrich—afterwards elected president of the association for 1922—gave a paper on the artistic-anatomical work of Leonardo da Vinci.

Chemical science (Section C) was unusually well represented at the Toronto meeting. Section C took part in four joint sessions with other sections and associated societies, including the Canadian Institute of Chemistry and the Toronto Section of the Society of Chemical Industry. A symposium on the Quantum Theory and a joint session with the Physiological Section of the Botanical Society of America were of special importance.

Section N (Medical Sciences) presented a symposium on "The Health and Development of the Child." The successful efforts of Dr. A. J. Goldfarb, of the College of the City of New York, secretary of Section N for the Toronto meeting, in arranging this program were greatly appreciated.

The extraordinary success of the meeting was due mainly to the tireless and varied activities of the members of the Local Committee for the second Toronto meeting, who foresaw all needed arrangements and added many pleasant and convenient extras. Most of the general arrangements were practically complete at the time of the general and permanent secretaries' preliminary visit to Toronto (November 21-23), and the three following weeks were occupied in working out the manifold details. The permanent secretary wishes to emphasize the efficient and cordial spirit of cooperation and help with which the members of the Local Committee responded to all requests and inquiries from Washington during the somewhat hectic weeks just before the meeting.

The Local Committee consisted of the following members: J. C. Fields, *Chairman;* F. A. Mouré, *Hon.-Treasurer;* H. L. Seymour, *Secretary;* the Honorable Henry Cockshutt, Lieutenant-Governor of Ontario; J. W. Bain; E. W. Banting; S. G. Bennett; E. A. Bott; G. S. Brett; E. F. Burton; J. R. Cockburn; the Honorable Manning Doherty; D. A. Dunlap; Sir Robert Falconer, President of the University of Toronto; Lady Falconer; Sir Joseph Flavelle; A. E. Gooderham; the Honorable R. H. Grant; A. Hunter; A. G. Huntsman; H. V. F. Jones; A. D. LePan; J. J. MacKenzie; J. C. McLennan; J. P. McMurrich; W. L. Miller; C. H. Mitchell; J. M. D. Olmsted; Sir Edmund Osler; I. R. Pounder; Sir Clifford Sifton; Sir Edmund Walker; C. H. C. Wright. The Local Subcommittees, with their respective chairmen, were as follows: Hospitality, Sir Robert Falconer; Entertainment and Dinners, I. R. Pounder; Ladies, Lady Falconer; The Hart House Conversazione, S. G. Bennett; Dormitories, J. M. D. Olmsted; Hotels, G. S. Brett; Transportation and Reception, C. H. C. Wright: Meeting Places, E. A. Bott; Exhibits, E. F. Burton; Signs and Messenger Service, E. W. Banting; General Program and Other Printing, J. P. McMurrich; Publicity, A. G. Huntsman; Membership, H. V. F. Jones; Registration Room, J. R. Cockburn.

Dr. Fields and Mr. Seymour are to be thanked for their indefatigable attention to all details, which made the meeting so exceptional. Especially was the very artistic official badge praised. It is a metal button with a narrow raised margin and the design in relief. The design consists of the figure of a beaver with a wreath of maple leaves, and the words "Toronto, A. A. A. S., 1921." This badge will serve as a worthy commemoration of one of the most satisfactory meetings of the association.

All those present keenly appreciated the kindness, efficiency and facility with which Sir Robert Falconer and Lady Falconer represented the University of Toronto, and they received the thanks of all for their personal hospitality as well as for that of the university. Visitors could not avoid noticing how much the university staff had put themselves out (frequently in the literal as well as in the figurative sense) so that the rooms might be available for the scientific sessions, and so forth. It is no inconsiderable inconvenience to a university staff to have their rooms occupied by others during practically the whole of the holiday vacation, and the hearty thanks of the association are due to the members of the University of Toronto.

As chairman of the subcommittee on Exhibits, Professor E. F. Burton did a great service to the association and to the cause of science; so satisfactory was the Toronto exhibition that it is hoped an exhibition of scientific apparatus may become a regular part of the annual meetings.

The very onerous and pressing work of caring for the publication of the general program was done by Dr. J. P. McMurrich, who handled this very difficult and confusing complex of details with great skill. It should be noted that the entire program—a book of 95 pages—had to be printed in a single week from the time the first batches of manuscript were received by Dr. McMurrich. Indeed, most of the program manuscripts did not reach him till December 20 and 21, and the book was completed by noon on December 24. The University of Toronto Press gave very efficient and really wonderful service in this connection.

The registration room, in charge of the executive assistant, Mr. Sam Woodley, was conveniently and centrally located, in the library building of the university. An able corps of assistants was provided, and the work of the registration office went forward with exceptional smoothness. The same form of visible directory as was used at the last annual meeting was employed at Toronto, and this again proved to be a valuable feature of the meeting. By this plan, a continuously corrected list of those in attendance, with their home addresses and those for the meeting, is kept convenient for public consultation in the registration room. The assistant secretary, Dr. Sam F. Trelease, assisted the permanent secretary in many ways, aside from his work as secretary of the council. He gave valuable service in the editing of the manuscripts for the general program before they were sent to Toronto be printed. He has also helped very much in the preparation of the present paper and the other reports of the meeting that are to be published in Science.

Publicity was unusually well handled at the Toronto meeting. As was announced in the preliminary announcement and also in Science before the meeting, the recently organized Science Service cooperated with the association in arousing public interest in the meeting, through the daily press. Dr. E. E. Slosson, editor of Science Service, and Mr. Watson Davis were present throughout the meeting, on behalf of the Science Service. Many of the papers occurring on the programs at Toronto were given attention in the weekly "Science News Bulletin" sent to newspapers by the Science Service for the week of the meeting, and many dailies received each day from the service a 500-word telegraphic report on the meeting.

Besides the valuable publicity work of the Science Service, which is under the control of the American Association, the U. S. National Academy and the U. S. National Research Council, and which operates for the sole purpose of disseminating scientific knowledge through the newspapers, just as valuable and efficient publicity work was accomplished by the Local Subcommittee on Publicity, of which Professor A. G. Huntsman was chairman. At Professor Huntsman's suggestion, a new feature was introduced this year by the permanent secretary's office. As the manuscripts for the general program came in during the week preceding Christmas day, the names of all speakers were copied off, after which the manuscripts were edited and forwarded to Toronto for printing. To each name occurring on each day's list was addressed a letter asking for an abstract of the paper to be given at Toronto by that individual, and enclosing a blank form for this abstract, to be returned to Professor Huntsman. This work had to be done with great rapidity, but large numbers of abstracts were received and these furnished material for the work of the Subcommittee on Publicity. It seems desirable to develop this feature of special personal requests for abstracts and to retain it for future annual meetings of the association. Professor Huntsman and his colleagues used the abstracts as they came in, so as to have representative and suitable material ready for the newspapers during the meeting, and they thus secured for the association unusually excellent and exceptionally satisfactory treatment by the daily press of Toronto and other cities.

A report of the proceedings of the Council at Toronto will appear in a later issue of Science.

Burton E. Livingston,
Permanent Secretary.

CAROLINE BURLING THOMPSON 1869-1921

Dr. Caroline Burling Thompson, professor of zoology at Wellesley College, died on December 5, 1921. Professor Thompson was noted not only for the excellence and thoroughness of her original methods of teaching, but also for her original research work in biology. She was an inspiration to her students and also found means of helping them in many practical ways, unknown to any but herself.

Miss Thompson did original research work in biology in connection with the marine laboratories both at Naples, Italy, and Woods Hole, Mass. Her most noted work was on the biology of termites—the most destructive of the social insects. She has been a collaborator of the Branch of Forest Entomology, Bureau of Entomology, U. S. Department of Agriculture, since March, 1917.

1916 saw Miss Thompson's first paper on termites. It was an original piece of research on the brain and frontal gland of a common termite of eastern United States. She discovered that there was very little differentiation between the brains of the different castes of this termite and none between the sexes, the most marked difference being in the optic apparatus. Miss Thompson suggests that the frontal gland may have arisen phylogenetically from the ancestral median ocellus now lacking. This work was of considerable importance, since the frontal gland is of great taxonomic value.

In 1917, a paper on the origin of the castes of a common termite revolutionized the attitude taken by students of termites. Hitherto the attitude had been almost entirely anthropocentric; Dr. Thompson disproved that the "complementary" or "substitute" queens or reproductive forms of termites could be manufactured through feeding by workers. She definitely proved that the origin of all castes is due to intrinsic causes. Thus, by careful scientific study, much of the mystery of the "complex" social system of the termites—which has led to admiration by man of these insects—has been proved a myth. Facts now supplant the older fantastic theories, so dear to writers of the eighteenth and nineteenth centuries.

Another paper in 1919 discussed the phylogeny of the termite castes and outlined breeding experiments which were in progress at the time of her death. It was hoped to work out a genetic formula for termites.

These papers were followed by several others on the development of the castes and reproductive forms of species of many genera of termites.

Work on the development of the castes of the honey bee had been planned and material fixed ready to section. It is to be regretted that ill health and other duties interfered. Miss Thompson was undertaking this work as she ever did with an open mind—realizing that very careful work had been done on the honey bee and that no generalizations could be made in advance. The social insects often radically differ in habits. What might be an anthropocentrism in case of the termites, might be a fact in the biology of the honey bee!

With two other co-workers, Miss Thompson was working on a more or less popular book on termites and her share was to be the internal anatomy of termites as well as phylogeny and genetic work.

A kindly, helpful spirit, of keen mind, but modest—Miss Thompson will be long remembered by her students and co-workers in science. A striking point in Dr. Thompson's personality, in fact its key note and which signalized her as an investigator and as a teacher, is that with all her splendid training and her admirable technique she was not biased by the current fashions of the school in which she was trained, but struck out into new fields. Her own research work will endure forever!

T. E. S.

WASHINGTON, D. C.
DECEMBER 10, 1921.

SCIENTIFIC EVENTS

THE HECKSCHER RESEARCH FOUNDATION

THE following grants have been made during the year 1921 by the Heckscher Research Foundation for the support of investigation at Cornell University:

1. To Professor J. Q. Adams a sum sufficient to secure his release from the duties of teaching for the first term of the year 1921-1922, to enable him to complete his book on "The Life of Shakespeare."

2. $2,000 to Professor C. C. Bidwell to enable him to carry on cryogenic measurements, and to study the relation between electrical conductivity and temperature for so-called "variable" conductors.

3. $700 to Professor J. C. Bradley to cover the cost of preparing illustrations and otherwise completing a manuscript embodying the results of investigations of the wing venation of Hymenoptera.

4. $1,200 to Professor A. W. Browne to aid him in investigations of certain problems in the field of the oxidation of hydrazine, especially in non-aqueous solutions (grant increased to $1,800).

5. $350 to Professor L. M. Dennis for carrying on investigations on the "Separation of the Isotopes of Lead by Chemical Processes."

5. $2,000 to Professor L. M. Dennis in aid of investigation of the preparation and properties of germanium and its compounds.

7. $500 to Professor F. L. Fairbanks for the purpose of developing and completing a traction dynamometer.

8. $250 to Professor S. H. Gage and Professor P. A. Fish for colored plates needed in completing the manuscript of an investigation concerning the digestion and assimulation of fat in the human and animal body.

9. $200 to Professor V. Karapetoff for an assistant and materials in carrying on investigations on mechanical aids in the design of electrical machinery and lines.

10. $1,125 to Professor W. R. Orndorff and Professor R. C. Gibbs to enable them to carry on more rapidly their investigations of the absorption spectra of certain organic compounds.

11. $1,800 to Professor F. K. Richtmyer for investigations in the laws of the absorption of X-rays.

12. To Professor E. W. Schoder a sum sufficient to secure his release from the duties of teaching for the first term of the year 1921-1922, in order that he may prepare for publication results of investigations in hydraulics, made by himself and the late Professor Turner.

13. $100 to Professor Sutherland Simpson to enable him to continue his investigations into the functions of the thyroid and parathyroid glands.

14. $500 to Professor A. H. Wright for investigation of the life history of North American frogs, toads and tree toads. Grant later increased by $350.

15. $1,200 to Professor V. Snyder to secure his release from the duties of teaching during the second term of 1921-1922, in order to permit him to continue during that term his studies of algebraic correspondences.

16. $1,400 to Professors W. R. Orndorff and R. C. Gibbs for the purchase of apparatus to be used in connection with investigations of absorption spectra of certain organic compounds.

17. $500 to Professor C. C. Bidwell for the purchase of metals to carry on cryogenic measurements.

18. $1,000 to Professor F. K. Richtmyer for apparatus to be used in research on the absorption of X-rays by various media.

19. $1,800 to Professor Wallace Notestein for editing historical documents on the parliamentary history of England.

20. $500 to Mr. H. S. Vandiver for investigations on the subject of algebraic numbers.

21. $500 to Professor J. G. Needham and Dr. P. W. Claassen for preparing a monograph on the Plecoptera of North America.

22. $750 to Professor B. F. Kingsbury for use in studies of the early developmental pattern.

23. $500 to Professor H. Hermannsson for use in the study of Icelandic books of the seventeenth century.

24. $850 to Professor H. M. Fitzpatrick for aid in the study of a large group of fungi known as the Pyrenomycetes.

25. $150 to Professor A. A. Allen to assist in experiments in the artificial propagation of the ruffed grouse and the canvasback duck.

26. $600 to Professor W. C. Ballard for use in an investigation into high power electron tubes.

28. $900 to Mr. H. S. Vandiver for use in continuing his investigations on algebraic numbers.

Supplement to No. 17. $500 to Professor C. C. Bidwell to continue his work on the chemical purification of metals.

29. $500 to Professor R. M. Ogden for use in completing a monograph on the psychology of audition.

30. $800 to Professor E. M. Chamot to cover the cost of publication of the "Results of Microscopic Investigations of Small Arms Primers."

31. $500 to Professor A. H. Wright for the publication of "A Biological Reconnaissance of Okefinokee Swamp."

32. $1,000 to Professor F. C. Prescott for the publication of a book entitled "The Poetic Mind."

33. $2,500 to Professor Clark S. Northrup for the publication of a book entitled "A Register of Bibliographies of the English Language and Literatures."

34. $500 to Professor R. H. Keniston and Professor G. H. Hamilton for the publication of a critical and linguistic study of an old Spanish poem, "El Libro de los Tres Reyes de Oriente."

35. $300 to Professor G. G. Bogert for research into the law of conditional sales.

36. $2,000 to Professor V. Karapetoff for investigations on mechanical aids in the design of electrical machinery and lines, and a study of fields of force or flow, electric, magnetic and hydraulic.

Supplement to No. 19. $150 to Professor Wallace Notestein to continue his work of editing historical documents.

37. $1,500 to Professors Bancroft, Chamot and Merritt for the study of structural colors in feathers.

Supplement to No. 25. $150 to Professor A. A. Allen to enable him to continue his experiments in the artificial propagation of the ruffed grouse and the canvasback duck.

38. $450 to Professors Orndorff and Gibbs for a study of the absorption spectra of orthocresolsulphonphthalein and other related compounds.

39. $3,000 to Professor J. S. Shearer for the study of the selective absorption of X-rays, and of new methods of exciting X-ray tubes.

Supplement to No. 3. $450 to Professor J. C. Bradley to enable him to complete his illustrations of the wing venation of Hymenoptera.

Supplement to No. 11. An additional sum of $450 to Professor F. K. Richtmyer for further investigations in the laws of the absorption of X-rays.

40. $3,000 to Professor H. Diederichs for study of the infiltration of air into buildings through walls and windows, the development of a satisfactory heat treatment of "Kinite" alloy steel, and of the combustion process in a Diesel engine.

41. $700 to Professor C. R. Crosby for drawings of the genitalia of a group of spiders, the linyphiidæ, to be used in devising a natural system of classification of the species and to determine the limits of the general and their affinities.

42. $300 to Professor W. F. Willcox for statistical investigations.

43. $300 to Professor W. L. Westermann for editing Greek papyri owned by Cornell University.

THE STANDARDIZATION OF BIOLOGICAL STAINS

The need of standardizing stains for biological uses has become increasingly evident during the last four or five years. During this period German stains have been either difficult to obtain or entirely unavailable; and the American products, although often excellent, have varied so much one from another as to give uncertain results. The manufacturers have been willing to meet the demand of biologists, but the latter have generally been uncertain just what they wanted. The efforts of the Society of American Bacteriologists to clarify the situation have already been mentioned in this publication[1]. More recently other societies have offered to assist in the work, many of the men concerned expressing a wish not to try to duplicate the Grubler stains, but to secure domestic stains better than their foreign predecessors.

The interest thus awakened led to a conference held on November 5, 1921, at the Chemists Club, New York City, to discuss the standardization of biological stains and the steps to be taken to develop a reliable American supply. The conference was under the auspices of the National Research Council, Dr. L. R. Jones, chairman of the Division of Biology and Agriculture, presiding. Those present were: L. R. Jones, H. E. Howe, and C. E. McClung, of the Research Council (Dr. McClung also representing the American Society of Zoologists); E. D. Ball and J. A. Ambler, of the Department of Agriculture; W. F. Keohan, of the Chemical Foundation; R. A. Harper and T. E. Hazen, representing the Botanical Society of America; H. J. Conn, representing the Society of American Bacteriologists; and R. T. Will of the Will Corporation.

H. J. Conn spoke for the Bacteriological Society, stating the interests of this society in the matter and showing what had been accomplished during the past year by cooperative work among the members of the society. He stated that stains must be standardized by three different methods: by chemical analysis, by testing for bacterial staining, and by testing for histological purposes. So far as bacterial staining is concerned, he considered his society to be already in a position to select satisfactory samples of basic fuchsin and methylene blue, and believed that the work now in progress on gentian violet would soon lead to a similar result in regard to that stain.

[1] H. J. Conn. The Production of Biological Stains in America. Sci. N. S., 53, 289-290.

The chemical and the histological work still remained to be done.

J. A. Ambler, of the Color Laboratory of the Department of Agriculture, with the approval of Dr. Ball, offered the resources of this laboratory to help in the work and undertake to make chemical analyses of samples that had already been tested by the Society of American Bacteriologists.

Drs. McClung, Harper and Hazen stated that some of the samples which were very satisfactory to bacteriologists did not give good results in cytological or histological staining, and agreed that considerable work was necessary to standardize the stains for this purpose. They offered to take steps to secure the active interest of their respective societies in this. It was pointed out that the zoologists had already appointed Dr. S. I. Kornhauser to assist in the work and that Dr. Victor C. Vaughan as chairman of the Division of Medicine had given assurance of the interest and support of that profession. Drs. Harper and McClung were appointed to act as a temporary committee with Dr. H. J. Conn on the organization of further plans including the nomination of a standing committee to the National Research Council. Such a committee has since been authorized to function under the Division of Biology and Agriculture, with the Division of Medicine cooperating, the membership of which is: H. J. Conn, Geneva, N. Y. (Chairman); S. I. Kornhauser, Denison University; L. W. Sharp, Cornell University; Frederick G. Novy, University of Michigan; F. B. Mallory, Boston City Hospital. The Chemical Foundation of New York City has agreed to support the undertaking, and has already deposited with the treasurer of the National Research Council $500.

INTERNATIONALIZING SERA STANDARDS

Cooperation of the foremost laboratories of the world, including the United States, for the unification of international standards of anti-toxic sera has been begun on a large scale by the League of Nations Health Committee. Two preparatory conferences have been held; the work has been divided amongst the various national laboratories, and the individual studies have been begun.

The United States has agreed to cooperate through the United States Public Health Service at Washington, and through the presence at the conference of Dr. Rupert Blue, assistant surgeon general, stationed at Paris. German scientific men, as well as Japanese, and representatives of all the greater European medical services will take part.

Up to the present there has been much confusion in the various national standards of measuring the strength of anti-toxic sera for diseases such as dysentery, tetanus, diphtheria, syphilis, etc. This has had two serious effects. Men of science have been handicapped in studying methods of treatment of various vital diseases abroad, because of the different standards of measuring the strength of the anti-toxic sera employed; secondly, as international trade in sera is increasing, it represents not only an inconvenience, but a positive danger to have their strengths listed at varying standards.

In order to obviate these difficulties, the Health Committee of the League of Nations began a series of studies last October, which resulted in an international conference at London in December, to prepare plans for the first joint experimental inquiry of the sort ever attempted. A program was adopted whereby the study of the effects of the various standards was divided according to diseases amongst the various laboratories represented. To the Hygienic Laboratory at Washington it was proposed to allocate the study of tetanus and diphtheria. As soon as these studies have been completed, they will be coordinated through the State Serum Institute at Copenhagen.

Other bodies which will cooperate in the work are the Medical Research Council of Great Britain, The Pasteur Institute of France, the State Institute of Italy, State Institute of Warsaw, Hygienic Institute of Basle, Pasteur Institute of Brussels, Kitasato Institute of Japan, as well as Austrian and German organizations.

RELIEF WORK OF BRITISH UNIVERSITIES

Maurice de Bunsen, chairman of the universities' committee, writes in *Nature* concerning the activities of the Imperial War Relief Fund, Universities' Committee. This committee, which was created at an inter-university conference which met at University College, London, on July 7, 1920, at the invitation of Lord Robert Cecil, and under the auspices of the Imperial War Relief Fund, has set before it the aim of presenting to the British universities the appeal of the universities in the war-stricken areas of Europe. Mr. de Bunsen writes:

> During the first year of the existence of the Universities' Committee 32,000*l.* was raised in cooperation with every university in Great Britain and Ireland. The committee at the opening of this university year carefully considered the problem of the Central European universities at the present time, and decided that it would be absolutely necessary for us to maintain the relief work promoted by the committee in cooperation with universities all over the world throughout the coming year.
>
> I may say briefly that the financial panic which has swept through Austria in particular during the last month has threatened the very existence of many distinguished men in universities of that country.
>
> The Universities' Committee has also taken on the further responsibility of endeavoring to raise funds for the relief of men of learning and students in Russia. In careful consultation with Dr. Nansen, the committee is establishing those links in Russia which shall ensure a wise distribution of the funds subscribed. Dr. Nansen has issued a personal appeal to the universities of the world to help to save from extinction the rapidly diminishing numbers of men in Russia who have been able to go through the ordeal of suffering to which many of them have been subjected during the past few years.

In a letter to graduate members of the British universities on behalf of the men of learning of Austria an urgent appeal has been made over the following signatures of distinguished representatives of learning: William Bragg, Bryce, A. S. Eddington, Richard Gregory, Haldane of Cloan, Frederic G. Kenyon, Walter Lock, Donald Macalister, Charles J. Martin, Henry A. Miers, Gilbert Murray, E. Rutherford, M. E. Sadler, Arthur Schuster, Napier Shaw, A. E. Shipley, George Adam Smith, Ernest H. Starling, J. J. Thomson.

THE SOUTHWESTERN DIVISION OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE second annual meeting will be held in Tucson, Arizona, from January 26 to 28. The University of Arizona has kindly offered the use of its buildings during this period. There will be four sections with chairmen as follows: Biological, Dr. Charles T. Vorhies, professor of biology of the University of Arizona; Physical science, Dr. V. M. Slipher, director of the Lowell Observatory of Flagstaff, Arizona; Social science, Dr. Edgar L. Hewett, director of the Archælogical museums at Sante Fe, N. M.; and the section on Education and Psychology, chairman to be selected.

The presidential address of Dr. A. E. Douglass will be delivered on the evening of the 26th., to be followed by a reception. On the evening of the 27th. the program will be under the auspices of the Arizona Archælogical Society. There will be illustrated lectures on the recent archælogical researches made in the Southwest. On the evening of the 28th. there will be a characteristic dance by the Yaqui Indians from Sonora.

There will be exhibits of southwestern animals, insects, plants and minerals. The new Stewart Observatory will be demonstrated under the direction of Dr. Douglass. The observatory is complete except for the 36-inch reflecting lens, the first casting of which failed owing to an electrical storm.

ELLIOTT C. PRENTISS,
Chairman of the Executive Committee.

SCIENTIFIC NOTES AND NEWS

AT the meetings held at Amherst, Dr. W. D. Mathews, of the American Museum of Natural History, was elected president of the American Paleontological Society, Dr. Waldemar Lindgren of the Massachusetts Institute of Technology president of the Society of Economic Geologists and Professor T. L. Walker of the University of Toronto president of the Mineralogical Society.

AT the recent meeting of the American Psychological Association at Princeton, Professor Knight Dunlap, of the Johns Hopkins

University, was elected president. Two new members of the council were elected: Professor Warner Brown, of the University of California, and Dr. F. L. Wells, of the Psychopathic Hospital, Boston.

Dr. W. C. Farabee, curator of the Museum of the University of Pennsylvania, was elected president of the American Anthropological Association at the Brooklyn meeting.

The Perkin medal of the American Section of the Society of Chemical Industry, was presented on January 13, to William M. Burton, chemist of the Standard Oil Company of Indiana. Presentation addresses were made by Sumner R. Church, R. F. Ruttan, Charles H. Herty, Russell Wiles and Charles F. Chandler, to which Mr. Burton replied.

Dr. E. P. Hyde, director of the Nela Research Laboratories, was made president of the International Commission on Illumination which met lately in Paris.

Dr. A. W. Rogers has been elected president of the South African Association for the Advancement of Science to preside at the next annual meeting to be held in July at Lourenco Marques.

We learn from *Nature* that Professor Horace Lamb, Sir Ernest Rutherford, Sir Arthur Schuster and Professor G. Elliot Smith have been elected honorary members of the Manchester Literary and Philosophical Society.

The honorary degree of doctor of science has been conferred by the University of Calcutta on Sir W. J. Pope, professor of chemistry, Cambridge University, and on Professor C. V. Raman, professor of physics, University of Calcutta.

Among the prizes recently awarded by the Paris Academy of Sciences was one to E. Roubaud for his works on malaria in France and the disappearance of malaria in temperate climates.

The *British Medical Journal* reports that the eminent histological anatomist Professor Johan August Hammar, of Upsala, celebrated his sixtieth birthday on August 21, and received on this occasion from his fellows, friends and pupils a *Festskrift* containing thirty-eight scientific papers written in Swedish, German, and English, covering over a thousand pages.

The position of naturalist of the *Albatross* in the Bureau of Fisheries, which for some time has been vacant for lack of an available candidate of suitable qualifications, has been filled by the appointment of Paul S. Galtsoff, who was formerly chief zoologist of the Russian Academy of Sciences and assistant director of the marine biological station at Sebastopol.

Earle E. Richardson, instructor in analytical chemistry and physics for the past four years at the Massachusetts Institute of Technology, has been appointed research physicist at the Eastman Kodak Company, Rochester, N. Y.

J. E. Walters, F. W. Schroeder and Frank Porter, chemists at the helium plant of the Bureau of Mines at Petrolia, Texas, have been transferred to the new cryogenic laboratory of the Bureau in Washington, D. C.

Dr. Ralph W. G. Wyckoff, of the Geophysical Laboratory, Carnegie Institution of Washington, is on a year's leave of absence, which he will spend at the California Institute of Technology at Pasadena, California.

The third Asiatic Expedition of the American Museum, under the leadership of Mr. Roy Chapman Andrews, is beginning its work in China, with the cooperation of Dr. Yen, minister of foreign affairs, and other members of the cabinet in Pekin. Dr. V. K. Ting, director of the National Geological Survey of China, and Dr. J. G. Anderson, mining adviser to the Chinese Government and curator of the Museum of the Geological Survey of China, have also given assistance.

Dr. Samuel J. Mixter, of Boston, delivered the Hodgen Lecture, under the auspices of the St. Louis Surgical Society and the Medical Fund Society on January 4.

William A. Durgin has been given leave of absence from the Commonwealth Edison Company, Chicago, to direct the new activities of the Department of Commerce toward the elimination of waste in industry by simplifying and standardizing commercial practices. The new organization will form a subdivision of the Bureau of Standards.

THE Huxley lecture at the University of Birmingham was delivered on November 25 by Professor C. Lloyd Morgan on "A philosophy of evolution."

CHARLES DARWIN'S birthplace, according to the London *Times,* has been sold. The purchase includes the Darwin Walk above the Severn River. It is said that its future use is to be for the Office of Works to house a body of clerks.

DR. HUBERT WORK, president of the American Medical Association, has appointed as the Commitee on the Gorgas Memorial, Drs. George E. de Schweinitz, Philadelphia; Charles W. Richardson, Washington, D. C., and Fred B. Lund, Boston. This appointment was made in compliance with the request received by the Board of Trustees from the Gorgas Memorial Institute of Tropical and Preventive Medicine of Panama for the cooperation of the American Medical Association.

DR. HOWARD B. CROSS of the Rockefeller Institute for Medical Research died at Vera Cruz on December 27 from yellow fever contracted at Tuxtepec. Dr. Cross was a member of the staff of the International Health Board of the Rockefeller Foundation. He was a graduate of the University of Oklahoma and received the doctorate of philosophy from the Johns Hopkins University in 1921.

THE death is announced at the age of 57 years of Max Verworn, professor of physiology at the University of Bonn.

DR. G. P. JORDAN, port health officer of Hong-Kong and professor of tropical medicine in the Hong-Kong University, died in London on December 4 at the age of 64 years.

THE spring meeting of the American Electrochemical Society is to be held in Baltimore from April 27 to 29. There will be three sessions, dealing respectively with electric furnace cast iron, the electrochemical industries and electromotive chemistry. Inspection trips will be made through industrial plants near Baltimore.

THE Association of German Men of Science and Physicians will hold its centennial meeting in Leipzig from September 17 to 23.

AT the recent meeting of the American Psychological Association in Princeton, N. J., provision was made for the accrediting as consulting psychologists of qualified persons belonging to the American Psychological Association. The committee asks that members of the Section for Clinical Psychology of this association desiring such action on their behalf await the receipt of a circular letter of instructions as to their procedure. Other members of the association are asked to await a further announcement of the committee which will be forwarded to SCIENCE and to the *Psychological Bulletin.*

THE annual report shows that the work of the United States Geological Survey for last year included detailed geologic surveys of 4,600 square miles, reconnaissance geologic surveys of 21,500 square miles, exploratory geologic surveys of 18,000 square miles, cooperative geologic work with 17 state organizations, studies of ore deposits in 10 states, oil and gas surveys in 10 states, geologic surveys in Alaska of 1,500 square miles, and the continuation of studies of mineral deposits in Alaska. It included also topographic surveys in the United States of 12,311 square miles and topographic reconnaissance surveys in the Alaska Range of 390 square miles, running of 4,796 miles of levels, establishing 1,123 bench marks and making 576 linear miles of river surveys. The Geological Survey continued measurements of stream flow throughout the United States and in Alaska and Hawaii, cooperating in part with other federal organizations and with 31 states and Hawaii; also continued investigation of waterpower resources of Southeastern Alaska. It also made field examinations in 11 states under the enlarged homestead and stock-raising homestead laws, increased designations of stock-raising lands by 31,000,000 acres, and reported on 7,000 applications for oil and gas prospecting permits, on 249 applications for coal prospecting permits, on 78 applications for coal leases and 7,500 applications under the mineral-leasing laws. It also conducted an engineering investigation and prepared an exhaustive report on a proposed "superpower system"—a comprehensive system for the generation and distribution of electricity for the operation of railroads and manufacturing industries in the region between Boston and Washington. Special publications of the year were "Guides to desert watering places in Arizona and California," and a large relief map of the United States. Other published reports numbered 132, containing more than 10,000 pages, and 60 new topographic maps were engraved and printed. The Survey distributed 631,000 books and 740,000 maps, of which latter 550,000 were sold.

UNIVERSITY AND EDUCATIONAL NOTES

A movement has been started to raise a fund of $2,000,000 to establish a medical school as a memorial to Major General William C. Gorgas. The present plan is that the fund be contributed by the nation and that the school be situated in Tuscaloosa, Ala., where General Gorgas lived as a boy. Dr. Seale Harris, of Birmingham, Ala., is chairman of the national committee.

Fire of unknown origin has almost completely destroyed the chemical building of the Colorado State Agricultural College at Fort Collins, Colo. The loss on buildings and equipment is estimated at $70,000.

The board of curators of the University of Missouri has elected Dr. John Carleton Jones, president of the university to succeed Dr. A. Ross Hill who resigned several months ago to become connected with the American Red Cross. Dr. Jones has been vice president of the university since 1918 and dean of the college of arts and sciences.

John H. Moffett has been appointed associate professor of metallurgy in the University of Minnesota.

R. S. Lowe, of the nitrate division, Ordnance Department, U. S. A., has been appointed dean of the department of chemical engineering, University of Cincinnati.

Reverend Dr. Charles Wesley Flint, president of Cornell College at Mount Vernon, Iowa, has been elected chancellor of Syracuse University in succession to Dr. James Roscoe Day.

Dr. Walter F. Tittman, formerly of the Bureau of Mines and later engaged in consulting practice at Pittsburgh, Pa., has been appointed head of the department of commercial engineering, Carnegie Institution of Technology.

Dr. Harold Diehl has been appointed head of the health service of the University of Minnesota, Minneapolis, to succeed Dr. John Sundwall.

DISCUSSION AND CORRESPONDENCE

COMMITTEE FOR THE PROTECTION OF ANIMAL EXPERIMENTATION

Some weeks ago it suddenly became apparent that the activities of the various antivivisection societies had finally reached a strength where they were able to menace effectively the health of the community. On a referendum vote in California they threatened all animal experimentation last year, and it was only with some difficulty that the measure was defeated. The Interstate Convention of Antivivisection Societies was held in Boston last month and at that time a committee was organized to undertake a campaign of sane, humane education to combat the propaganda of those who seek to prevent the making of vaccines and antitoxins, the testing of all such drugs as ergot and a general interference with medical methods of proved efficacy for the diagnosis, the prevention and cure of disease.

A committee of the Boston Society of Natural History was first appointed of which T. Barbour was chairman, to arrange for Mr. Ernest Harold Baynes to deliver two lectures, one upon a "Nature Study" subject, the other entitled "The Truth about Vivisection." Mr. Baynes delivered the last lecture December 17 to a large and enthusiastic audience in Huntington Hall, Boston. It was an amplification of the article which he prepared for the *Woman's Home Companion,* July, 1921, and which at once aroused a howl of consternation from all of the antivivisection groups in the country. So much interest was aroused in the general question that the lecture committee of the Boston Society of Natural History reorganized itself into the Committee for the Protection of Animal Experimentation. An appeal for funds, signed by President Charles W. Eliot, Professor Richard P. Strong, M. D., Ernest Harold Baynes, Dr. John C. Phillips, Dr. Edward Wigglesworth, Dr. Townsend W. Thorndike and Dr. Thomas Barbour, brought a most encouraging response. The committee has published several statements, designed to instruct the community as to just what the results may be if the antivivisectionists succeed.

Cardinal O'Connell was one of the first to endorse the movement in a most inspiring letter which was followed by letters of endorsement from persons in all stations of life and representing many different interests, particularly Life Insurance Companies, Agricultural Interests and Charitable Organizations of many sorts.

The newspapers gave the work of the committee generous publicity and its efforts as a whole have become so successful that there is now a widely expressed desire that the work of the committee be carried forward by some permanent organization. The committee has studied carefully the organization and work of the Research Defense Society in England and it is probable that some organization of this sort will be founded.

To be really effective the Society should be national in its scope and have an able, active field secretary and should aim to protect the public from the mischievous activities, not only of the antivivisectionists, but the antivaccinationists, the medical freedomists, so-called, and all others who aim to lower the standards of medical education or jeopardize the public health in other ways.

A correspondence is invited with those interested and our literature is available for free distribution.

EDWARD WIGGLESWORTH, PH. D.
J. C. PHILLIPS, M. D.
T. BARBOUR, PH. D.
FOR THE COMMITTEE

POISONOUS SPIDERS

One of the best reviews of our knowledge of the poisonous properties of spiders is contained in Dr. Henry C. McCook's beautifully illustrated volumes, "American spiders and their spinning work." In Volume 1, page 274, he concludes that most of the cases of serious poison in the United States are caused by the bite of the widely distributed Lineweaver, *Lactrodectus mactans,* and the Saltigrade, *Phidippus morsitans.* He cites an instance of serious sickness resulting from the bite on a man's back of *Lactrodectus.* He also thinks it very probable that the large Mygales, commonly called tarantulas, on account of their large fangs and exceptionally large supply of poison, can inflict very serious bites.

He cites instances of spiders killing fish and birds, in one instance the victims being two sunfish about two inches long, which were promptly killed by the poison of a spider I saw at work. From my description Dr. McCook thought this was a Dolomedes.

In his third volume Dr. McCook quotes Professor Bentkau of Bonn, who suffered very serious pain and general swelling from being twice bitten by a *Chiraianthium nutrix* on the fingers.

Dr. McCook thinks it most likely that even the bites of the first two mentioned species are in most instances of small consequence and that the bites of the great majority of spiders are of little more consequence than those of mosquitoes and not nearly as serious as the stings of bees, hornets, etc.

In instances that have come under my direct observation of spiders biting human beings the results have been comparable with mosquito bites.

F. R. WELSH

A LONG-LIVED WOODBORER

IN SCIENCE, Friday, August 5, 1921, H. E. Jaques, Iowa Wesleyan College, Mt. Pleasant, Iowa, contributed a note, "A Long-lived Woodborer." It was intimated that *eburia quadrigeminata* (Say) spent forty years growing from egg to mature larva, in the top piece of an old birch bookcase. A number of such stories are current, but I am of the opinion that the simple solution of the whole matter is as follows: *Eburia quadrigeminata* breeds in the heartwood of dead, dry, seasoned logs and wood,—*Hicoria, Quercus, Robinia, Betula, Fagus, Fraxinus, Castanea, Ulmus* and perhaps others. The eggs are placed in the cracks and crevices of dry, weathered or seasoned scars, "cat faces," and similar placed. An impregnated female in some manner got into the house, and in crawling over the piece of furniture took advantage of a crack in the varnish or wood, and inserted an egg.

I can not believe that any Cerambycid larva could exist for forty years in a piece of furniture. In fact, the normal duration of the larval stage of insects of this family is from one to five years.

I think the same explanation will cover the other case mentioned in this article. The adults of this species often hide beneath bark, and might have crawled between the bricks and doorsill.

A. B. CHAMPLAIN

PENNSYLVANIA BUREAU
OF PLANT INDUSTRY,
HARRISBURG, PA.

PERCIVAL LOWELL

THE absorbing interest that Dr. Percival Lowell was able to throw about the astronomical investigations of his later years has obscured to an extent the fact that he was a man of many parts. There are comparatively few who are familiar with his keen observations of the nearer Orient, crystallized into published essays, and fewer still have known of his interest in botany, geology and general natural history, in one or more departments of which he has made contributions to science.

A comprehensive view of him is presented in Miss Louise Leonard's recent volume, "Percival Lowell—An Afterglow" (Boston: The Gorham Press), a book which through the medium of selections from his own writings shows him in his variety of studies. No serious undertaking has yet been made towards a biography of Lowell—the time since he passed on is perhaps yet too short, but in this volume one has a valuable reminder of him. Extracts from his letters are deftly framed in a Foreword, a prelude and an afterpiece, the last a poem that he loved. There is no appraisal of Dr. Lowell's scientific achievements, but everywhere is reflected his spirit of investigation, cheerfulness and wish to help his fellow man.

J. R.

THE PASTEUR CENTENARY

THE year 1922 marks the lapse of a century from the year of Louis Pasteur's birth and a "Centenary" volume of Pasteur's collected scientific writings would be a fitting homage to the memory of such a man.

In view of the conditions in Europe, is it not possible for investigators here to sponsor such an undertaking, in the English language, and contribute to it by means of translations of the original French articles and memoirs?

AUGUSTO BONAZZI

OHIO AGRICULTURAL
EXPERIMENT STATION,
WOOSTER, OHIO

SCIENTIFIC BOOKS

Insect Transformation. By GEORGE H. CARPENTER, D. Sc., Professor of Zoology, Royal College of Science, Dublin, London. Methuen & Co. Ltd. 1921, pp. 282, figs. 124.

PROFESSOR CARPENTER for many years has been doing admirable work in Ireland. Well trained in biology, and a broad zoologist, he has interested himself in many aspects of scientific work. His publications on crop and animal pests have been of great service to the Irish farmers and stock growers; he has been much interested in the admirable zoological garden in Dublin, where they breed lions in confinement more successfully than in any other place in the world, and has been active in the Royal Irish Academy, of which he is secretary.

His book on "Insect Transformation," just published, is a mature book, written by a broad man, and differs in many interesting and important ways from any book yet published.

It bears on every page evidence of competent knowledge, very broad reading and deep reflection.

There are only seven chapters in the book of nearly three hundred pages. The first one is devoted to "Form, Growth and Change," beginning with an examination of the structure, both external and internal, of the adult insect. His second chapter is entitled "The Open Type of Wing Growth," using this term to characterize those insects which have incomplete metamorphosis. The next chapter is devoted to "The Hidden Type of Wing Growth," in which he makes a careful and full exposition of the structure in different stages of those insects which have complete metamorphosis and therefore in which the wing growth is hidden in the larval form. Another chapter treats of "Some Wingless Insects." Then comes a fascinating and very full chapter, covering nearly sixty pages, on "Growing Insects and Their Surroundings," a condensed insect ecology of great value and admirably done.

The last chapter is devoted to "The Problems of Transformation," in which he contrasts the transformations of insects and the changes which other animals undergo in the course of their development, considering the primitive type of insect larva, the two types of wing growth, and the history of the insect orders as revealed by the rocks.

In the earlier chapters it will be seen that the author gives an account of the growth and transformation of the insects of the different orders, showing especially the astounding variations among the early stages, particularly the larvae. The excellent and extensive ecological chapter "On the Surroundings of Growing Insects" follows most naturally; while in the final chapter, with equal happiness of arrangement, he really considers the meaning of the facts described in the earlier pages.

Prepared in this way and by a thoroughly competent man, this attractive, well printed, and very well illustrated book will find its readers not only among the entomologists but among those interested in biology in a broad way.

L. O. Howard

RESEARCH FUNDS IN THE UNITED STATES

In the Bulletin of the National Research Council for March, 1921, Callie Hull has compiled information on the funds available in the United States in 1920 for scientific research. This is the first compilation of its kind, and readers of Science will be interested in seeing a brief summary of the contents of this paper. The following review of these statistics can not be considered absolutely accurate. In some cases it is difficult to judge of the application of some arbitrary rules that had to be adopted in order to make the tables brief. I am satisfied, however, that the tables are essentially reliable, and that if absolutely correct figures could be obtained in every case, no great variation from the figures here given would result.

Annual incomes from funds for scientific research in the United States, which have been set aside by private individuals or corporations, range in amounts from less than $25.00 to more than $10,000,000. It is interesting to note the distribution over our land of the institutions that dispense these funds. Most of them are on the Atlantic coast, from Connecticut to South Carolina. The principal centers are Boston, New York and Washington. There is a broad belt of smaller centers extending from the Atlantic westward through the northern states to beyond the Mississippi. On the Pacific coast we find a center in and around San Francisco. Very few research funds have been established in the states lying on the high plains and plateaus of the west, where culture is recent, or in the southern states, where there is as yet relatively little centralization of wealth.

Funds of this kind have been established only in 26 states. Of these, New York ranks first and North Dakota last. In the amount of established funds the rank of these states is as follows: (1) New York, (2) Massachusetts, (3) Illinois, (4) California, (5) Maryland, (6) Pennsylvania, (7) Minnesota, (8) New Jersey, (9) Iowa, (10) Connecticut, (11) Ohio, (12) Kansas, (13) Utah, (14) Wisconsin, (15) Indiana, (16) Michigan, (17) Missouri, (18) Alabama, (19) Washington, (20) Texas, (21) Rhode Island, (22) Idaho, (23)

	Number of funds
Yielding income annually of more than $1,000,000	3
Yielding income annually of $1,000,000–$100,001	7
Yielding income annually of $100,000–$10,001	67
Yielding income annually of $10,000–$1,001	150
Yielding income annually of $1,000–$101	298
Yielding income annually of $100 or less	40*
	565

* Many of the smaller funds in the last two items are research scholarships in various universities.

Virginia, (24) North Carolina, (25) Arizona, (26) North Dakota. The District of Columbia ranks next to New York.

There are in all some 565 funds available for research in our country, and these may be classified according to size, as in the above table:

The donations made for such funds have greatly increased during the last twenty years, as will be seen from the following table:

Period covered	No. of new funds established in each period	Annual yield
Up to 1800	3	$ 1,000
1800 to 1850	3	$ 50,000
1851 to 1870	4	$ 5,000
1871 to 1880	5	$ 60,000
1881 to 1890	17	$ 40,000
1891 to 1900	44	$ 166,000
1901 to 1910	65	$ 1,275,000
1911 to 1921	175	$17,000,000*

*The Rockefeller Foundation, which is included in this last amount, yields nearly five times the amount of all other funds so far established.

It is interesting to note that out of the great number of people of large means in our nation, no less than five hundred, in round numbers, have been sufficiently interested in the advancement of scientific research to make donations for its maintenance; and that of these five hundred individuals, it is a mere score of men that has furnished by far the larger part of the money available for such purposes. Among these we note Smithson, Rockefeller and Carnegie, two of whom are known as among the wealthiest men in our nation.

Though it appears that most donators have provided that the gifts they have made should be used in some particular branch of research, nevertheless by far the largest bequests have been given to research in general; that is, the selection of the particular work to be done has been left to those in trust of the funds. The following table will emphasize these points:

Branch of research specified by donor	Number of funds established	Annual yield
General research work	125	$17,000,000
Medicine	135	$ 4,000,000
Biology and natural history	35	$ 352,000
Physics	34	$ 241,000
Astronomy	22	$ 173,000
Geology	15	$ 137,000
Archeology and anthropology	24	$ 117,000
Botany	14	$ 100,000
Chemistry	65	$ 78,000
Engineering	31	$ 55,000
Zoology	9	$ 49,000
Industrial research	34	$ 49,000
Psychology	8	$ 29,000
Mathematics	3	$ 2,600

It will be noted that medical research heads the list, with 135 established funds and an annual income of $4,000,000. This is doubtless because medical knowledge is generally recognized as of the greatest practical importance to the welfare of mankind. Mathematics brings up the rear. It would probably appear to most of us to be the subject farthest removed from practical interests. Biology, which ranks second, has much to do with the procuring of food; and Psychology, which ranks next to the last, is not yet generally recognized as a subject of practical application.

Copies of the paper here reviewed can no doubt be secured from The National Research Council, 1701 Massachusetts Ave., Washington, D. C.

J. A. Udden

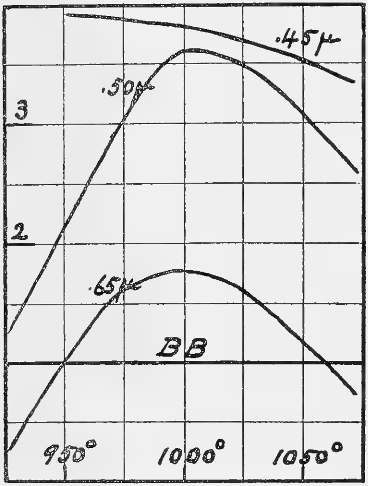
University of Texas

SPECIAL ARTICLES

EMISSION BANDS OF ERBIUM OXIDE: A CONFIRMATION

In a paper by the late Professor W. G. Mallory[1], published in 1919, a photometric study of the spectrum of glowing erbium oxide was described. When the oxide was heated to 1,000 degrees Centigrade three regions, in which the principal emission bands of this interesting spectrum are situated, were found to be brighter than the corresponding wave-lengths in the spectrum of an ideal black body at the same temperature; the red region slightly brighter and the green and blue several times brighter.

This result has been questioned, although not so far as we are aware in print, on the ground that no radiator can exceed the emission of a black body of the same temperature.



In other words it is held, as a matter of thermodynamics, that the brightest regions in the spectrum of a selective radiator may reach, but never reach beyond, the envelope which encloses the area representing the distribution of radiation from a black body of the same temperature. The explanation offered in Mallory's paper suggests luminescence of the incandescent oxide superimposed upon the ordinary radiation due to temperature.

In the course of studies now in progress, in which an altogether different method is used[2], we find many instances of luminescence superimposed upon the ordinary temperature radiation of incandescent oxides and producing intensities greatly in excess of those of the same regions in the spectrum of the black body. Moreover in the case of erbium oxide we find these excesses in the same regions and at the precise temperature designated by Mallory.

The accompanying figure is from our data for the three regions in question and covers temperatures slightly below 1000°. Intensities are in terms of the brightness of the corresponding radiation from a black body of the same temperature as the oxide and are thus directly comparable with Mallory's results.

While the sample of erbium oxide used by us did not happen to be quite as actively luminescent as in Mallory's experiment the effect is there and is of the same order. His observations are corroborated in every essential respect.

E. L. Nichols
H. L. Howes
Physical Laboratory of Cornell University
October, 1921

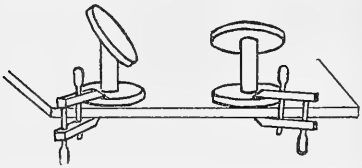
[1] Mallory: *Physical Review* (2) XIV p. 54.

[2] To be described in a forthcoming paper.

LABORATORY DETERMINATIONS OF DIP AND STRIKE

The writer has observed that many geology students are unable to make correct determinations of dip and strike. This weakness seems to be due to the difficulties of presenting the subject in the field, to lack of sufficient laboratory training before entering the field, and especially to lack of suitable apparatus. In the field, the determination of dip and strike appeals to the student as a very minor and uninteresting detail in comparison with the other geological features to which his attention is called. Furthermore, the rock surfaces are usually so irregular that the instructor can not make a very close check of the student's readings. In the laboratory, the tilted drawing boards, table tops, or rock slabs commonly used are not very efficient because they often possess straight edges indicating the line of strike and are usually so insecurely fastened that checking the readings, again, becomes almost impossible. In an attempt to overcome some of these difficulties the writer constructed the following apparatus which has proved so useful and convenient that it is offered as a suggestion to teachers of geology.

This apparatus consists of two circular pieces of wood about eight inches in diameter, connected by a spindle two inches in diameter and eight inches in length. It is fastened to



the edge of a table by means of wooden clamps. Ordinary iron clamps are not used because they cause a deflection of the compass needle amounting to two or three degrees. The absence of straight edges in the outline of the upper disk necessitates finding the line of strike by locating a position of the clinometer in which no inclination is registered and then drawing a line along the edge of the compass box upon a piece of paper fastened to the top board by thumb tacks. The strike line can be changed to all points of the compass by clamping the apparatus in different positions. The dip is constant for each model but, since several models are necessary for an average class, this is taken care of by making each model with a different dip. Models could easily be made with the dip adjustable but such modifications would mean more expense and more trouble in checking students' readings. Furthermore, it is the direction of dip and not the amount which seems to offer difficulties to the student. It has been found that ten models with dips ranging from three degrees to eighty-eighty degrees answer the purpose.

The models are securely clamped in various positions in the laboratory and their dip and strike determined by the student and checked by the instructor. The models are then turned on their bases, clamped, read, and checked again. The students are then required to make corrections for magnetic declinations, assuming that the models are situated in their own region. The readings are again corrected on the assumption that they were taken in Alaska or Ohio or any other place that the instructor suggests. After the student has gained the ability to make accurate determinations on a series of such models, assuming different geographic locations for the purpose of correcting for magnetic declinations, he is fairly well equipped to use the compass and clinometer in the field.

H. G. Turner
Lehigh University

ARTIFICIAL PRODUCTION OF TIPBURN

Experiments conducted at the Iowa Experiment Station have proved that *Empoasca mali*, the potato leafhopper, is the factor in the production of tipburn or hopperburn of potato. Emulsions were made by crushing a large number of adults of both sexes in water. Small amounts of this material were injected into the leaves of the potato plants and in several days an injury was produced similar to, if not identical with tipburn. Difficulty was experienced in getting large amounts of the emulsion into the leaf tissue, but enough was injected to produce burning. When this emulsion was placed on the leaf and then the tissue pricked with a fine needle, negative results were noted. Emulsions made from crushed nymphs failed to produce injury in more than a few cases, and in these it was not pronounced.

That these insects contain some toxic substance was further demonstrated by placing the residue left over from the insects after the emulsion had been poured off on leaf petioles and then pricking this in by means of a fine scalpel. In every case, a lesion was produced, the tissue at these points first turning yellow and then brown. Later the cells collapsed leaving a rather large scar.

Although Bordeaux mixture is toxic to the nymphs, yet it acts comparatively slowly so that by keeping a leaf sprayed with this compound colonized with live nymphs tipburn was produced. This would appear to show that Bordeaux mixture does not prevent tipburn by its action on the leaf but rather by its action on the insect.

F. A. Fenton and I. L. Ressler
Iowa State College

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EVOLUTIONARY FAITH AND MODERN DOUBTS[1]

I VISIT Canada for the first time in delightful circumstances. After a period of dangerous isolation, intercourse between the centres of scientific development is once more beginning, and I am grateful to the American Association for this splendid opportunity of renewing friendship with my western colleagues in genetics, and of coming into even a temporary partnership in the great enterprise which they have carried through with such extraordinary success.

In all that relates to the theme which I am about to consider we have been passing through a period of amazing activity and fruitful research. Coming here after a week in close communion with the wonders of Columbia University, I may seem behind the times in asking you to devote an hour to the old topic of evolution. But though that subject is no longer in the forefront of debate, I believe it is never very far from the threshold of our minds, and it was with pleasure that I found it appearing in conspicuous places in several parts of the program of this meeting.

Standing before the American Association, it is not unfit that I should begin with a personal reminiscence. In 1883 I first came to the United States to study the development of Balanoglossus at the Johns Hopkins summer laboratory, then at Hampton, Va. This creature had lately been found there in an easily accessible place. With a magnanimity, that on looking back I realize was superb, Professor W. K. Brooks had given me permission to investigate it, thereby handing over to a young stranger one of the prizes which in this age

[1] Delivered before the American Association for the Advancement of Science on Wednesday evening, December 28, in the Convocation Hall of the University of Toronto.

of more highly developed patriotism, most teachers would keep for themselves and their own students. At that time one morphological laboratory was in purpose and aim very much like another. Morphology was studied because it was the material believed to be most favorable for the elucidation of the problems of evolution, and we all thought that in embryology the quintessence of morphological truth was most palpably presented. Therefore every aspiring zoologist was an embryologist, and the one topic of professional conversation was evolution. It had been so in our Cambridge school, and it was so at Hampton.

I wonder if there is now a single place where the academic problems of morphology which we discussed with such avidity can now arouse a moment's concern. There were of course men who saw a little further, notably Brooks himself. He was at that time writing a book on heredity, and, to me at least, the notion on which he used to expatiate, that there was a special physiology of heredity capable of independent study, came as a new idea. But no organized attack on that problem was begun, nor had any one an inkling of how to set about it. So we went on talking about evolution. That is barely 40 years ago; to-day we feel silence to be the safer course.

Systematists still discuss the limits of specific distinction in a spirit, which I fear is often rather scholastic than progressive, but in the other centers of biological research a score of concrete and immediate problems have replaced evolution.

Discussions 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 looks 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 Mendalian 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. All was clear ahead.

But soon, though knowledge advanced at a great rate, and though whole ranges of phenomena which had seemed capricious and disorderly fell rapidly into a co-ordinated system, less and less was heard about evolution in genetical circles, and now the topic is dropped. When students of other sciences ask us what is now currently believed about the origin of species we have no clear answer to give. Faith has given place to agnosticism for reasons which on such an occasion as this we may profitably consider.

Where precisely has the difficulty arisen? Though the reasons for our reticence are many and present themselves in various forms, they are in essence one; that as we have come to know more of living things and their properties, we have become more and more impressed with the inapplicability of the evidence to these questions of origin. There is no apparatus which can be brought to bear on them which promises any immediate solution.

In the period I am thinking of it was in the characteristics and behavior of animals and plants in their more familiar phases, namely, the Zygotic phases that attention centered. Genetical research has revealed the world of gametes from which the zygotes—the products of fertilization are constructed. What has been there witnessed is of such extraordinary novelty and so entirely unexpected that in presence of the new discoveries we would fain desist from speculation for a while. We see long courses of analysis to be traveled through and for some time to come that will be a sufficient occupation. The evolutionary systems of the eighteenth and nineteenth centuries were attempts to elucidate the order seen prevailing in this world of zygotes and to explain it in simpler terms of cause and effect: we now perceive that that order rests on and is determined by another equally significant and equally in need of "explanation." But if we for the present drop evolutionary speculation it is in no spirit of despair. What has been learned about the gametes and their natural history constitutes progress upon which we shall never have to go back. The analysis has gone deeper than the most sanguine could have hoped.

We have turned still another bend in the track and behind the gametes we see the chromosomes. For the doubts—which I trust may be pardoned in one who had never seen the marvels of cytology, save as through a glass darkly—can not as regards the main thesis of the Drosophila workers, be any longer maintained. The arguments of Morgan and his colleagues, and especially the demonstrations of Bridges, must allay all scepticism as to the direct association of particular chromosomes with particular features of the zygote. The transferable characters borne by the gametes have been successfully referred to the visible details of nuclear configuration.

The traces of order in variation and heredity which so lately seemed paradoxical curiosities have led step by step to this beautiful discovery. I come at this Christmas Season to lay my respectful homage before the stars that have arisen in the west. What wonder if we hold our breath? When we knew nothing of all this the words came freely. How easy it all used to look! What glorious assumptions went without rebuke. Regardless of the obvious consideration that "modification by descent" must be a chemical process, and that of the principles governing that chemistry science had neither hint, nor surmise, nor even an empirical observation of its working, professed men of science offered very confidently positive opinions on these nebulous topics which would now scarcely pass muster in a newspaper or a sermon. It is a wholesome sign of return to sense that these debates have been suspended.

Biological science has returned to its rightful place, investigation of the structure and properties of the concrete and visible world. We cannot see how the differentiation into species came about. Variation of many kinds, often considerable, we daily witness, but no origin of species. Distinguishing what is known from what may be believed we have absolute certainty that new forms of life, new orders and new species have arisen on the earth. That is proved by the paleontological record. In a spirit of paradox even this has been questioned. It has been asked how do you *know* for instance that there were no mammals in palæozoic times? May there not have been mammals somewhere on the earth though no vestige of them has come down to us? We may feel confident there were no mammals then, but are we sure? In very ancient rocks most of the great orders of animals are represented. The absence of the others might by no great stress of imagination be ascribed to accidental circumstances.

Happily however there is one example of which we can be sure. There were no Angiosperms—that is to say "higher plants" with protected seeds—in the carboniferous epoch. Of that age we have abundant remains of a world wide and rich flora. The Angiosperms are cosmopolitan. By their means of dispersal they must immediately have become so. Their remains are very readily preserved. If they had been in existence on the earth in carboniferous times they must have been present with the carboniferous plants, and must have been preserved with them. Hence we may be sure that they did appear on the earth since those times. We are not certain, using certain in the strict sense, that the Angiosperms are the lineal descendants of the carboniferous plants, but it is very much easier to believe that they are than that they are not.

Where is the difficulty? If the Angiosperms came from the carboniferous flora why may we not believe the old comfortable theory in the old way? Well so we may if by belief we mean faith, the substance, the foundation of things hoped for, the evidence of things not seen. In dim outline evolution is evident enough. From the facts it is a conclusion which inevitably follows. But that particular and essential bit of the theory of evolution which is concerned with the origin and nature of *species* remains utterly mysterious. We no longer feel as we used to do, that the process of variation, now contemporaneously occurring, is the beginning of a work which needs merely the element of time for its completion; for even time can not complete that which has not yet begun. The conclusion in which we were brought up, that species are a product of a summation of variations ignored the chief attribute of species first pointed out by John Ray that the product of their crosses is frequently sterile in greater or less degree. Huxley, very early in the debate pointed out this grave defect in the evidence, but before breeding researches had been made on a large scale no one felt the objection to be serious. Extended work might be trusted to supply the deficiency. It has not done so, and the significance of the negative evidence can no longer be denied.

When Darwin discussed the problem of inter-specific sterility in the "Origin of Species" this aspect of the matter seems to have escaped him. He is at great pains to prove that inter-specific crosses are *not always* sterile, and he shows that crosses between forms which pass for distinct species may produce hybrids which range from complete fertility to complete sterility. The fertile hybrids he claims in support of his argument. If species arose from a common origin, clearly they should not always give sterile hybrids. So Darwin is concerned to prove that such hybrids are by no means always sterile, which to us is a commonplace of everyday experience. If species have a common origin, where did they pick up the ingredients which produce this sexual incompatibility? Almost certainly it is a variation in which something has been added. We have come to see that variations can very commonly—I do not say always—be distinguished as positive and negative. The validity of this distinction has been doubted, especially by the *Drosophila* workers. Nevertheless in application to a very large range of characters, I am satisfied that the distinction holds, and that in analysis it is a useful aid. Now we have no difficulty in finding evidence of variation by loss. Examples abound, but variation by addition are rarities, even if there are any which must be so accounted. The variations to which inter-specific sterility is due are obviously variations in which something is apparently added to the stock of ingredients. It is one of the common experiences of the breeder that when a hybrid is partially sterile, and from it any fertile offspring can be obtained, the sterility, once lost, disappears. This has been the history of many, perhaps most of our cultivated plants of hybrid origin.

The production of an indubitably sterile hybrid from completely fertile parents which have arisen under critical observation from a single common origin is the event for which we wait. Until this event is witnessed, our knowledge of evolution is incomplete in a vital respect. From time to time a record of such an observation is published, but none has yet survived criticism. Meanwhile, though our faith in evolution stands unshaken, we have no acceptable account of the origin of "species."

Curiously enough, it is at the same point that the validity of the claim of natural selection as the main directing force was most questionable. The survival of the fittest was a plausible account of evolution in broad outline, but failed in application to specific difference. The Darwinian philosophy convinced us that every species must "make good" in nature if it is to survive, but no one could tell how the differences—often very sharply fixed—which we recognize as specific, do in fact enable the species to make good. The claims of natural selection as the chief factor in the determination of species have consequently been discredited.

I pass to another part of the problem, where again, though extraordinary progress in knowledge has been made, a new and formidable difficulty has been encountered. Of variations we know a great deal more than we did. Almost all that we have seen are variations in which we recognize that elements have been lost. In addressing the British Association in 1914 I dwelt on evidence of this class. The developments of the last seven years, which are memorable as having provided in regard to one animal, the fly Drosophila, the most comprehensive mass of genetic observation yet collected, serve rather to emphasize than to weaken the considerations which I then referred. Even in Drosophila, where hundreds of genetically distinct factors have been identified, very few new dominants, that is to say positive additions, have been seen, and I am assured that none of them are of a class which could be expected to be viable under natural conditions. I understand even that none are certainly viable in the homozygous state.

If we try to trace back the origin of our domesticated animals and plants, we can scarcely ever point to a single wild species as the probable progenitor. Almost every naturalist who has dealt with these questions in recent years has had recourse to theories of multiple origin, because our modern races have positive characteristics which we cannot find in any existing species, and which combination of the existing species seem unable to provide. To produce our domesticated races it seems that ingredients must have been added. To invoke the hypothetical existence of lost species provides a poor escape from this difficulty, and we are left with the conviction that some part of the chain of reasoning is missing. The weight of this objection will be most felt by those who have most experience in practical breeding. I can not, for instance, imagine a round seed being found on a wrinkled variety of pea except by crossing. Such seeds, which look round, sometimes appear, but this is a superficial appearance, and either these seeds are seen to have the starch of wrinkled seeds or can be proved to be the produce of stray pollen. Nor can I imagine a fern-leaved Primula producing a palm-leaf, or a star-shaped flower producing the old type of *sinensis* flower. And so on through long series of forms which we have watched for twenty years.

Analysis has revealed hosts of transferable characters. Their combinations suffice to supply in abundance series of types which might pass for new species, and certainly would be so classed if they were met with in nature. Yet critically tested, we find that they are not distinct species and we have no reason to suppose that any accumulations of characters of the same order would culminate in the production of distinct species. Specific difference therefore must be regarded as probably attaching to the base upon which these transferables are implanted, of which we know absolutely nothing at all. Nothing that we have witnessed in the contemporary world can colorably be interpreted as providing the sort of evidence required.

Twenty years ago, de Vries made what looked like a promising attempt to supply this so far as *Oenothera* was concerned. In the light of modern experiments, especially those of Renner, the interest attaching to the polymorphism of *Oenothera* has greatly developed, but in application to that phenomenon the theory of mutation falls. We see novel forms appearing, but they are no new species of *Oenothera*, nor are the parents which produce them pure or homozygous forms. Renner's identification of the several complexes allocated to the male and female sides of the several types is a wonderful and significant piece of analysis introducing us to new genetical conceptions. The Oenotheras illustrate in the most striking fashion how crude and inadequate are the suppositions which we entertained before the world of gametes was revealed. The appearance of the plant tells us little or nothing of these things. In Mendelism, we learnt to appreciate the implication of the fact that the organism is a double structure, containing ingredients derived from the mother and from the father respectively. We have now to admit the further conception that between the male and female sides of the same plant these ingredients may be quite differently apportioned, and that the genetical composition of each may be so distinct that the systematist might without extravagance recognize them as distinct specifically. If then our plant may by appropriate treatment be made to give off two distinct forms, why is not that phenomenon a true instance of Darwin's origin of species? In Darwin's time it must have been acclaimed as exactly supplying all and more than he ever hoped to see. We know that that is not the true interpretation. For that which comes out is no new creation.

Only those who are keeping up with these new developments can fully appreciate their vast significance or anticipate the next step. That is the province of the geneticist. Nevertheless, I am convinced that biology would greatly gain by some cooperation among workers in the several branches. 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 cannot 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, 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.

Both we and the systematists have everything to gain by a closer alliance. Of course we must specialize, but I suggest to educationists that in biology at least specialization begins too early. In England certainly harm is done by a system of examinations discouraging to that taste for field natural history and collecting, spontaneous in so many young people. How it may be on this side, I can not say, but with us attainments of that kind are seldom rewarded, and are too often despised as trivial in comparison with the stereotyped biology which can be learnt from text-books. Nevertheless, given the aptitude, a very wide acquaintance with nature and the diversity of living things may be acquired before the age at which more intensive study must be begun, the best preparation for research in any of the branches of biology.

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.

I have put before you very frankly the considerations which have made us agnostic as to the actual mode and processes of evolution. When such confessions are made the enemies of science see their chance. If we cannot declare here and now how species arose, they will obligingly offer us the solutions with which obscurantism is satisfied. Let us then proclaim in precise and unmistakable language that our faith in evolution is unshaken. Every available line of argument converges on this inevitable conclusion. The obscurantist has nothing to suggest which is worth a moment's attention. The difficulties which weigh upon the professional biologist need not trouble the layman. Our doubts are not as to the reality or truth of evolution, but as to the origin of *species,* a technical, almost domestic, problem. Any day that mystery may be solved. The discoveries of the last twenty-five years enable us for the first time to discuss these questions intelligently and on a basis of fact. That synthesis will follow on an analysis, we do not and cannot doubt.

WILLIAM BATESON

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE MAIN FEATURES OF THE PROCEEDINGS OF THE COUNCIL AT THE TORONTO MEETING

THE Treasurer's report for 1921 was accepted and will be published in SCIENCE. It shows that the total endowment funds of the Association now amount to $121,414.77.

The Permanent Secretary's financial report for the fiscal year 1920-21 was accepted and will also be published in SCIENCE. The total income of the permanent secretary's office for the fiscal year was $56,463.20.

The council appropriated the sum of $4,000 from the treasurer's appropriable funds, to be allotted as grants for research, according to the recommendations of the Committee on Grants; and it also appropriated $500 from the same funds, to be refunded by the treasurer to the permanent secretary, on account of a $500 grant made from the permanent secretary's funds early in 1921.

The council voted (A) that the treasurer should, now and in the future, invest in securities only additions to the permanent funds, and that he should invest these additions as soon as practicable after their receipt by him; (B) that the treasurer should hold available for appropriation by the council all income from capital funds; and (C) that the balance of the income now available for grants for research after deducting the disbursements for this purpose ($4,500) authorized above, should be held by the treasurer as an emergency research fund available for appropriation by the council as grants for research. (By previous action of the council the treasurer pays annually to the permanent secretary a sum amounting to $3 for each life or sustaining member still living, on account of the journal).

The budgets for 1922 of the permanent secretary, the general secretary, and the treasurer were approved.

The action of the executive committee was approved, in the following elections to membership in the Finance Committee: A. S. Frissell, New York, N. Y.; Milton E. Ailes, Washington, D. C. The Treasurer, R. S. Woodward, is chairman of the Finance Committee.

The action of the executive committee was approved in the election of the following members to emeritus life-membership on account of the Jane M. Smith Fund: Professor B. K. Emerson (M 70, F 77), Amherst, Mass.; Professor Eugene A. Smith (M 71, F 77), University, Ala.

Forty-eight members were elected to fellowship in the association, on nominations duly approved by the section secretaries.

The council expressed by a rising vote its appreciation of the fact that Past President T. C. Mendenhall, who presided at the first Toronto meeting of the Association, in 1889, had found it possible to be present at the second Toronto meeting and to take part in the deliberations of the council.

It was voted that the fourth Boston meeting of the Association (for the fiscal year 1922-23) shall occur from December 26 to 30, 1922, inclusive.

It was voted that the annual meeting for 1923-24 shall occur at Cincinnati, and that the annual meeting for 1924-25 shall occur at Washington.

The council asked the general secretary to take up with the Pacific Division the question of a joint meeting of that division and the association in the summer of 1922, and this question was referred to the executive committee with power.

The report of the secretary of the Committee on Grants, showing a complete history of the work of this committee, was accepted and ordered to be printed in Science. This report will be published later.

On recommendation of the secretary of the Commitee on Grants the council voted that the records of the Committee on Grants shall hereafter be kept in the permanent secretary's office.

Seven resolutions bearing on the general welfare were adopted, and these are published in the present issue of Science.

The council elected the president and the vice-presidents for the sections, for 1922. These elections have already been reported in Science (Vol. 55, p. 15-16, Jan. 6, 1922.).

The council elected three council members and two members of the Executive Committee; and the president appointed, on recommendation of the council, three members of the Commitee on Grants. The names of these officers are published in Science.

On vote of the council, the president was to appoint a committee to consider the general question of convocation week (the week in which New Year's Day falls) as the time for the annual meetings of the Association, this committee to consist of: J. McKeen Cattell, *Chairman*; E. H. Moore; and three others.

On vote by the council, the president appointed the following committee to consider the subject of reciprocity between the United States and Canada, as this concerns scientific work: E. L. Nichols, *chairman*; F. D. Adams; T. C. Chamberlin; J. C. Fields; J. C. Merriam.

The report of the Committee on An International Auxiliary Language was accepted, and the resolutions at the end of this report were adopted by the council. These are published in this issue of Science.

The general secretary was directed to transmit a vote of thanks to the institutions that have acted as hosts for the Toronto meeting.

The council passed a vote of thanks to President E. H. Moore, in appreciation of his tactful and efficient service as chairman of the council during the Toronto sessions.

The executive committee of the council voted that no specially printed program for any section (aside from those included in the general program) can be paid for from the Permanent Secretary's funds without special authorization beforehand.

The executive committee approved the plan of having the assistant secretary go to the meeting place before the meeting, in time to care for the publication of the general program, etc.

The executive committee voted that the chairman of the Committee on the History of Science shall act as vice-president for Section L for 1922, and that the secretary of that committee shall act as secretary of Section L for 1922. It was also voted that the Committee on the History of Science shall act as the Section Committee for Section L for 1922.

Burton E. Livingston,
Permanent Secretary.

RESOLUTIONS ADOPTED BY THE COUNCIL

Seven resolutions bearing on the general welfare of American peoples were adopted by the Council of the American Association for the Advancement of Science at the Second Toronto Meeting, December 27-31, 1921. These resolutions follow:

A resolution on the desirability of the duty-free importation of scientific materials and apparatus by educational and research institutions in the United States, adopted by the Executive Committee of the Council of the American Association for the Advancement of Science at the regular spring meeting of the committee, April 24, 1921, and approved and officially adopted by the Council at the Toronto meeting, December 29, 1921.

[The text of this resolution was published in Science for May 27, 1921.]

A Resolution Bearing on the U. S. Forest Service and the U. S. National Forests.

Whereas, The transfer of the U. S. Forest Service and National Forests from the Department of Agriculture to the Department of the Interior has been proposed in connection with the reorganization of the U. S. government departments, and is embodied in certain bills before Congress (S2740, and S2382, S2203);

Whereas, This proposed transfer ignores the connection between forestry and agriculture, and the essential dependence of the Forest Service upon the various activities of the Department of Agriculture, such as the work on soils, and on the control of plant diseases and insect pests, as well as plant and animal investigations, and so forth;

Whereas, The scientific and administrative functions of the Forest Service are so interdependent that a splitting up of the Forest Service would seriously impair its efficiency;

Whereas, A large proportion of the forest land of the U. S. is on farms, and would require the attention of the Department of Agriculture in any case, and thus the proposed transfer would give rise to a duplication in the government departments such that the main purpose of the transfer would be defeated;

Whereas, The rapidly diminishing timber resources of the country make strong leadership in forestry, such as that provided by the Forest Service, a matter of vital public concern;

Whereas, The National Forests were placed under the Department of Agriculture by President Roosevelt to insure their development along sound lines, and have since been managed by the Forest Service with an exceptionally high degree of efficiency in the best interests of the local communities and of the country as a whole; and

Whereas, The proposed transfer would be a distinct backward step in a matter affecting the general welfare;

Therefore, Be It Resolved, That the American Association for the Advancement of Science strongly disapproves and vigorously opposes any action by which the Forest Service or the National Forests of the United States or of Alaska, in whole or in part, would be removed from the jurisdiction of the United States Department of Agriculture.

A Resolution bearing on the Introduction of Non-native Plants and Animals into the National Parks of the United States.

Whereas, One of the primary duties of the National Park Service is to pass on to future generations for scientific study and education, natural areas on which the native flora and fauna may be found undisturbed by outside agencies; and

Whereas, The planting of non-native trees, shrubs or other plants, the stocking of waters with non-native fish, or the liberating of game animals not native to the region, impairs or destroys the natural conditions and native wilderness of the parks;

Be It Resolved, That the American Association for the Advancement of Science strongly opposes the introduction of non-native plants and animals into the national parks and all other unessential interference with natural conditions, and urges the National Park Service to prohibit all such introductions and interference.

A Resolution bearing on Scientific Journals published by the Government of the United States.

Whereas, Scientific research and its applications to the public welfare are essential to the nation, as is recognized by our government in its support of scientific work; and

Whereas, The publication of scientific work is a necessary part of the work itself to make it of use to agriculture, manufactures and the life of the nation, as has long been recognized by the government in the publication of scientific journals, bulletins and reports;

Therefore Be It Resolved, That the American Association for the Advancement of Science, whose members include more than 10,000 of those most actively concerned with scientific work, urgently request that the Congress of the United States take steps to assure the resumption of the publication of journals devoted to research, such as *The Journal of Agricultural Research, The Experiment Station Record* and *The Monthly Weather Review.*

A Resolution on the Question of an International Auxiliary Language.

Whereas, All the sciences are alike interested in unifying the fundamental tools of thought, and have been notably successful in so doing, with respect to our system of numbers, the Arabic numerals, the metric system, the measurement of latitude and longitude, angular divisions, mathematical symbols, chemical formulæ, time and the calendar, notation in music, and other technical usages; and

WHEREAS, There appears to be a generally expressed need for a suitable international auxiliary language for the prompt and world-wide diffusion of scientific data, and for intercommunicating between nations differing in languages;

THEREFORE, BE IT RESOLVED, That the American Association for the Advancement of Science:

(*a*) Recognizes the need and timeliness of fundamental research on the scientific principles which must underlie the formation, standardization, and introduction of an international auxiliary language, and recommends to its members and affiliated societies that they give serious consideration to the general aspects of this problem, as well as direct technical study and help in their own special fields wherever possible;

(*b*) Looks with approval upon the attempt now being made by the National Research Council and the American Council of Learned Societies to focus upon this subject the effort of those scholars in this country best fitted for the task, and to transmit the results to the appropriate international bodies;

(*c*) Indorses the heretofore relatively neglected problem of an international auxiliary language as one deserving of support and encouragement;

(*d*) Continues its Committee on International Auxiliary Language, charging it with the furtherance of the objects above enumerated and reporting progress made to the association at its next meeting.

A Resolution bearing on the Introduction of the Metric System in the United States.

WHEREAS, The metric system of weights and measures has been favorably endorsed by many societies and organizations affiliated with the A. A. A. S.;

WHEREAS, The A. A. A. S. has by resolution of its governing Council already affirmed its belief in the desirability of adopting the metric system by the United States; and

WHEREAS, Legislative bills aiming to bring about the adoption of the metric system have been introduced in Congress;

THEREFORE, BE IT RESOLVED, That the A. A. A. S. urges on Congress the passage of legislation which will go farther than the present legislation (which permits the use of the metric system) and will require the use of the metric system in such branches of trade and commerce as are subject to general direction and regulation by the government of the United States.

A Resolution bearing on the Appointment of the U. S. Commissioner of Fisheries.

WHEREAS, The United States Commissioner of Fisheries has presented his resignation; and

WHEREAS, The position is one demanding, for the proper discharge of its duties, technical knowledge of the scientific work of the fisheries and their utilization for the benefit of the nation, as well as administrative skill and experience;

THEREFORE, BE IT RESOLVED, That the Council of the American Association for the Advancement of Science desires to emphasize, in connection with the selection of a new commissioner, the prime importance of securing a man who possesses both the special experience and scientific knowledge of the field, combined with the necessary administrative ability for discharging the duties of the position; and

BE IT FURTHER RESOLVED, That copies of this resolution be sent to the President of the United States and to the Secretary of Commerce.

RESEARCH IN THE FIELD OF AGRICULTURE

THE one big agricultural lesson which the War has driven home is a realization of the definite relation between the world's increasing population and the amount of food material of all kinds which it is possible to make the civilized and war-free portions of the world produce. Never before have we realized so clearly as now that the population of the world is crowding closely upon its present limits of food production and that some countries in fact for a long time have fallen far short of their needs in their own production of food. In spite of all the recent development in aerial navigation, wireless communication, manufacturing, and extension of transportation facilities and of trade, agricultural productivity, just as much as ever, remains the foundation of our well being. And the significance of all this is that agriculture must be made increasingly intelligent and must lay hold of all that science can offer to meet the ever increasing demand not only for food but for better foods.

There is a broadening opportunity, then, for investigation of agricultural problems and for applying our best knowledge of the principles of chemistry, engineering, biology, sociology, and economics to the production, distribution, and consumption of food and of the raw materials of manufacture. The man who by reason of his intelligence can take advantage of our knowledge not only to make two ears of corn grow where only one grew before, but to make those two ears higher in their nutritive value or to convert a higher percentage of their food value into ultimate human energy through the mechanism of a steer, a pig, or a grist mill and bakery, will make his mark and will render a service to humanity in which he can take solid satisfaction. There are scores of careers open in connection with the many, many unsolved or partially solved agricultural problems for young men and young women who have the brains and educational equipment to tackle them. Research in agriculture not only adds to the sum of human knowledge; it adds to the amount we may have to eat, to the comfort of the clothes on our backs, to the cheapness of all these necessities, and to the amount of money we may all have for the enjoyment of the other things of life.

Our knowledge of the physics and chemistry and biology of the soil, for instance, needs re-study in the light of the modern development of these sciences and the perfection of instruments and methods in these fields of research. These newer methods must be applied to the study of fertilizers and their action, and to plant and animal nutrition. The fat soluble A's and the water soluble B's must yield their secrets. The problems of disease resistance and immunity must be reinvestigated by the newer methods now available. We must perfect instruments and methods for the study of the ultra-microscopic organisms and disease producing agencies as the physicists have done in the study of the atom and electron. We do not yet know the causative agent of the mosaic diseases which are becoming more destructive to many of our important crops each year. Peach yellows is almost as great a mystery as it was in the beginning. We do not know the causative agent of hog cholera and a number of other destructive diseases of live stock. The newer chemistry and physics applied to the study of plant and animal physiology are opening a new chapter in those fields. Many obscure problems in storing and transportation of perishable fruits and vegetables are yielding to these newer methods of study.

Plant and animal diseases reduce our food producing efficiency fully 20 per cent. per annum on the average. Our understanding of them and the methods of controlling them is still very imperfect. The whole field needs reworking by men trained in the newer methods and in the light of our modern knowledge. The idea of the fixity of species and their special creation has only recently been laid to rest. We are just entering the field of genetics and plant and animal breeding. What has been accomplished so far has depended upon chance variation and selection. We are only just beginning to unravel the laws governing variation and heredity. What powers the greater and more exact knowledge may give us we can only dimly conjecture now. The new physics, chemistry, and biology are yet in their infancy. They are our keys to greater knowledge. Our modernly trained scientist who is to devote himself to the building up of the new agricultural science must have these keys at his command. He must prepare himself with the same thoroughness that the modern chemist or physicist prepares for his work. He will need also to learn the art and necessity of cooperation. One mind cannot compass the whole field. The advance of the future will be made largely by closely cooperating groups of chemists, physicists, biologists, pathologists, etc. The colleges and universities must study and promote every phase of this great problem. They must find the leaders and the promising students and provide them with all they need for their work. The field is an attractive one for those who desire to render great service and who love the joy of discovering truth. The scientists, the inventors, the teachers, the poets, and the writers devote their energies to these fields for the love of the work and the joy that acknowledged accomplishment brings. It is something that money cannot buy. The financial reward is seldom thought of. Nevertheless it is coming to be an important accompaniment.

The universities and colleges are being heavily drawn upon by commerce and industry for trained thinkers and investigators. Great private foundations must go to the universities for trained men. Governmental agencies, state and national, can not find enough trained students to meet their needs. The experiment stations and the national Department of Agriculture are constantly in need of more and better trained personnel. While salaries offered by government and state agencies are usually not as large as those paid in the industrial world there are other compensations. There is a strong and increasing demand for men trained in the various branches of agricultural science. Work of this kind in foreign fields is very attractive to many. The state universities and agricultural colleges are awake to the new needs. They are organizing their research with the cooperation and backing of the national and state governments, with a view to encouraging the promising investigator and student and to maintaining the vivifying atmosphere that the research spirit and accomplishment gives to the university. Thorough preparation not too specialized in the first two or three years is essential to future success. The basic sciences, mathematics, physics, chemistry, and biology, together with a knowledge of modern languages must be stressed with the specialized work in the selected field.

In the graduate schools the development in the next few years will doubtless be along the line of developing special research facilities in particular fields. It should be possible to find there the men, the books, the laboratories, and the equipment necessary for the most effective investigation in the particular fields stressed. This would bring about a greater interchange of students which would be good for the university as well as the student. There never has been a time when the need for agricultural research of the first order was as necessary as it is today. The growing recognition of this need and appreciation for the service that may be rendered promises well for the future. The call for prepared and devoted workers should be heeded by the best young men and women of our colleges.

A. F. Woods

University of Maryland

SCIENTIFIC EVENTS

INVESTIGATION OF CARBON MONOXIDE POISONING

In order to make accurate observations for determining and treating carbon monoxide poisoning among those employed in mines, metallurgical plants, and tunnels, a number of investigations are being conducted at the Pittsburgh Experiment Station of the United States Bureau of Mines.

Methods of collecting and preserving blood from persons affected or overcome by carbon monoxide have been investigated and developed. Blood samples were collected in various parts of the United States, forwarded to Pittsburgh, and there examined. A preliminary report has been submitted.

The following methods of analysis of blood in the presence of carbon monoxide have been studied by Bureau of Mines investigators: Haldane's picrocarmin method, tannic acid method, spectrophotometric method, and the Van Slyke gasometric method. The Haldane picrocarmin method proved to be the least desirable, being very inaccurate with low concentrations; the tannic acid method was accurate but tedious; the spectrophotometric method was accurate and rapid, but required expensive apparatus; the Van Slyke method was the most dependable, but it required a comparatively large sample, 2 to 4 c. c., for each determination. A report on these methods of analysis has been submitted.

A study of the feasibility of using in first-aid work a mixture of carbon dioxide and oxygen, first recommended by Dr. Yandell Henderson, for resuscitation of persons overcome by carbon monoxide was conducted on both dogs and men. Results indicated that in its present state of development the method is not feasible for use by first-aid men.

In the conduct of the above investigations a superior method for the selection of analysts for color work in chemistry was developed, which it is believed can be applied to advantage in any laboratory requiring careful colorimetric determinations. Also the solubility of carbon monoxide in serum and plasma was determined, the amount of carbon monoxide dissolved in the serum proving to have little effect upon the accuracy of colorimetric determinations. The figures for the solubility of carbon monoxide in serum have also a purely scientific value in the calculation of carbon dioxide in serum and the determination of the hydrogen in concentration.

In addition to these studies on carbon monoxide Dr. Yandell Henderson and Dr. W. Haggard, as consulting physiologists to the Bureau of Mines, in work done at the Laboratory of Applied Physiology at New Haven, Conn., on the problem of the elimination of carbon monoxide from the blood after a dangerous degree of asphyxia, have determined that ventilation of the lungs could be increased from 300 to 400 per cent. by adding 6 to 10 per cent. of carbon dioxide to pure oxygen. These investigators have also shown that the effects of carbon monoxide upon the heart are not specific, but are secondary to general asphyxia and a terminal failure of respiration. Material is now available for a report showing that symptoms and effects sometimes assigned to chronic carbon monoxide poisoning are in reality due to the effects of benzol and related substances in illuminating gas. This conclusion has a direct bearing on the use of mixtures of gasoline and coal distillate in underground locomotives.

WORLD LIST OF SCIENTIFIC PERIODICALS[1]

The Conjoint Board of Scientific Societies proposes, if sufficient support is obtained, to arrange for the issue of a world list of periodical publications which contain the results of original scientific research, and has entrusted preliminary arrangements to a committee, of which the following are members: Sir Sidney F. Harmer (chairman), Mr. F. W. Clifford, Sir Richard Gregory, Dr. P. Chalmers Mitchell, Mr. A. W. Pollard, and Professor W. W. Watts, secretary.

The list will be an octavo volume containing, in alphabetical order, the titles and places of publication of all such periodicals in existence on January 1, 1900, and of all issued after that date.

Libraries in London, Oxford, Cambridge, Edinburgh, Dublin and Aberystwyth which take in these periodicals will be indicated in the list, and, wherever possible, at least one library in the United Kingdom will be indicated for each title.

The copies will be printed on one side only to facilitate alterations and additions.

The objects of the proposed volume are: (1) To supply as nearly as possible a complete list of current scientific periodicals; (2) to indicate, where possible, at least one library where each periodical is taken; (3) to form a basis for cooperation between libraries, so that both the number of duplicates and the list of periodicals not taken in may be reduced; and (4) to enable each library to use the list for its own purposes, by placing a mark against the title of each periodical it possesses, by cutting up for a card index, etc.

The trustees of the British Museum, recognizing the importance of this work to scientific research and bibliography, have consented to allow the compilation to be undertaken by the staff of the Museum. They are unable, however, to defray the cost of printing and publication.

Although the value of a list of this kind to libraries and scientific societies would be very great, it is scarcely possible that the production of so costly a work would be entertained by a publishing firm as an ordinary commercial enterprise. If, however, a sufficient number of libraries and institutions agree in advance to purchase one or more copies, when issued, the compilation of the list will be put in hand at once. Already a large bulk of material has been collected in the British Museum by various societies and by the Conjoint Board.

I shall be glad to receive by January 31, if possible, the names and addresses of institutions or individuals who will support this proposal by undertaking to subscribe for one or more copies of the list. The price per copy will be 2*l.* 2*s.* net.

W. W. Watts

Conjoint Board of Scientific Societies,
Burlington House, London, W. 1

[1] From *Nature*.

EMILE CARTAILHAC AND OSCAR MONTELIUS

Professor Emile Cartailhac, of the University of Toulouse, died suddenly on November 25 last, at the age of seventy-six. Professor Cartailhac, besides being a teacher, was a museum curator, and of late years served also as official guide to the local caverns of archæological interest, but he nevertheless found time for extensive field research and publication. As dean of the French prehistorians, he was instrumental not only in giving tremendous impetus to scientific archæology but also in training several of the younger men that still remain to carry on the work.

Oscar Montelius, former antiquary to the Realm of Sweden, succumbed to pneumonia in Stockholm, on November 4, at the age of seventy-eight. His death marks the close of a most distinguished career, for although primarily in charge of the Swedish archæological collections in the National Museum at Stockholm and thoroughly in love with his task, Professor Montelius concerned himself quite as much with the prehistory of the rest of Europe, as well as of the adjacent portions of Asia and Africa. In many respects his work was complementary to that of the late Gustav Retzius and his writings are characterized by the same breadth and profundity. Montelius did more than any one else toward placing the chronology of the Neolithic and Metal ages on a sound basis. His death, coming so nearly at the same time as that of Professor Emile Cartailhac of France, is a distinct loss to all students of prehistoric archæology.

N. C. Nelson

OFFICERS OF THE BRITISH ASSOCIATION

The following, as we learn from *Nature,* have been appointed presidents and recorders (to whom all communications should be sent) of the different sections of the British Association for the meeting to be held at Hull on September 6-13 next under the presidency of Professor C. S. Sherrington: *Section A* (*Mathematics and Physics*): President, Professor G. H. Hardy; Recorder, Professor A. O. Rankine, Imperial College of Science and Technology, S. W. 7. *Section B* (*Chemistry*): President, Principal J. C. Irvine; Recorder, Professor C. H. Desch, University of Sheffield. *Section C* (*Geology*): President, Professor P. F. Kendall; Recorder, Dr. A. R. Dwerryhouse, University College, Reading. *Section D* (*Zoology*): President, Dr. E. J. Allen; Recorder, Mr. R. D. Laurie, University College, Aberystwyth. *Section E* (*Geography*): President, Dr. Marion I. Newbigin; Recorder, Dr. R. N. Rudmose Brown, University of Sheffield. *Section F* (*Economics*): President, Professor F. Y. Edgeworth; Recorder, Professor H. M. Hallsworth, Armstrong College, Newcastle-upon-Tyne. *Section G* (*Engineering*): President, Professor T. Hudson Beare; Recorder, Professor G. W. O. Howe, Elmswood, Malden, Surrey. *Section H* (*Anthropology*): President, Mr. H. J. E. Peake; Recorder, Mr. E. N. Fallaize, Vinchelez, Chase Court Gardens, Enfield, Middlesex. *Section I* (*Physiology*): President, Professor E. P. Cathcart; Recorder, Dr. C. Lovatt Evans, National Institute for Medical Research, Mount Vernon, N. W. 3. *Section J* (*Psychology*): President, Dr. W. H. R. Rivers; Recorder, Dr. C. Burt, 30 Princess Road, Regent's Park, N. W. 1. *Section K* (*Botany*): President, Professor H. H. Dixon; Recorder, Mr. F. T. Brooks, 31 Tenison Avenue, Cambridge. *Section L* (*Education*): President, Sir Richard Gregory; Recorder, Mr. D. Berridge, 1 College Grounds, Malvern. *Section M* (*Agriculture*): President, The Right Hon. Lord Bledisloe; Recorder, Mr. C. G. T. Morison, School of Rural Economy, Oxford.

OFFICERS OF THE AMERICAN ASSOCIATION

At the Toronto meeting of the council of the American Association for the Advancement of Science there were elected, besides the officers whose names were published in Science for January 6, the following:

Chairman of Section D: Otto Klotz, director of the Dominion Observatory, Ottawa.

Secretary of Section K: Frederick L. Hoffman (to retire at the end of 1924), Prudential Life Insurance Company of America, Newark, N. J.

Secretary of Section N for 1922: A. J. Goldfarb, College of the City of New York, New York, N. Y.

Members of the Council: J. McKeen Cattell (to retire at the end of 1924), Garrison-on-Hudson, N. Y.; F. G. Cottrell (to retire at the end of 1924), National Research Council, Washington, D. C.; Henry C. Cowles (to retire at the end of 1925), the University of Chicago, and John C. Merriam (to retire at the end of 1925), the Carnegie Institution of Washington.

Members of the Executive Committee: Simon Flexner and W. J. Humphreys were elected to succeed themselves, as members of the executive committee (to retire at the end of 1925).

The following were appointed to membership in the Committee on Grants, to succeed Henry Crew, Joel Stebbins and G. H. Parker, who retired at the end of 1921: E. G. Conklin (to retire at the end of 1925), Princeton University, E. L. Nichols (to retire at the end of 1925), Cornell University), and F. R. Moulton (to retire at the end of 1922), the University of Chicago.

SCIENTIFIC NOTES AND NEWS

Dr. Edgar F. Smith, provost emeritus of the University of Pennsylvania, has been elected an honorary member of the Chemical, Metallurgical and Mining Society of South Africa.

Charles W. Goodale has been awarded the gold medal of the Mining and Metallurgical Society of America for distinguished service in increasing the safety of men in mining and metallurgical operations.

Dr. F. G. Cottrell, of the National Research Council, has been elected an honorary member of the French Society of Chemical Industry.

The American Society of Agricultural Engineers has elected A. J. R. Curtiss, of Chicago, president for the coming year.

According to the *Journal* of the Washington Academy of Sciences, the following Washington scientific men have been appointed members of the technical staff of the American delegation to the Conference on the Limitation of Armament: Dr. L. W. Austin, radio specialist of the Navy Department; Dr. J. H. Dellinger, chief of radio investigations at the Bureau of Standards; Gen. Amos E. Fries, chief of the Chemical Warfare Service of the Army; Gen. George O. Squier, chief of the Signal Corps of the Army; and Dr. S. W. Stratton, director of the Bureau of Standards.

At the recent meeting of the American Association of Anatomists in New Haven, the following officers were elected: *President,* Clarence M. Jackson, University of Minnesota; *Vice-President,* Harold D. Senior, New York University; *Secretary-Treasurer,* Lewis H. Weed, Johns Hopkins University; *Members of the Executive Committee:* Davenport Hooker, University of Pittsburgh, and Benjamin F. Kingsbury, Cornell University.

Celebrations were held at Liége on December 4, in honor of the completion of fifty years of scientific work of Professor Leon Frédéricq. A bas-relief portrait of himself in bronze was presented to him, and this will be placed later in the Institute of Physiology at Liége. Representatives of the Universities of Lausanne and of Strasbourg conferred honorary degrees upon Professor Frédéricq.

A Dutch pharmacist, Dr. H. Baljet, of Arnheim, has been awarded the Davy prize by the University of Geneva for an essay on the dosage of digitalis.

The docent of neurology at the Karolinska Mediko-Kirurgiska Institut at Stockholm, Dr. N. Antoni, has been awarded the Lennmalm prize for 1921 by the Swedish Medical Association.

S. J. Speak has been elected president of the Institution of Mining and Metallurgy, London.

Dr. Robert N. Nye, formerly research assistant to Dr. F. B. Mallory, has accepted the position of assistant director of the division of biologic laboratories of the Massachusetts State Department of Public Health.

Dr. William A. Perlzweig has resigned the position of biochemist in the New York branch of the Hygienic Laboratory and has accepted an appointment as chemist to the Medical Clinic of the Johns Hopkins University.

A medical scholarship for women is to be established in the University of California in memory of Dr. Sarah Sluey of the class of 1876. Dr. Sluey was the first woman who graduated in medicine from the university.

T. M. Jasper, assistant professor of mechanics at the University of Wisconsin, has been placed in charge of tests in the joint investigation of the fatigue of metals, being carried on at the Engineering Experiment Station of the University of Illinois, in conjunction with the National Research Council and the Engineering Foundation.

Mr. Philip L. Gile, formerly connected with the American Agricultural Chemical Company, in their agricultural service bureau, and for eleven years prior to that position chemist of the Porto Rico Agricultural Experiment Station, is at present in charge of the division of soil chemical investigations of the Bureau of Soils, U. S. Department of Agriculture, Washington, D. C.

At the annual general meeting of the Harveian Society, held in London on January 12, Dr. G. de Bec Turtle delivered the presidential address on "Some Points on Spasm in the Alimentary Tract."

Alfred H. Brooks, of the United States Geological Survey, retiring president of the Washington Academy of Sciences, delivered an address on "The Scientist in the Federal Service" at the annual meeting held at the Carnegie Institution on January 10.

Warren T. Clarke, professor of agricultural extension of the University of California, has been invited as a guest of the Pacific Mail Steamship Company to study the control of ants on shipboard. He sailed on December 12 on the *Columbia* which makes Mexican and Central American ports passing through the Canal and proceeding by way of Havana to Baltimore.

The American Society for Testing Materials and the United States Forest Service have been designated by the American Engineering Standards Committee as joint sponsors for the development of uniform standard methods of testing wood. This action was taken as the result of a canvass made of the principal national bodies concerned with the proposed project, from which it was apparent that there is a real demand for the work, and that the joint sponsorship here indicated would be acceptable to the industry.

A conference under the auspices of the National Research Council in Washington was held on December 23 to consider the problem of the university and college student of superior attainment. The conference was attended by Frank Aydelotte, president of Swarthmore College; S. P. Capen, director of the American Council on Education; J. Crosby Chapman, associate professor of educational psychology, Yale University; John J. Coss, assistant professor of philosophy, Columbia University; Louis T. More, professor of physics, University of Cincinnati; A. A. Potter, dean of the schools of engineering, Purdue University; J. J. Tigert, United States commissioner of education; Ernest H. Wilkins, professor of romance languages, University of Chicago; C. E. Seashore, professor of psychology, University of Iowa, and chairman of the Division of Anthropology and Psychology, National Research Council, and A. L. Barrows, assistant secretary of the National Research Council. Dr. Vernon Kellogg, permanent secretary of the council and chairman of the Division of Educational Relations, presided. General discussions, specially introduced by various members of the conference, were had of such subjects as honors courses, fellowships, special privileges, sectioning of classes, analyzed ratings, etc. Various suggestions were made of work which might be done to stimulate interest in and active attention to the problem by university and college faculties, and a resolution was passed urging the National Research Council to continue and extend work along the line already undertaken by it.

The *London Times* announces that the council of the Royal Horticultural Society has become responsible for continuing the publication of Curtis's *Botanical Magazine*. During the war the number of subscribers fell and, when Messrs. Lovell Reeve & Co., who had bought the magazine from the Curtis family in 1845, found themselves unable to continue the publication, they offered the copyright to Kew for £250. Although the botanical authorities would gladly have carried on the publication, the government refused to sanction the purchase, and at one time there was considerable anxiety lest the copyright should be sold and cross the Atlantic. At a dinner of some leading horticulturists on the first night of the Chelsea Show the feeling was so strong that the magazine must remain in England that the requisite sum was guaranteed at once and the copyright was purchased on the following day. The next step was to propose to allow the magazine to appear as an official publication from Kew; but the Treasury refused to sanction the conditions imposed by the new owners. The latter then approached the council of the Royal Horticultural Society, with the result that it is hoped to resume publication in 1922, and an early announcement will be made as soon as the negotiations and arrangements are complete.

The Elgin Observatory of the Elgin National Watch Company, at Elgin, Illinois, on Armistice Day, November 11, 1921, obtained its first chronographic record of the French scientific radio time signals from the LaFayette Station, Bordeaux, France, at a distance of 4,400 miles. The recording apparatus devised by Frank D. Urie is entirely automatic, the incoming radial signals controlling the movement of the chronographic pen. The receiving aerial is a small one consisting of a single wire 180 feet long and 30 feet high.

We learn from the *Journal* of the American Medical Association that a bill has been introduced in the Senate and House of Representatives to "reorganize and promote the efficiency of the United States Public Health Service." It is known as the Watson-Dyer bill. The bill provides for 550 officers of the reserve corps of the Public Health Service, including 50 dental surgeons and 50 scientists other than medical officers, who may be transferred to and commissioned in the regular corps of commissioned officers of the Public Health Service by the President, in the grades of assistant surgeon, passed assistant surgeon, surgeon, senior surgeon, and assistant surgeon-general. Officers in the last grade will be known as medical directors. No officer will be commissioned or promoted until after passing an examination before a board of regular commissioned officers of the Public Health Service. The bill further provides that no reserve officer shall be commissioned in the regular corps of the Public Health Service who has not had three years' satisfactory service in the army, navy or Public Health Service, a part of which service must have been between April 6, 1917, and November 11, 1918. There are only 200 regular commissioned officers in the Public Health Service at present. They are largely engaged in administration, scientific research, industrial and child hygiene, neuropsychiatry, domestic and foreign quarantine, immigration, prevention of venereal diseases, public health education, and other matters pertaining to public health. There are about one thousand commissioned officers of the reserve of the Public Health Service on active duty, caring for ex-service men. These officers are indispensable, yet they have no fixed tenure of appointment. The Watson-Dyer bill transfers at least half of them to the regular service without any additional expense.

UNIVERSITY AND EDUCATIONAL NOTES

Mr. George F. Baker, chairman of the board of directors of the First National Bank, has given $700,000 to Columbia University for the purchase of an athletic field on Dyckman Street. The property, which comprises twenty-six acres, will be developed at a cost of about $3,000,000.

The University of North Carolina has received the sum of $26,000 for the establishment of the Graham Kenan fellowship in philosophy. The gift was made by Mrs. Graham Kenan in memory of her late husband.

Professor Wm. R. Work, of the Carnegie Institute of Technology, has been placed in charge of the department of electrical engineering, to succeed Professor Alexander J. Wurtz, who has been made research professor in the new research division of the institute.

Dr. J. A. Gunton has been appointed head of the chemistry department in Transylvania College, Lexington, Ky. Dr. Gunton recently received his doctorate of philosophy from the University of Illinois.

Dr. Clifford S. Leonard, for the past year fellow in chemistry to Sweden on the American-Scandinavian Foundation, has completed his research at the Karoline and Nobel Institutes of Stockholm and has been appointed research instructor of pharmacology at the University of Wisconsin.

Dr. R. H. Aders Plimmer has been appointed by the Senate of London University to the university chair of chemistry, tenable at St. Thomas's Hospital Medical School, beginning with the new year. At present he is head of the biochemical department of the Rowett Research Institute at the University of Aberdeen.

DISCUSSION AND CORRESPONDENCE

SEARCH FOR THE RECORD OF ROBERT HANHAM COLLYER, M. D.

Dr. Collyer was registered as practicing medicine in London as late as the year 1878. After this it is believed he returned to America. Long previous to this, namely, in 1867, he had announced in the *Anthropological Review* a very important discovery,—a prehistoric jaw-bone of great geologic age. Of this Mr. J. Reid Moir of Ipswich, England, writes:

> I am of the opinion that if the Foxhall jaw-bone could be reexamined now, it would be possible to say with considerable certainty as to whether it was derived from the Crag, or not. But, unfortunately, the specimen cannot now be found, and advertisements placed by me in various newspapers and other journals have failed to bring it to light. Owing to the kindness of the acting registrar to the General Council of Medical Education and Registration of the United Kingdom, I have been informed that Dr. Robert Hanham Collyer was registered in England on the 23rd of June, 1868, with the qualification M.D., Medical College, Pittsfield, Massachusetts, 1839. His application for registration is dated the 23rd of October, 1867, when he gave his address as 40, Carlton Hill, St. John's Wood. At the time of his registration he was at 1, Norman Terrace, Stockwell, which he subsequently changed to 199, Brompton Road, S. W., which was his registered address in 1878, in which year his name lapsed from the Medical Register in consequence of this address having been found to be inaccurate by means of an inquiry under Section 14 of the Medical Act. According to the American Medical Directory, the college from which, apparently, he obtained his degree is described as the Berkshire Medical College, Pittsfield, Massachusetts, an institution which is classed with those which are extinct—or merged with other colleges. There is reason to believe that Collyer returned eventually to America, taking the Foxhall jaw-bone with him. It would seem unlikely—in view of the importance he attached to the specimen—that no instructions would be left by him for the preservation of the specimen after his death, and I hope that the publicity now given to this matter may result in the Foxhall jaw-bone being once more brought to light.

There are several clues to aid our search. First the records and graduates of the Pittsfield Medical College. Some member of Dr. Collyer's class may have left descendants. Or, some member of his family may recall him. Or, the Philadelphia Academy of Natural Sciences may find letters from Dr. Collyer to Dr. Samuel G. Morton, the distinguished anthropologist of that institution.

Henry Fairfield Osborn

American Museum of Natural History, New York City

THE PROTECTION OF MICROSCOPIC SECTIONS

Referring to Professor Long's suggested method for protecting microscopic sections from mechanical injury in Science of October 7th., may I suggest the following, which will remedy the difficulty without resorting to the use of a thin film of parlodion.

Instead of using the *natural* Canada balsam for mounting (which does remain fluid for years), use balsam prepared by heating the natural product on a water bath until it is hard, but not brittle, when cool. Then dissolve in a menstruum such as chloroform or xylol. After balsam is applied to the slide allow to stand over-night and then finish by placing cover glass over the sections, using gentle heat to render the balsam fluid. This mounting medium will then be found to be hard enough to withstand any pressure applied on the cover glass by careless students.

It is advisable to prepare this balsam oneself, unless it can be procured from a reliable firm which uses the above method of preparation.

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THE HISTORY OF SCIENCE

Relative to your recent articles on the history of science and its present position in American colleges, you might be interested to know that efforts are being made to adapt the history of science as a cultural course for engineering students. I taught such a course in the college of engineering of the University of Colorado, and now am teaching it in the college of engineering of New York University.

Philip B. McDonald
December 27, 1921.

AMEBOID BODIES ASSOCIATED WITH HIPPEASTRUM MOSAIC

In a recent publication [1] the writer described and pictured certain bodies in the cells of corn plants suffering from mosaic disease. Since the bodies are confined to diseased portions of the plant, it was suggested that they might be of etiological significance.

Those who are working on the mosaic disease problem will be interested to know that similar bodies have now been found in the light green portions of mosaic leaves of *Hippeástrum equéstre* Herb. This plant belongs in the Amaryllidaceae and is not closely related to corn. Its leaves which are thick and soft are well suited for cytological studies. The mosaic pattern shown by *Hippeástrum* is quite different from that of corn. The intracellular bodies associated with this disease will be described in detail in a future paper.

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[1] Bul. Exp. Sta. H. S. P. A. 3:44-58 (1921)

THE TUNING FORK

In Science for November 11, I cited briefly some inadequate references to the actions of a tuning fork to justify the preservation of matter that was very old; there was no reason to name the writers for these references were minor parts of their papers. But in Science for December 16, one of the writers, Mr. Young, comes to the front, as if I had made a personal attack on him, and defends his former expressions, but qualifies them, still leaving the subject in a very confused state. He quotes his former dynamically unsound "statement that the fork has only a single note at the base" and now adds the indefinite remark, "This of course is only an approximation"; it is noteworthy that he does not attempt to state what he thinks is the truth.

In his final paragraph he attributes to Professor Watson an "alternative explanation" which is only a corollary of Chladnis' old accepted theory; but probably the professor of physics would not use over his own signature such an inexact expression as the "center of mass tends to rise" or "lower," or leave it doubtful whether "center of mass" always relates to the same point.

Charles K. Wead

QUOTATIONS

"KEY" CHEMICALS

Lord Crewe and Lord Haldane argued last week for the release of scientific apparatus and chemicals from the restrictions imposed by the safeguarding of industries act and the reparation act. Scientific research and the teaching of scientific students, they alleged, were seriously impeded because of the delay and difficulty in importing certain chemicals and apparatus from Germany. The stronger the evidence for their case, the more certainly does it lead away from the action they pressed on the government. Although protection may be dubious as a general principle, there are certain industries of little intrinsic economic importance, and yet vital to the national safety, because of the dependence of larger industries upon them. Are there any avocations more certainly "keys" to national prosperity than scientific research and the training of scientific workers? In these matters we must depend neither on Germany nor on any foreign country. If dependence exist at present, the administration of the acts should be tightened, not relaxed, until we become self-supporting. But the case is probably over-stated. Before the war scientific workers here and in the United States had got in the habit of using such chemicals as bacteriological stains and such forms of optical glass as microscopic lenses from one or two German makers, not because these were better than all others, but because they were standardized and all workers using them could easily compare their results. Convenience, not necessity, had led to a German monopoly. American bacteriologists are endeavoring to meet the state of affairs by agreeing on a reliable standard brand of each kind of stain and discouraging the use of variants. Similar action might be taken in this country not only with regard to stains, but to many other kinds of chemicals and of apparatus used in research. But we note with concern as further witness of the aloofness of the state from science, that the interpellations on this scientific question were addressed to the minister of transport, who undertook, apparently to the satisfaction of every one, to refer it to the president of the Board of Education. Is there not a Royal Society, at one time the natural adviser of the government on scientific matters?—*The London Times.*

SCIENTIFIC BOOKS

Studies on some Flagellates. E. Penard. Proc. Acad. Nat. Sci. Phila., 1921, Part 1, Oct. 12. Idem, Etudes sur les Infusoires d'eau douce; Geneva, "1922" [1921].

The inadequacy of our knowledge of local protozoan faunas is emphasized by two recent papers by the veteran Swiss protozoologist, Penard, in which he describes, chiefly from two limited regions in the environs of Geneva, 7 new Flagellates and 148 new species of Ciliates, including 8 new genera. Central Europe has been more intensively studied faunistically than any other portion of the world, yet six years observation by one student has brought to light 155 new forms in groups which are the especial delight of the microscopist and which have been by no means neglected by the protozoologist. Faunistic data furnish material essential to the study of many far-reaching problems in ecology, in distribution, in geology, and especially in paleogeography. Yet it is evident, from such papers as Penard's, that our faunistic data for all regions are only fragmentary.

Many of Penard's papers, like those of Leidy, show an intimate and friendly companionship with these microscopic forms, being full of data as to behavior, structure and function being described together, conveying to the reader a vivid impression of the lives of these organisms and showing an interest on the part of the observer which is contagious. May it not be that laboratory zoology is to-day disproportionately emphasized in comparison with out of door studies? A broad knowledge of field natural history, combining taxonomic, faunistic and ecological studies and studies of behavior under natural environmental conditions, is essential to any adequate attack upon many problems, among which are some of the most interesting in the whole field of zoology. This is a type of work to which it is easy to introduce young students and it is one to which a fair proportion of them could well afford to devote their lives, for evidently our knowledge in this field is most inadequate. The field, while easy to enter, calls for the finest qualities of skill, accuracy, persistence and judgment. It commands a natural interest and it gives data of wide bearing.

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SPECIAL ARTICLES

THE FORMS OF GAS AND LIQUID CAVITIES IN GELS, AND THEIR INTERPRETATION BY SURFACE COMPRESSION

IT has been observed by both chemists and biologists that gas bubbles arising in gels exhibit lenticular forms. The most complete investigation of the phenomenon has been made by Hatschek who, after making measurement on many bubbles, endeavored by a statistical study of their orientations to explain the observed facts, including the divergence from sphericity, by postulating definitely oriented directions of cleavage within the gel, corresponding presumably to a honeycomb microstructure of its water-poor phase. Neither Hatschek himself nor later workers have been convinced that this explanation was the true one. Working with gelatine, but more especially with silica gels, the writers have produced, from air-saturated media, controllable airbubbles both by rise of temperature and by reduction of air pressure, and have observed additional facts that lead to an altogether different, albeit simple and complete, interpretation of everything observed.

Concomitantly as the gas content of a bubble is caused progressively to diminish, the space formerly occupied by the gas becomes filled by infiltration with liquid from the liquid phase of the gel, giving rise finally to liquid-filled, phantomlike, cavities, whose very existence has heretofore escaped observation. The forms of these cavities thus arising spontaneously in an isotropic medium on alteration of a single external condition are exceedingly symmetrical and beautiful. As demonstrated by photomicrographs, they exhibit two main types:

(1) If derived from gas cavities of oblate spheroidal form, the liquid-filled phantoms are of forms that may be likened to bivalve molluscs whose shells are either (a) segments of spheres, or bowl-shaped; or (b) of inflected curvature, like a circular basin with a flaring edge; or (c) like the last, but with a central apical spike like that of a helmet. Each one of these forms is immediately explicable if it be considered that, while forming, the original airbubble thrust aside the elastic water-poor phase of the gel, which was thus obliged to collect in an elastic layer or membrane under compression round the periphery of the bubble. The bubble cavity is thus contained and enveloped by a membrane which may appropriately be considered in surface *compression*, as contrasted with the customary surface tension, because adjacent portions of this enveloping membrane tend to move apart from instead of toward each other, in a direction tangential to the surface of curvature. The sphere is the stable form that must be enveloped by a membrane in surface tension, but is no longer stable if its bounding membrane is in surface compression; and this instability is, therefore, in such a case, relieved first by an exhibition of oblateness and later by an out-thrusting of the membrane in the region of smallest radius of curvature, giving rise to the forms observed in a manner entirely predicable by purely geometrical reasoning.

(2) If derived from gas cavities of prolate spheroidal form, the liquid cavities are of forms somewhat like that of those walnuts, occasionally met with, that have three instead of two lunes or boat-like portions composing their shells. This spontaneously formed solid, trilunar, figure has one axis of triad symmetry perpendicular to one plane of symmetry, and is usually of sharpened angle both along its three edge-ribs and especially at the ends of its chief axis, by reason of the outward thrust of its enclosing membrane, precisely as would be predicted by the reasoning noted above. An example of this form is shown in Fig. 2;

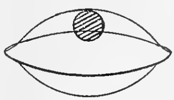

FIG. 1

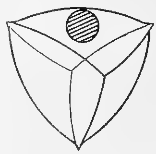

FIG. 2

while Fig. 1 shows the form referred to under (b) above. These figures are from photomicrographs of cavities not more than one millimeter in diameter; and each cavity contains, besides liquid, a small spherical bubble of air, which appears dark.

It is believed that the forms here described and interpreted are unique in inorganic nature.

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UNLIKE INTERPRETATIONS OF FULLER'S SCALE IN DETERMINING DEGREE OF ACIDITY

In following directions for making up bacteriological culture media the writer has been impressed by the marked differences in acidity as recommended by different bacteriologists. For example, "The Standard Methods of Water Analysis," adopted by the American Public Health Association, 1917, and commonly used by bacteriologists, recommends the use of culture media of a + 1.0 acidty.[1] Smith (4, p. 69), however, apparently recommends a + 15.0 agar and a + 10.0 gelatin, and these figures are frequently used by plant pathologists in designating the acidity of culture media.

The question which naturally arises is, do bacterial pathogens of plants require in general a much higher degree of acidity than bacteria of milk, sewage, water, animal pathogens, etc., or is it possible to explain this difference by assuming unlike interpretations of Fuller's scale. The writer with the hope of clarifying the situation has compared the descriptions of Fuller's method as given by Smith, whose texts are universally used by plant pathologists, with the description usually presented by bacteriologists, particularly animal pathologists, and also with the description originally presented by Fuller. He finds that Fuller's scale is interpreted differently.

Smith's (l. c.) description follows: "The plus and minus on Fuller's scale denotes, respectively, acid and alkaline media. The + 10, for example, means that exactly 10 cubic centimeters of normal alkali must be added to a *liter* (writer's italics) of the culture medium to render it exactly neutral to phenolphthalein, and, correspondingly — 10 means that the fluid is alkaline to phenolphthalein and that 10 cc. of normal acid would need to be added to bring 1 *liter* back to the neutral point." He follows this interpretation of Fuller's scale, as amount per liter, in his very recent work (5, p. 106): "Our standard agar is + 15 and our standard gelatin + 10 on Fuller's scale, or 1.5 per cent. and 1 per cent. respectively, if reckoned on 100 c. c. portions. It is best to keep to Fuller's scale since we make up media in liters, not in 100 c. c. portions."

The following description of Fuller's scale, taken from Park and Williams' (3, p. 102), is typical of the interpretations placed upon this scale by various texts on animal pathogens: "Calculation—Five c. c. of medium require 2.4 c. c. of N/20 NaOH, therefore *100 c. c.* (writer's italics)—would require 2.4 c. c. of N/1 NaOH—; in other words, the medium is 2.4 per cent. acid to phenolphthalein or + 2.4 if expressed according to *Fuller's method* or *scale.*" It will be noted that in this interpretation Fuller's scale is used as degree of acidity in *100 c. c.* of medium in contrast to those interpretations in which the scale denotes degree of acidity in *1,000 c. c.* of medium.

Fuller's (1, p. 388) own description reads as follows: "For accuracy and convenience, the expression of acidity or alkalinity of culture media in numbers of cubic centimeters of a normal solution *per liter* (writer's italics) is by far the best, and I recommend its universal adoption as a standard method." Concerning degree of acidity with reference to optimum growth, he says (p. 391): "Speaking in general terms the available data appear to warrant the placement of the optimum degree of reaction within narrower limits, between 10 and 20 of our scale," and (p. 394) he adds, "As it is very urgent that some fixed point be adopted I venture to suggest that for quantitative water analysis . . . . 18 on our scale be taken as a standard. This means, of course, that such a solution would require 18 cubic centimeters per liter of normal alkali to render it neutral to phenolphthalein." This usage, as amount per liter, has been generally adopted by plant pathologists, while the animal pathologists, in general, use the scale as denoting amount per 100 c. c.

It should be pointed out that Fuller does not

[1] Since Fuller's scheme has several decided disadvantages it is being supplanted by more accurate methods. (See Report of the Committee on the Descriptive Chart for 1919. *Jour. Bact.*, 5: 127-143. 1920).

use the plus (+) sign to denote degree of acidity although he does use the minus (—) sign for alkalinity. In a table which shows the relationship of different degrees of reaction to the number of bacteria developed (p. 393) he presents under "reaction" the following figures: 40, 35, 30, 25, 20, 15, 10, 5, 0, —5, —10, —15, —20, —25, adding, "Numbers refer to cubic centimeters per liter of normal acid or alkali necessary to change it to phenolphthalein neutral point. Minus (—) means an alkaline solution." The plus (+) sign was apparently not used by Fuller, the figure itself without any sign standing for acidity. While the writer has not definitely ascertained when and by whom the plus (+) sign was first used, it is probable that it was first brought into general use by the *Report of the Committee of Bacteriologists of the American Public Health Association* (2) in 1898. This committee, of which Fuller was a member, made the following recommendation (2, p. 75): "Manner of expressing the degree of reaction of culture media: Since at the time the reaction is first determined culture media are more often acid than alkaline, it is proposed that acid media be designated by the plus sign and alkaline media by the minus sign, *and that the degree of acidity or alkalinity be noted in parts per hundred*" (writer's italics). "The bulk of available evidence from both Europe and America points to a reaction of +1.5 as the optimum degree of reaction for bacterial development in inoculated culture media" (p. 76).

It is quite evident that animal pathologists and bacteriologists in general have substituted for the methods proposed by Fuller those proposed by the Committee of the American Public Health Association of 1898, although they usually cite or designate Fuller's scale, while plant pathologists use Fuller's original recommendations with the exception of adding the plus (+) sign to indicate acidity.

Since +10.0, +15.0 in 1,000 c. c. of the medium correspond to +1.0, +1.5 respectively in 100 c. c. of the medium it is evident that the degree of acidity recommended for plant pathogens corresponds to the acidity recommended for bacteria in general, and it is necessary to know the author's interpretation of Fuller's scale when considering the degree of acidity described or recommended.

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(1) FULLER, GEORGE W. *On the proper reaction of nutrient media for bacterial cultivation.* Jour. Amer. Pub. Health Asso., 20: 381-399. 1895.

(2) *Report of a Committee of Bacteriologists to the Committee of the American Public Health Association on the Pollution of Water Supplies.* Jour. Amer. Pub. Health Asso., 23: 56-100. 1898.

(3) PARK, W. H., and WILLIAMS, A. W. *Pathogenic microörganisms.* Lee & Febiger, publishers, Philadelphia, 1920.

(4) SMITH, ERWIN F. *Bacteria in relation to plant diseases.* Vol. 1. Published by the Carnegie Institution of Washington. 1905.

(5) SMITH, ERWIN F. *An introduction to bacterial diseases of plants.* W. B. Saunders Company, publishers, Philadelphia, 1920.

THE AMERICAN CHEMICAL SOCIETY

(Continued)

DIVISION OF RUBBER CHEMISTRY
W. W. Evans, *chairman*
Arnold H. Smith, *secretary.*

Report of committees, executive, physical testing, abstract, chemical analysis and accelerator.

Mineral rubber: C. O. NORTH. The purpose of this paper is to bring out the desirable and undesirable properties of M. R. in order that M. R. makers will appreciate more fully how their product is employed. Changes in stress strain relations, hysteresis losses, permanent set, energy of resilience and abrasion with increase in M. R. ratio to rubber are shown. M. R. is essentially a plastic material. When a stock containing it is stretched, the M. R. flows with the rubber. On release the M. R. flows back with the rubber. The principal evidence of its presence is a slowing up or logging of the return.

The Tetra-hyroxyphenyl derivative of rubber and its tetra-methyl ether. HARRY L. FISHER AND HAROLD GRAY. The tetra-phenoxy derivative of rubber described by Weber (ber. 33, 791) is shown to be the tetra-hydroxyphenyl derivative not only by the method of formation, and by its solubility in aqueous NaOH, but especially by the fact that it can very readily be methylated to the corresponding tetra-methoxyphenyl derivative. The reaction for preparing the hydroxyphenyl compound from rubber tetrabromide and phenol is like a Friedel-Crafts' reaction, being speeded up by the use of anhydrous aluminum chloride, zinc chloride, etc. Other halogen derivatives of rubber such as the dihydrochloride also react with phenol.

Microscopy of rubber fillers. IRENE C. DINER. The principal rubber fillers, namely, barytes, whiting, zinc oxide, lithopone, litharge, red lead, antimony sulphide, iron oxide and gas black, are included in a large chart showing the characteristics which differentiate these microscopically. Among the properties shown are size, color, shape, crystal structure, impurities and optical properties. A basis of a positive method of identification of the fillers is indicated, based upon 17 different measurable physical properties. It is hoped that this method will in time supercede the present lengthy and cumbersome qualitative and quantitative analysis. Besides being shorter it is more exact since it gives the exact state in which the filler is present rather than merely the amount of each element with a good guess as to their association, for example, whether the substance be present pure or impure, hydrated or anhydrous, etc.

The use of the microscope and photomicrographs in the study of inorganic materials used in rubber. BENTON DALES AND W. W. EVANS.

Recent developments in the art of rubber microsectioning. HENRY GREEN. A method for making microsections of rubber has been developed which is free from the various inconveniences associated with the method heretofore employed of freezing the sample with CO_2 and liquid air. The elasticity is destroyed and sufficient rigidity acquired by treating the sample with dilute SC_1 solution. Sections are obtained ½ mm x 4 mm in area, which under a magnification of 1,500 diameters appears, in round numbers, to be a strip 3 ft. wide and 20 ft. long. This is sufficient to show all the characteristics of the sample. The sections can be made exceedingly thin, beautifully transparent and of uniform thickness.

Piperidine-piperidyl-dithiocarbamate as a rubber accelerator in the presence of zinc oxide: G. S. WHITBY AND A. H. SMITH. One part of piperidine-piperidyl-dithiocarbamate in a 90 rubber 10 S, 10 zinc oxide mix cuts the time of vulcanization at 141 degrees C from three hours to less than one minute. At 131 degrees C it cuts the time of vulcanization from seven hours to one minute. It is fully vulcanized in three to four minutes at 115 degrees. When only two parts of S are used the time of vulcanization is one minute at 141 degrees, or two minutes at 131 degrees, or ten minutes at 115 degrees. Stress-strain data are given.

An improved oven for accelerated aging of rubber. C. W. SANDERSON.

General discussion. *Accelerated aging tests.* Led by W. W. Evans, review of article, *Ten years experience with accelerated aging tests,* by W. C. Geer and W. W. Evans.

An apparatus and method for abrasion tests on rubber compounds: J. C. SPROUL AND W. W. EVANS.

The determination of true free sulfur and true coefficient of vulcanization in vulcanized rubber: W. J. KELLY. The application of the method devised for pure gum stocks (J. Ind. Eng., Ch. 12: 875, 1920) to compounded stocks. Free sulfur determined by the 'satured alcohol'' method. For combined sulfur the sample is extracted with alc. KOH and ether HCl, the latter removing any sulfide as H_2S and dissolving accelerators which form water on ether soluble hydrochlorides. In this way considerable sulfur is removed in addition to that extracted by acetone and which had previously been considered as combined with the rubber. In some cases an additional extraction with water is necessary, but the details of this remain to be worked out.

Corrected stress-strain curves for rubber: J. W. SHIELDS. An improved method is explained for drawing stress-strain curves for rubber which takes into account the decrease in cross section of the specimen. Such curves do not have the S shape which is characteristic of uncorrected curves. The corrected curves show the modulus of rubber to be least at the smallest elongation and to increase gradually as the specimen is stretched. The method for determining the true modulus of unstressed rubber is illustrated. The equation for this curve is developed and the values of the equation constants given for several stocks.

The determination of the particle size of pigments. W. W. VOGT. By a turbidimetric method it is possible to determine the capacity of a pigment to extinguish direct light rays. This capacity, called obscuring power, is a direct function of the average particle size of the pigment. The values of O. P. are shown to be consistent with particle size as determined microscopically and furthermore to be in close accord with the practical compounding value of the pigment. Hence, by the determination of the O. P. of an unknown pigment it is possible to predict what its practical compounding value will be in relation to known pigments.

The solubility of sulfur in rubber: C. S. Venable and C. D. Green. Values have been obtained for the solubility of sulfur in rubber at 55°, 75°, 95° C. The procedure used was essentially to pack thin rubber strips in sulfur, maintain at the desired temperature until equilibrium was reached, and then analyze for combined and free sulfur. Various precautions were adopted to insure that equilibrium was reached. It was found that the solubility of sulfur in rubber increases slowly with the vulcanization coefficient, this increase being more rapid as the temperature increases. It was found that when this coefficient was greater than 7 per cent. combined sulfur, it was impossible to obtain solubility values by the method used due to the fact that the rubber becomes almost impermeable to free sulfur. This impermeability probably has more to do with the non-blooming of hard rubber stocks than the increased solubility of free sulfur. By extrapolating the curves obtained, it can be calculated that a stock having 4 per cent. combined sulfur at 140° C will be saturated with about 15 per cent. free sulfur.

Reactions of accelerators during vulcanization. IV. Mechanism of the action of zinc compounds: C. W. Bedford and L. B. Sebrell. Zinc sulphydrate vulcanizes rubber in the presence of sulfur at ordinary temperatures. Zinc persulfides are stable compounds and vulcanize rubber in heat cures far more rapidly than ordinary sulfur. Zinc salts of organic accelerators form polysulfides without decomposition into zinc sulfide and disulfides. Disulfides are changed to mercaptans by hydrogen sulfide and in the presence of zinc oxide they form zinc salts. (An answer to Bruni, *India Rubber J.*, 62 [1921] 63.)

The action of volatile organic solvents and vulcanizing agents on organic compounding materials and resinous gums: Frederick Dannerth. The purpose of this investigation has been to obtain fundamental data for the industries which use plastic masses. The amount of matter soluble in certain liquids at stated temperatures has been studied. We have also noted: The amount of a given solvent which will mix with any other given solvent at a given temperature; the swelling action of certain solvents on stated organic materials; the action of certain vulcanizing agents on pitches and oils as well as their action on chicle, balata, guttapercha and jelutong. The influence of the product has been studied, first using only organic compounding material and secondly using only the resinous gums.

The preparation and testing of crude rubber: O. de Vries.

Section of Cellulose Chemistry
Harold Hibbert, *chairman.*
G. J. Esselen, Jr., *secretary.*

Acetolysis of spruce pulp. Preliminary communication: Walter Russell and Louis E. Wise. Acetolysis of spruce sulfite pulp, when carried out as in the case of acetolysis of cotton, yields appreciable amounts of cellobiose octaacetate. The yield of cellobiose appears to depend on the normal (Alpha) cellulose content of the pulp, rather than on the so-called "total cellulose." The cellobiose reaction furnishes another link in the chain of evidence that the normal cellulose of spruce wood is chemically similar, if not identical with that of cotton.

Studies on cellulose chemistry. III. The constitution of cellulose: Harold Hibbert. The recent work of Karrer and of Freudenberg on octacetylcellobiose confirms the view advanced previously by the writer that the ratio of this product to dextrose pentacetate obtained from the decomposition of cellulose acetate is much higher than corresponds to the pentaglucosidylglucose formula for cellulose put forward by Hess. The results cast considerable doubt on the correctness of his formula, but, on the other hand, are in no way in disagreement with that advocated by the writer. Further evidence in support of these is to be found in the recent paper of Denham on the methylation of cellulose.

IV. The action of HBr on carbohydrates and polysaccharides: Harold Hibbert and Harold S. Hill. Cellobiose gives a yield of 27 per cent. of bromomethylfurfuraldehyde while lactose gives less than 7.0. These two derivatives are structurally identical and there is thus the possibility of utilizing this reaction for the determination of configuration. The mechanism of the reaction is being carefully studied in view of its bearing on the constitution of cellulose.

The condensation of citral, with certain ketones and the synthesis of some new ionones: Harold Hibbert and Laura G. Cannon. The best method for purifying citral is the one developed by Tiemann. Of the condensing agents hitherto employed, sodium ethylate is the most satisfactory, but metallic sodium is equally efficient. Better yields of a purer product have been obtained. The bisulfite method of purification is capable of general application in the purification of pseudo-ionones, giving yields of about 85 per cent. and chemically pure products. New ionones have been synthesised from methyl propyl ketone and acetophenone.

The rôle of celluloses in plant life: R. W. Thatcher. Celluloses are classified according to their chemical composition into three groups: the hemi-celluloses or pseudo-celluloses; the normal celluloses; and the compound celluloses. Hemi-celluloses are amorphous polysaccharides which are probably reserve carbohydrates deposited in the structural, or cell-wall, materials rather than in storage organs. Normal celluloses are amorphous forms of polysaccharides having an empirical formula similar to that of starch; but exhibiting a characteristic fibrous structure instead of the granular structure characteristic of starches. They are true cell-wall, structural material; they can be hydrolyzed by certain bacteria but probably have no nutritive function in higher plants. Compound celluloses are either colloidal complexes or definite chemical compounds of true cellulose with some encrusting material which serves to stiffen and harden the celullar structure and convert it into "wood." They are among the most inert plant compounds and probably have no role other than that of adding strength and stiffness to the stems or other tissues of plants.

The determination of the "bromine figure" or "chlorine factor" of pulp and the utilization of these quantities in bleaching: Alfred Tingle. The extent to which bromine solutions, approximately decinormal, act on cellulose and on unbleached sulphite spruce pulp, has been investigated. Accurate measurements could only be made when the material was brought into solution before treatment with bromine. Under the experimental conditions used, it was found that bromine did not act on cellulose to any appreciable extent in an hour, but that it acted on unbleached sulphite pulp in stages, one of which was completed in 30 minutes. From measurements of this action a quantity was found, constant for each sample of pulp, which bears a definite and simple relation to the chlorine-consumption in bleaching the pulp.

The alleged absorption of aluminum from solutions of aluminum sulphate by cellulose: Alfred Tingle. Both neutral and basic solutions of aluminum sulphate were brought in contact under various conditions with cellulose in the form of (*a*) acid-washed filter paper, (*b*) bleached sulphite spruce pulp. By the methods employed, no change in the aluminum content of the solutions could be detected, except when a pulp was used which contained calcium compounds and gave a strongly alkaline reaction to water, with which it was extracted. The deduction is made that absorption does not occur to any appreciable extent, and that the phenomena which have been accounted for by this cause are due to other causes.

The distillation of methoxyl groups in wood distillation products: L. F. Hawley and Subramanya Aiyar. It has been reported that the treatment of wood with sodium carbonate previous to distillation increases the yield of methyl alcohol. The source of this increase has now been determined. Maple wood containing 6.09 per cent. methoxyl when distilled gave products with percentages of methoxyl as shown in column 1 of the table. On distilling the wood after treatment with 1 per cent. sodium carbonate the methoxyl distribution is as shown in column 2 of the table and the increase of methyl alcohol is seen to come partly from the dissolved tar and partly from the charcoal. The proportion of total methoxyl in the original wood recovered in the distillation product remains about the same.

PERCENTAGE OF METHOXYL BASED ON THE WEIGHT OF THE WOOD DISTILLED

	Original wood.	Wood treated with Na_2CO_3
Charcoal	0.285	0.044
Settled tar	0.517	0.588
Dissolved tar	0.303	0.173
Pyroligneous acid	1.617	1.953
Gas (methane)	1.306	1.468
Total	4.028	4.226

Acetic ether as a solvent for nitro cellulose and cellulose acetate: H. F. Wilkie. In discussing acetic ether as a solvent for nitro cellulose and cellulose acetate a review is made of the subject of cellulose esters solvents in general. The production of high grade anhydrous ethyl acetates or acetic ether as the pure product is designated and results obtained in experimenting with it as a solvent of cellulose esters point to the strong possibility of it taking the place of amyl acetate. It can be procured in large quantities and the ultimate supply is unlimited. Data is given to support the following claims: It is neutral in reaction and remains so on long exposure to air, light or moisture, and is non-hydroscopic. Acetic ether is a powerful solvent of nitro-cellulose and a good solvent for cellulose acetate. It works well in combination with the other well known solvents and non-solvents, and is a pure substance which evaporates without residue and at a uniform rate, giving rise thereby to homogeneous films. By a very important property it possesses of forming various constant boiling mixtures (especially one with water) more volatile than itself it combines with the advantages of its low boiling point the ability to act as the high boiling solvents in overcoming the evil effects of water absorption.

Requirements of a brief, critical monograph on the chemistry of cellulose: LOUIS E. WISE. The article outlines the type of material and data that should be incorporated into a monograph on cellulose. Many of the older terms that still appear in the cellulose literature should be deleted or redefined. Proper weight should be given to carefully selected fundamental data and to the work of critical investigators. All hypotheses dealing with the constitution of cellulose or its derivatives should be subjected to close scrutiny, and those based on good experimental data should receive emphasis. Recent work on the colloidal properties of cellulose should be included. The monograph besides being critical should be suggestively written so as to stimulate research. A brief volume with a good bibliography appears to be more desirable than a series of monographs.

SECTION OF PETROLEUM CHEMISTRY

T. G. Delbridge, *chairman.*

W. A. Gruse, *secretary.*

An unusual type of casinghead gasoline: C. E. COATES AND B. Y. TIMS. The Terrebonne gas field, which is situated about twenty miles below Houma, Louisiana, gives gas and a pressure of about 1,200 pounds per square inch. This gas is piped to Houma and supplies the town and vicinity with fuel. The pipes are provided with drips which fill up rather frequently and are pumped out. As the condensate did not seem to be like ordinary gasoline either in odor or boiling point a sample was investigated with the following results: Boiling began at 195° C. The fractions first obtained were refractionated and eventually obtained with fairly constant boiling points. The lowest fraction had a formula $C_{12}H_{22}$. The higher fraction seemed to belong to the same series. The condensate contained no members of the parafine series at all, but probably is made up of dicyclopentyl and its homologues.

Some observations on the polymerization of amylene: THOS. MIDGLEY, JR., AND G. W. HANK. The action of dilute and concentrated sulfuric acid and of heat on the polymerization of amylene has been studied in some detail, and a chart of polymerisation reactions is presented. It is suggested that di- and tri-amylene have cyclic structures. The subject is of interest in connection with the gumming of cracked gasolines.

The iodine and bromine values of petroleum products: E. M. JOHANSEN. A number of petroleum products were examined, the results being recorded in numerous tables. It was shown that the total iodine or bromine values do not correspond to the relative unsaturation of petroleum products, as only a part of the absorbed halogen is combined by addition. As the Hanus solution does not permit the separate determination of this part, solutions of bromine or bromine and iodine in carbon tetrachloride were used, by aid of which the desired addition values were obtained. The influence of varying experimental conditions upon the reactions were studied. It appears that the absorption of bromine is less affected by the variations than that of iodine. A bibliography of the literature on the subject was compiled.

Specific heats and heats of vaporization of motor fuels: ROBERT E. WILSON AND D. P. BARNARD, 4TH. The authors present the results of a series of observations on the total sensible heats of completely vaporized motor fuels. These, combined with critically compiled data from the literature on heats of vaporization of motor fuels, make it possible to draw accurate total heat curves over the whole range of temperatures up to 500° C. and derive fairly accurate values for the specific heats of the hydrocarbon vapors. Combinations of this with vapor pressure data make it possible to determine just how hot the air or the fuel must be preheated in order to completely vaporize the motor fuel in a carburetor.

Further observations on the value of the R. E. test: C. H. OSMOND AND T. G. DELBRIDGE. Data are given showing that the R. E. test distinguishes between some oils which give the same results by other emulsification tests. Criticisms of the method as published in the A. S. T. M. Proceedings for 1920 have led to minor changes in the method and particularly in the interpretation of the readings. Further precautions are given, also explanations of some of the procedure. Modification of the test for application to oils of very low viscosity is also given.

The inversion of phases in oil-water emulsions: LEON W. PARSONS. A broad survey has been made of the literature regarding emulsions and a brief discussion is given of the main factors influencing the properties and general behavior of mineral oil-water emulsions. An experimental investigation of these emulsions, with special reference to such as are likely to occur in practice, and to methods of breaking them, has been made. The phenomenon of "inversion of phases" has been studied and data regarding the influence of the following factors on the nature and stability of various emulsions has been obtained: (*a*) Nature of oil used; (*b*) Nature of emulsifying agent; (*c*) Type of emulsion obtained; (*d*) Inversion point and its relation to stability of emulsions; (*e*) Industrial applications of above results to technical emulsions.

Emulsions with finely divided solids: T. R. BRIGGS. The chief function of an emulsifying agent is the formation of a viscous film at the dineric interface. Lowering of the surface tension is not essential and presumably plays no part when finely divided solids serve as emulsifying agents. Oil in water and water in oil emulsions may be produced with finely divided solids; in the first type the solid must be wetted more strongly by water than by oil, but in the second type it must be wetted more strongly by oil. Certain factors influencing the relative wetting are considered. It is also shown that solids tending to form the first type of emulsion exert an "antagonistic" effect on solids tending to form the second type of emulsion, the effect being entirely analogous to Clowe's antagonistic action between soaps of sodium and calcium.

Emulsifying agents in oil field emulsions: J. L. SHERRICK. The presence of some third component, usually a colloid, to serve as an emulsifying agent is recognized by most workers as a necessary condition for stable emulsion formation. Experimental results indicate that earthy matter, carrying adsorbed asphalt, asphaltenes, etc., and present in the oil as a hydrophobe colloid, functions as the emulsifying agent in oil field emulsions. This conclusion is in line with Richardson's work on Trinidad asphalt (*J. Phys. Chem.*, 19, 245-6. 1915). Addition of certain organic solvents decreases the adsorption of asphalt on the earthy material and renders these emulsions unstable. As the adsorbed asphalt is removed the earthy matter ceases to be a hydrophobe colloid such as is necessary for the stabilization of a water-in-oil emulsion.

A short discussion on the formation of crude oil and water emulsions: A. W. MCCOY.

Common Characteristics of crude petroleum emulsions: E. E. AYRES, JR. This paper deals with crude petroleum emulsions as they occur industrially. It is pointed out that these emulsions are comparatively uniform in properties. The subsidence produced by gravity and by centrifugal force is discussed and the two methods compared for crude petroleum emulsions. The coalescence produced by contact under the influence of gravity and high centrifugal force is in the same degree. Three methods for producing coalescence are discussed—heat, filtration and colloid reactions. Heat is often incorrectly applied. Properly used, heat will greatly assist resolution. The filtration method described is based on the principle of contact between water globules and a medium more readily wetted by water than by oil. The method of "colloid reactions" is based on the opposition of hydrophile to the hydrophobe colloid. One may be neutralized by the other so as to yield a zero stability. The formation of reagents to accomplish such reactions is discussed.

Recovering petroleum from emulsions by chemical treatment: RALPH R. MATTHEWS AND PHILIP A. CROSBY. Satisfactory results are shown which were obtained by treating tank bottoms (emulsified petroleum) with a chemical known as Tret-O-Lite, which consists principally of sodium oleate. An aqueous solution when thoroughly mixed with the emulsion at 100-120° F. causes it to separate and results in the recovery of pipe line oil. A later development in the work has resulted in a liquid compound produced by sulphonating oleic acid and then making alkaline with caustic soda. This seems more effective, and methods and results of commercial applications to crude oil emulsions are shown. Experimental work is now going on relative to producing and using an oil soluble compound which will be more effective than the above and more easily handled.

Oil field practice in handling crude oil emulsions: SIDNEY BORN. The latest developments in handling crude oil emulsions are described in some detail. Five different methods are discussed: The steaming plant, chemical treatment, the Cottrell process, the centrifugal method and the topping plant. The types of plants and process most suitable for different fields and conditions will be of interest to the practical operator. A new method developed by the writer is described for handling large amounts of B. S.

CHARLES L. PARSONS,
Secretary

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THE TREND OF EARTH HISTORY[1]

SOME years ago a witty member of the mining engineering profession read a paper before the Canadian Institute of Mining Engineers, picturing geologists, and particularly historical geologists, as a group of romancers—the lineal descendants and heirs of the old professional story-tellers of the middle ages. He accounted for the general popularity of the subject of geology by the fact that every one loves a story-teller, while but few people are interested in questions of cold fact.

Nearly all opinions, correct or otherwise, are based upon a modicum of fact; and so, for this impression of historical geologists as dreamers and story-tellers, there is a certain foundation in reality. It will scarcely do, however, to accept so distorted a picture as even an approximation to the truth.

Are the data with which the student of Earth history works so obscure, so fragmentary and so equivocal that his conclusions are not entitled to confidence? In part, Yes; but in large measure, No. They are in fact much like the data of human history, and particularly of archeology. That they are not exact quantitative evidence is true, and this tends to make them seem untrustworthy in the eyes of the student of the more exact sciences. Nevertheless, the data are real, and safe conclusions may be drawn from them if care and due caution are applied to the operation. Furthermore, the solving of one problem often leads to the solution of another which had previously resisted all attempts at interpretation. In spite of the obvious incompleteness of the geologic record, we nevertheless have a large number of clearly ascertained facts about the physical and biologic history of the earth, and

[1] Address of the Vice-President and Chairman of Section E—Geology and Geography, American Association for the Advancement of Science, Toronto, December 28, 1921.

even some hints about its birth and antecedents.

The biologic phase of the subject overshadowed the physical in the minds of the historical geologists of the nineteenth century so largely that we now know more about the character and sequence of organic forms than about other phases of the Earth's history. Courses in historical geology have generally been taught by paleontologists, and the history of animals and plants fills most of the pages devoted to historical geology in textbooks and manuals. In the last few decades, however, more and more attention has been given to the nature and sequence of the climates, physiographic changes, volcanic outbursts and other physical events; and our knowledge of this phase is now growing so rapidly that it bids fair to overhaul and pass the earlier wave of biological study. To appreciate the truth of this statement, it is only necessary to scan the list of papers that have been published in recent years on such subject as unconformities, sedimentation, orogenic epochs, paleogeography, physiographic history, glacial epochs, and the like.

The study of the physical history of the Earth assumes new aspects from decade to decade, as a question here and there is answered and other problems arise out of the interaction of newer ideas. One of the commonest questions which geologists are asked is —"How old is the earth?" and "How many years have elapsed" since this or that event in its history took place? The question has been attacked from many angles, and although exact calculations are not yet and perhaps never will be possible, we may have increasing confidence in the general character of the returns.

Counting the growth-rings in the big trees of California shows that some of those giant growths are more than 4,000 years old, and yet no marked change has taken place in the surface of the land on which they stand since they sprouted from the soil.

Baron De Geer, after a most painstaking study of the laminated glacial clays of northwestern Europe, seems to have compiled a definite record of seasonal changes of deposition covering some six or seven thousand years, during which certain post-glacial lakes were being filled with deposits of silt.

Less accurate estimates of geologic time have been based on recessions of Niagara Falls and other cataracts. These problems are usually complex and the factors not all well known. Hence, estimates of the number of years since the ice sheet left Niagara vary all the way from 7,000 to 50,000 years. Nevertheless, this gives a general order of magnitude which is of value. The mean of the two extremes is probably not very far from the truth.

The most complete part of our geologic record is the composite pile of strata of the sedimentary rocks. Many attempts have been made to translate the thickness of these beds into terms of years, but our knowledge of the rate at which sediments accumulate under various conditions is still far too inaccurate. We know rates in certain isolated instances, but they vary within wide limits, and we do not yet understand the factors that govern the variations. There is good reason to believe, however, that the rate of deposition generally has been overestimated, and hence the periods of time have been made too short.

Within the last fifty years, the various estimates which have been made of the time represented by the Paleozoic, Mesozoic and Cenozoic eras have varied between three million years for the lowest and six thousand million years for the highest. The average of twenty such estimates is about 250 million years, but most of the individual figures are about 100 million or less.

On the whole, from decade to decade there has been a disposition to lengthen the estimates, as the testimony of the stratigraphic column became better understood. In 1893, Walcott allowed 45 to 70 million years for the three eras. In 1899 Geikie estimated 100 million years. In 1913, Holmes calculated an average of about 300 million years for the same group of periods, and, in 1916, Barrell suggested 360 to 540 million years as the best estimate based on the sedimentary deposits. This tendency to recognize more clearly the immense duration of the various geologic periods has been due largely to a growing understanding of the many diatems, or interruptions in the stratigraphic column, as well as variation in the rate at which different types of sediments have been laid down.

Soon after the discovery of the fact that radium undergoes an exceedingly slow decomposition leaving helium and lead as products, it was found that the minerals of the oldest rocks contained more helium and lead than those of younger rocks. The following are a few examples selected from the calculations by Strutt expressed in terms of the time from certain periods down to the present:

1. Miocene .... 6 million years
2. Upper Carboniferous........146 million years
3. Early pre-Cambrian..........710 million years

Holmes recognized that much of the gas emitted might have escaped during the subsequent existence of the minerals. Using the less migratory element, lead, as a basis of calculation, he reached the figures 1,000-1,600 millions years for the age of certain minerals from the Archean rocks. It is particularly significant, that the testimony of different minerals from the same intrusion, considering the errors expectable in analytic work, generally agrees rather closely; and there is almost as good a correspondence between the lead ratios of minerals of the same general age but from widely separated localities. According to Barrell's interpretation, the rare-earth minerals of the Llano uplift in central Texas contain uranium-lead indicating an age of about 1,125 million years. They are roughly of middle pre-Cambrian Age. Unless there are concealed sources of error in the careful work of our best radiologists, we seem justified in accepting their estimates as fairly satisfactory approximations—very much the best we have ever had—which indicate that the Mesozoic rocks are tens of millions, the Paleozoic rocks hundreds of millions, and the most ancient pre-Cambrian rocks more than 1,500 millions of years old.

Reviewing these attempts to express the history of the earth in terms of years, we find that from the time of Archbishop Ussher and his estimate of 5,700 years for the total history of the earth up to his day, or even Lord Kelvin who allowed 20 to 40 million years for the entire evolution of the planet, the tendency has been to greatly increase our estimates of the length of time involved in even the later part of the Earth's history; for we must not forget that the time from the earliest Archean period to the present is probably very short, as compared with the time that has elapsed in the formation of the earth as a planet and is to elapse before its final refrigeration—if such is ever to occur. The contemplation of such vast lapses of time makes the brief span of human history seem absurdly short. It is difficult to realize, when studying "history," commonly so-called, that we are reading only the latest chapter of the last volume of a great series of tomes numerous enough to fill a large library.

The physical events that crowded this tremendous space of years are being made known as geologic field studies progress. Among them are the orogenic disturbances, or diastrophic revolutions, when long winding wrinkles were bulged upon the Earth's surface, only to waste away under the slow attack of the weather. While they are in this process of decay, we call them mountain systems. At such times, the shallow epicontinental seas are generally withdrawn into the ocean basins, the average height of the continental masses above sea-level is increased, and the work of erosion accelerated.

That part of North America now occupied by the Rocky Mountain System was, from before the Cambrian down to the Cretaceous period, for the most part a region of plains or low hills, undergoing either general erosion or decomposition. Much of the time it was sea-bottom. Then followed a period of profound disturbance. The stratified rocks were wrinkled into folds, and their foundation of ancient crystalline rocks compressed and mashed beneath them. Great slices were sheared over the subjacent mass for many miles. Molten lava welled up into the disturbed formations and even burst forth on the surface scattering cinders and volcanic dust far and wide. Remnants of the lava flows and stocks still mark the sites of volcanic cones which have since been demolished. This disturbance subsided, but was repeated soon afterward at the close of the Paleocene Period. The deformation was again renewed in the Miocene period and in a milder form still more recently. From the bulged and wrinkled tract thus prepared, the Rocky Mountains, as we know them to-day, have been carved by the combined agencies of erosion.

By contrast, on the eastern slope of North America, periods of relative stability in the crust alternated with these compressive disturbances, from a remote pre-Cambrian time down to about the close of the Paleozoic era. Since then the region has been comparatively quiet, and its history is chiefly the story of the erosion of the surface, modified from time to time by slight and gentle uplifts and subsidences of broad areas.

These are examples of a great geologic principle. All regions of the globe have had similar periods of disturbance alternating with those of quiet, but as to time and intensity they have differed among themselves. In the earlier days of geology these crumpling disturbances were usually ascribed to the cooling and consequent shrinkage of the globe. Other hypotheses are now in the field, and the contest is still in full swing. Whatever their cause, we do not find much evidence of a general decrease in the activity of such internal earth forces. On the contrary, the middle Tertiary revolution was one of the most widespread and intense of which we have any record. There have been many fluctuations but no general trend.

Volcanic action likewise varies in intensity, and transfers its activity from one region to another from period to period; generally accompanying but locally ignoring the diastrophic disturbances. Yet, on the whole, the volcanic activity of the last two geologic periods is equal in intensity and widespread distribution to anything known to us in earlier periods.

The demolishing of the hills and mountains by streams, winds, glaciers, and the other erosive agencies proceeds most actively during the periods of crumpling. At such times broad, flat-bottomed valleys are planed off only on the outcropts of the *softest* rocks. The wearing away of the harder masses proceeds at a much slower pace. Before such plains can be extended over the more resistent outcrops, the heaving and sagging of the uneasy earth interrupt the process and rejuvenate the erosion cycle.

Eventually the internal unrest subsides; the body movements virtually cease for a long period until renewed in the oncoming of the next orogeny. In this period of relative quiet, the erosive agencies are able to reduce to comparative flatness not only the outcrops of the soft, but also the harder rocks, until peneplains of broad extent have been produced. Only the hardest masses and those farthest removed from the main drainage channels continue to stand out as mountains. The early Cambrian and the Jurassic periods saw peneplains extended over most parts of North America of which there is sufficient record. Meanwhile, the adjacent seas were gradually being filled with the detritus swept from the land, and were in consequence creeping out upon the continental platforms in the form of shallow seas.

To-day we evidently are living in the midst, or perhaps near the close, of one of the lesser periods of internal disturbance. For this reason our broad plains of erosion, such as the Mississippi Basin, Central Russia and northwest Siberia are limited for the most part to the outcrops of soft rocks. Nevertheless, we appear to have, even to-day, in central Canada and eastern Siberia ancient peneplains, on hard rocks, which have been so little dusturbed and dissected that they still retain in large measure their distinctive character.

For a hundred years or more paleontologists have been gathering and assembling information regarding the kinds of animals and plants represented by the fossils in the rocks. From them we learn the distribution of these plant and animal societies both in space and time. When enough information has been gathered regarding the distribution of the marine sediments and faunas of a particular age, we are in a position to map, at least roughly, the sea and land areas of the time. Such maps have been made within the last few years in considerable variety and for more than one of the continents. They are admittedly crude approximations to the truth; yet they show certain general facts that are fairly well substantiated. The more detailed studies of this kind have made us realize that throughout the recorded part of geologic history there have been alternate expansions and contractions of the oceans, with reciprocal changes in the land areas. Schuchert has estimated that about the middle of the Ordovician time the sea covered two thirds or more of what we now call North America, as well as large parts of other continents. It was one of the distinctively oceanic epochs. On the other hand, the epochs that began and terminated the Paleozoic era were times of diastrophic activity marked by such extreme contractions of the ocean-covered areas that we can find on our present lands only small traces of the marine strata of those ages. The rest of them are doubtless buried beneath the present oceans.

These oscillations of the shore-line seem to be wholly irregular and pulsating. We can discern no definite tendency toward either a progressive contraction or a progressive expansion of the ocean. If there be such a tendency, it must be so gradual that even many geologic periods are not sufficient to reveal its nature to us. Only on theoretical grounds may we suspect that the oceans are constantly growing a little larger, for they are receiving from time to time water derived from the steam of volcanic eruptions; and there is reason to think that much of this water is a real contribution from the interior of the earth and that it has never before been a part of the hydrosphere.

We have come to understand that the hills, mountains, valleys and other topographic details of the land are almost entirely the result of what James Geikie has aptly called "land sculpture." Streams of water, the wind, glaciers, the waves of the sea and still other agencies combine their efforts to produce a composite result, which in some regions may be more the work of one agency and in others largely the work of another.

On the average these various processes of erosion seem to work with exceeding slowness. The pyramids of Egypt, now nearly six thousand years old, have suffered only trivial wear from the continual sandblast action of the desert winds through all those centuries. From estimates of the amount of material carried out by the streams to the ocean in solution and in suspension each year, we may calculate that the continents are being worn away at a rate which, if evenly distributed, would be sufficient to lower the land surface one foot in about every 10,000 years; but we are well aware that this erosion is much more rapid in a few specially favored localities than elsewhere and hence that over most of the land the rate of denudation is correspondingly slower.

On the other hand, we have clear evidence that these processes have brought down nearly to base-level large areas of land surface in a mere fraction of one of our geologic periods. The Paleozoic rocks of southern Oklahoma, compressed, folded and strongly elevated late in the Pennsylvanian or Carboniferous period, were beveled off to such an extent before the Permian period that the rocks of that age now rest upon the truncated edges of the older beds, although but a fraction of the Pennsylvanian period intervenes between the two events. In the Rocky Mountains of Colorado and Wyoming an interval of active erosion, following the first uplift of the Rocky Mountain system, stripped off the many thousands of feet of sedimentary formations to such an extent that the old pre-Cambrian crystalline terranes were exposed to erosion before the oldest Tertiary strata were deposited. This lapse of time, although amounting, no doubt, to hundreds of thousands of years, was so short that it now appears to us only the quick transition between two of our commonly recognized geologic periods. Few things show more clearly how coarse are the divisions on the great time-scale of earth history.

Our knowledge of the climates of even the better known periods of geologic history has lagged behind that of the physiographic and biologic changes. For a long time inferences were drawn almost entirely from the nature of the fossils. Coral reefs were understood to mean tropical or sub-tropical climates. The bones of reindeer in France and of musk-oxen in Kentucky indicated a colder climate than that enjoyed by the same regions to-day. On the other hand, the leaves of palms and breadfruit trees, preserved in lignite beds on the coast of Greenland, suggested a much milder climate there, in one of the early Tertiary epochs. Unfortunately, many formations contain no fossils or only such as have no clear significance.

More recently the nature of the sedimentary rocks themselves has been recognized to be indicative of climate. It was pointed out long ago that ancient glacial beds in India showed a period of cold climate in a region which is now warm. Beds of rock salt in the Permian strata of Germany were correctly interpreted to mean arid conditions. But it is only recently that the climatic relations of the less extreme, through much more common, types of sediments have come to be understood in a general way. In the not distant future we may expect to read the climatic significance not only of all terrestial deposits but to some extent even of the marine formations, although the latter are much less affected by changes of climate.

An individual rock formation is itself a more or less legible record of the local climatic conditions at the time and place of its origin. Such local climates must have been related in considerable measure to temporary features of the land topography. Thus, some of the deposits which indicate aridity were probably laid down on the lee sides of high mountain ranges. Others were due to the prevailing distribution of oceans and currents. It has long been recognized that the broad expansion of seas in the Ordovician and Silurian periods must have favored an untrammelled circulation of currents capable of equalizing temperatures between the tropical and polar regions far more effectively than is possible to-day.

In spite of such local influences on climate, we may, by considering the climatic implications of all the formations of a particular epoch, gain a general impression of the average climate of the globe for that time, and these average climates may be compared among themselves and with that of the present. Although only a good beginning of this work has been made thus far, it should be but a few years till we shall understand ancient climates at least as well as we already know ancient land configuration.

All that we have learned thus far about the earth's climatic history goes to show that, ever since the earliest periods of which we have a sufficient record, there have been frequent oscillations between colder and warmer and between moister and drier climates, but always within narrow limits. At no time does the climate appear to have been inimical to life over all or even half of the globe. To-day over a considerable part of the land surface it is so dry, as in central Arabia, that scarcely any plants or animals can exist. On the Antarctic continent—once inhabited by a varied assemblage of plants and doubtless animals—life has been practically exterminated by the outward growth of the great ice-sheet. We have no evidence in geologic history that conditions have ever been especially more severe; and yet in the records of almost every geologic period back to the Archean we find some places which have been glacial and others which have been arid.

Temperatures between 0° and 80° Centigrade, at least during the growing season, are required by nearly all living creatures, and for the vast majority of them the range is less than 40°. The polar districts are to-day below the minimum, and much larger areas have been as cold in certain past epochs; but we have no evidence that the maximum has ever been exceeded. This is a very narrow range, and yet the fluctuations of terrestrial climates seem to have been confined within it ever since the Archean period, if not earlier. The writers of the older text-books of geology, placing perhaps too much confidence in the nebular hypothesis of Buffon and La Place, supposed that the temperature of the earth had constantly decreased from the white heat of an astral period down through an era of molten rock, and a later one of vaporous oceans, to conditions as we find them to-day. The accumulating testimony of the sedimentary strata does not appear to support this supposition. This record, extending back perhaps some hundreds of millions of years, seems to reveal to us a history marked by slight oscillations of climate, but in a broad way singularly uniform and without evidence of a progressive increase or decrease of either general humidity or temperature.

In view of opinions which were generally current a generation ago that geologic history revealed a slow but stately progression from smaller to larger continents, from more active mountain-building and volcanic action to quieter conditions, and of warmer, moister climates to colder and drier climates, these results of more recent studies are particularly instructive. The earth's physical history, during the past fifteen or more geologic periods, seems actually to be represented by neither a perceptibly ascending nor a descending curve, but by a slightly wavy line which is either essentially horizontal or more probably is rising or descending so very slowly that all of the recognized periods of the earth's history combined are too short to show the trend.

When we turn to the history of living things on the earth, however, we have unrolled before us a definite progression which we are accustomed to regard as an upward trend.

Logically, geologists should not include the history of organisms as a part of their science. Such matters should concern the zoologist and botanist. From the outset, however, geologists have been much interested in the study of fossils and the biologists have seldom protested against this adoption. The study of fossil organisms has indeed absorbed nearly all the attention of many men generally regarded as geologists.

No question related to the earth's history arouses greater interest than that of the origin of life. Yet of the beginnings of life we have absolutely no trace in the geologic record. Our notions regarding that remarkable event are necessarily derived from speculations based on the known laws of chemistry and physics, and on the theories of evolution.

Land plants of such familiar types as the ferns and club-mosses we have traced by their fossil remains back to the Devonian or even to the Silurian period. Ages before that, at least as far back as the early part of the Algonkian period, the sedimentary deposits were of such a nature as to strongly indicate that the land was in part covered by an effective mantle of vegetation. This may have been supplied by the mosses and lichens, such as now form that thick and characteristic blanket of the ground in the sub-arctic regions—the "tundra." They would effectively cover the ground, but only under the most favorable circumstances could they be preserved as fossils. Aquatic algæ have been satisfactorily identified in considerable variety in rocks that were laid down early in the Proterozoic era; and there are indirect evidences and perhaps the actual fossil remains of bacteria quite as early. On purely theoretical grounds this has long been expected.

Animals of comparatively advanced classes, such as the arthropods, were highly diversified as far back as the lower Cambrian epoch and have been reported from even older rocks. Simpler animals, such as the radiolarians, have been detected in the pre-Cambrian rocks of France. We may, therefore, reasonably expect to find fossil animals in even the oldest sedimentary rocks, if they are not so altered by metamorphism as to have lost their original structures.

Under the best of circumstances, however, we can hardly hope to find traces of animals more primitive than those represented among groups already known in fossil and living form.

No branch of geologic history has been so assiduously studied as the evolution of the animals. Thanks to this activity, ranging over more than a century, we now have a large fund of information from which to generalize. It has long been recognized that new genera, orders and classes have made their appearance one after another, risen to prominence, flourished for a while, and then declined either to extinction or to a lowly status where some of them have lingered on in obscurity through many succeeding periods. The ammonites, which once inhabited every sea on the globe in great variety, disappeared utterly at the close of the Mesozoic era, and to-day we have nothing more closely related to them than their cousin, the Nautilus. The great class of reptiles, which dominated the land in the Mesozoic era, and whose sway was then apparently unchallenged by any other living thing, has largely disappeared and such types as have survived to the present day have been relegated to the jungles and waste places of the earth, where they must depend for the most part on concealment or upon fleetness to escape from their more powerful enemies.

Many explanations of these declines and extinctions have been offered—a few absurd, others plausible. Doubtless several causes were involved in the result. But whatever the cause may have been, it is evidently a law of nature that the career of each type and of each group must take the form of a rising and falling curve.

We now clearly understand that in the course of this rise and fall of species, genera, and larger groups, there has been a slow but steady increase in complexity of structure and in function, in both animal and plant bodies. The worm has been succeeded by the more highly constituted mollusk, which has in turn been supplanted by the arthropod, the fish, and finally the mammal.

Each animal type seems to embody an experiment to test the worth of one or more important new devices which are the distinctive contribution of that type to the progress of animal development.

The trilobites in the sea and the insects on land introduced the wholly coordinated nervous system and the power of rapid well-directed motion, with better seeing powers and even the possibility of flight in the air. These improvements represented a great advance over the corals, which wait helplessly for their food to drift into their mouths, or even over such worms, starfishes and mollusks as slowly grope through mud or sand or crawl with proverbial snail's pace over the surface. In a broad sense, the arthropods may be said to have introduced into the world the rapacious habit—the active pursuit of food.

Another advance was represented by the first vertebrates and particularly by the fishes, which have attained nearest to perfection of all water-inhabiting animals either previous or subsequent. They invented the spindle form and the stern propeller, both of which have been imitated necessarily by every successful swimming thing from the shark, the ichthyosaur and the porpoise to the modern submarine torpedo. The fishes also introduced the photographic or image-recording eye, which is far superior to the light-sensitive spots of certain echinoderms or even the remarkable compound eyes of the insects.

The reptiles in their turn devised the solid bony skeleton without which active life upon the dry land had previously been limited to small animals such as the insects. They introduced the encased egg, capable of being incubated in air instead of water. This placed the class one step ahead of the amphibians, which must always remain near water. The reptiles invented also a type of cover which was able to withstand the evaporation of the body liquids, without loss of that flexibility which was essential for rapid motion. They were not, however, so successful in coping with that other element of climate—temperature. The chill of winter reduced their bodily processes to inaction and obliged them to hibernate except in the warmer months in the year. For that reason they must always have been, as they are now, largely confined to the warmer parts of the globe.

The probable descendants of the reptiles—the mammals—somehow contrived that wonderful invention, warm blood, and with it the necessary heat-conserving cover of hair. These enabled the mammals to range over nearly all parts of the globe regardless of climatic and seasonal changes and to maintain their bodily activities constantly at the most favorable temperature by oxidizing carbohydrates as bodily fuel. It would be hard to overestimate the importance of this innovation.

(To be concluded)

Eliot Blackwelder
Harvard University

ON THE DIFFERENTIAL EFFECTS OF THE INFLUENZA EPIDEMIC AMONG NATIVE PEOPLES OF THE PACIFIC ISLANDS

Since the influenza pandemic of 1917-1918, the writer has had occasion to make two journeys to insular areas of the Pacific Ocean, for the prosecution of special field-studies. In two specific instances, incidental observations were made on the differential effects of the imported disease upon the human inhabitants of certain islands; it is the object of the present brief communication to record the essential facts.

I. The first area is that of the Society

Islands, of which Tahiti is the largest and best-known member. The fundamental point is that the pure-blooded natives of this group of islands suffered a mortality which was reported to vary from fifteen to twenty-five per cent. in different circumscribed communities, while the half-caste population lost a distinctly smaller percentage; the white inhabitants lost very few of their numbers, thus manifesting a high natural resistance.

The disease was brought to Tahiti in November 1918 by a vessel from San Francisco, some of whose passengers had developed the malady after embarking. The vessel was released from quarantine, despite the protests of the medical officials, and within twenty-four hours the contagion had begun its rapid spread throughout Papeete, the main town of Tahiti. So far as the writer could ascertain by enquiries in the summer of 1919, the incidence of the epidemic was about the same for all of the three classes of the community, distinguished above. Very few failed to contract the disease. Many natives fled from Papeete to the remote districts of Tahiti and to the other islands, so that all parts of the group were affected.

It was impossible to secure exact quantitative data as to the numbers of deaths among the three divisions of the population, for the figures have not been compiled by the authorities; but the qualitative result stated above became clearer with each additional conversation with medical men and traders, and with numerous native chiefs and commoners. In every case, the questions were framed so as to elicit a statement without disclosing the point at issue; those who are familiar with native peoples will realize that this is a necessary precaution when seeking information. Without a single exception the statements agreed as to the essential facts.

Thus the natural resistance of the foreigners proved to be high, even under the adverse climatic conditions of the tropics, while the alien parentage of the half-castes gave to them a greater chance of survival as compared with the unmixed natives, among whose kind a prior process of selection had not occurred as among the nations of Europe and America.

2. The second instance is that of two different native peoples that exhibited an astounding difference in mortality when attacked by the same disease. In the summer of 1920 the writer visited the Mariana or Ladrone Islands, where most of the available time was devoted to field-work in Guam; an opportunity was seized, however, to spend a few days on the island of Saipan, which lies about 120 miles to the northward of Guam. The principal settlement of this island is the town of Garapan, where the population comprises about 1,500 Chamorros, or Mariana Islanders, and an approximately equal number of natives of the Caroline Islands. The two peoples occupy distinct divisions of Garapan on either side of a dividing road, and they remain essentially separate in culture, dress, language and matrimonial relations.

At this place the writer found a gifted Spanish Chamorro named Señor Gregorio Sablan, who was the teacher-missionary as well as the official interpreter. He described the coming of the influenza epidemic by means of a vessel from Japan about a year before, and he gave very definite accounts of its ravages. As everywhere else, practically all of the inhabitants contracted the disease. The percentage of deaths among the Chamorros of Saipan was in excess of twelve per cent., while among the Caroline Islanders, equal in total number, the deaths were stated to have been *only six, or about four-tenths of one per cent.*

Clearly, then, the latter people displayed a degree of resistance to the pandemic that is astonishingly high in comparison with that of all of the other islanders which the writer personally observed. The circumstances in Garapan are such as to bring out this fact most sharply, because the two contrasted groups of natives lived in the same community under practically identical conditions of housing and regimen. Only in the matter of dress was there an obvious difference. The Chamorros clothe the body completely, after the manner of the Filipinos, while among the Carolinians the men are naked save for a small loin cloth, and the women wear a fiber mat, or length of cloth, around the body from the waist to the knees. It is at least conceivable that the differences in such respects might affect the temperature reactions of the body during fever, more advantageously in the case of those with less clothing. But if this is the explanation in the particular instance under consideration, it does not seem to hold in others; the Melanesians to whom the disease was brought suffered as greatly as the Chamorros and Tahitians, according to reports, although they cover the body at least as little as do the Caroline Islanders. Whatever the explanation of the Saipan observations, the fact remains that the two contrasted peoples differed greatly in their mortality; in the absence of any distinguishable external factors, their difference is most reasonably to be attributed to constitutional peculiarities.

HENRY E. CRAMPTON

BARNARD COLLEGE,
COLUMBIA UNIVERSITY,
DECEMBER 24, 1921.

PRESENTATION TO PROFESSOR EMERSON

THIS society has come at last to the fountainhead of American geology—Amherst College. Nearly a century ago, while Amos Eaton was inspiring students at the Rensselaer School by his novel modes of teaching, and Silliman the greater, at Yale, was illuminating the facts and fancies of this science by his brilliant and fascinating deliveries, Edward Hitchcock was actually creating a geological survey of this Commonwealth of Massachusetts and initiating classes of students into the astonishing revelations and practical applications of a new science. It was a difficult field he found here in this Connecticut Valley and its complicated uplands; many different categories of geological facts crowded upon him, but he interpreted them with clarity and with such degree of distinction that he was, in due course, selected by Governor Marcy of New York as the first state geologist for that well organized survey; an appointment which he accepted, entered upon but soon abandoned because that field was too far away from Amherst College —indeed, reason in plenty!

Let us remind ourselves that Edward Hitchcock was a distinguished divine, professor of natural theology and geology and president of this college, in the most uplifting days of the last century. This minister of the gospel was boldly entering upon paths lined with harvest fields of truth which to his contemporaries were fields of poison weeds. With equanimity he faced the bigotry of common ignorance and the theological odium; but his students heard and followed him gladly into those days of delightful and romantic adventure over this countryside, when every hill and knoll, each stream and gully, each glacial boulder and picturesque retreat was baptized by the geologist-president and his classes, with ceremonies of address and poem and song: Mounts Castor and Pollux, Mount Pleasant and Mount Pleasanter, Mettawampe and Aquilo, the Crescent, the Occident, the glacial stones Rock Rimmon, Rock Oreb, Rock Etam, and so on through a long list of natural monuments; names which should never be permitted to disappear from the map of Massachusetts, for they are storied monuments not only of her science and her scenery but of one of her great sons.

If I pay thus brief tribute to the eminent Hitchcock, it is only to intimate the influence which helped to mould this other great teacher of our science to whom we are come tonight with our hearts in our hands. Professor Emerson has grasped the very horns of the altar of this science, and as we consider wherein has lain his glowing success as a teacher, let us remember the atmosphere he breathed here in his student days. It was an atmosphere sweetened by the fragrance of a science just bursting into flower, tinged with joyous and natural emotions, but never robbed of its spirit of devotion. Teachers are the personifications of immortality. The men whom Emerson trained, and who have arisen one by one to their own niches in the science, sent out in

[1] Address of presentation to Professor Benjamin Kendall Emerson, LL.D., of Amherst College, at the annual meeting of the Geological Society of America, at Amherst, December 29, 1921.

their turn the influence that here inflated their hopes; and their own students, now turned teachers too, have sent the echos of the Emersonian days flying—an endless course, like the pursuit of the truth. The footprints in the Connecticut River sandstones were to Longfellow the theme of the Psalm of Life; to Hitchcock they were more than footprints on the sands of time; he saw in the varying depth of these impressions, made heavier on one side than on another as the creature changed its course or turned a corner, the play of a different muscle and the nerve message from the brain which compelled the muscular motion. There he found, registered in the immortal rocks the very purpose and impulse of life. And thus too, the great teacher. While about these tables, there are some who owe Professor Emerson a direct allegiance, probably there are none who have not been reached by the ever widening rings of his influence or been guided by his imprints on the science. We are here tonight to heap upon him our pledges and congratulations, to establish thus a milepost to mark here the passage of the years. Every rock in the fields of Old Hampshire County claps its hands and the mountains of the Commonwealth break forth into singing, for they are his by a peculiar right and by an emphasis of interest. To him who has sounded their depths and touched their heights, whose eyes have looked in upon the record written in their hearts, whose inspired hammer has loosened their tongues that their tales may be a part of human knowledge and their secrets turned to the advantage of the state —it is to him we make our pledge of admiration and regard. When Edward Hitchcock retired from the presidency of Amherst College, the trustees not knowing, perhaps, how else to express their substantial regard, presented him with silver plate. So too we, in best of heart and with keener sense of our act, ask you to believe this gift which comes from all of us, is but the miniature symbol of the measure of our regard.

JOHN M. CLARKE

SCIENTIFIC EVENTS

DR. WHITE'S GIFT TO MORGANTOWN AND THE UNIVERSITY OF WEST VIRGINIA

DR. I. C. WHITE, since 1897 state geologist of West Virginia, distinguished for his contributions to the geology of coal and petroleum, and Mrs. White have given to the University of West Virginia and the city of Morgantown 1,911 acres of Sewickley coal, situated on Helen's Run, in Marion County. Officers of the geological survey estimate that the tonnage of the acreage will approximate 15,000,000 and on a conservative royalty basis should yield at least $4,000,000 over a period of years, $2,000,000 to the city and $2,000,000 to the university.

Dr. F. B. Trotter, president of the university, and City Manager Sutherland have issued the following statement:

The funds arising from the sale or lease belonging to the West Virginia University are to be used as follows:

The income from the proceeds of said coal is to be used in assisting the State of West Virginia to equip and maintain a geological department of the State University at Morgantown, West Virginia, after the state shall have constructed an adequate fire-proof building, including museum space for minerals, fossils, working laboratories, lecture rooms, etc., the only restriction upon the expenditure of the income being that it shall be devoted solely to the use and benefit of the geological department of the State University in the city of Morgantown, W. Va.

The income from the moiety belonging to the city of Morgantown is to be used in equal proportions under the following two heads, viz.:

First: For assisting the city of Morgantown in the purchase, improvement and maintenance of a public park in or near said city, for the pleasure and enjoyment of all its people.

Second: For assisting the city of Morgantown in securing, equipping and maintaining a public hospital of ample size and facilities in which the citizens of Morgantown, West Virginia, and especially all those of limited financial resources, can secure proper medical and surgical attention at a minimum cost, and in case of the very poor, free of all cost for such medical, surgical and hospital care as is necessary for their restoration to health.

Dr. White's letter to the officers of the university reads:

It gives Mrs. White and myself much pleasure to be able to transfer to the state university as a Christmas gift, an undivided one-half interest in 1,911 acres of Sewickley coal located near Fairmont, Marion County, W. Va., for the benefit of the geological department of the university. Whatever of success has come to me in science and business has been due in large degree to the training I received at the university, my alma mater, and it gives me much happiness to be one of the first of her sons to recognize this obligation in a substantial manner.

The tract conveyed is, with the exception of a ten-acre tract, all in one solid block, and the Helen's Run branch of the Western Maryland Railway passes directly across the southwestern end of the same at a point from which the coal under the entire tract can be removed, with natural drainage to a shaft sunk along that railway. This Sewickley coal will have an average thickness of six feet, and hence with a liberal allowance for mining waste, the entire tract should yield, in round numbers, about 15,000,000 net tons of coal, or 7,500,000 for the university's portion. With the rapid exhaustion of the coal from the Fairmont region, it is reasonable to expect that within a period of a very few years a lease at not less than 25 cents per ton royalty can readily be obtained on this property, with agreements for increase as the years go by, so that on a graded royalty this tract should finally yield a net return to the university of approximately $2,000,000. It is doubly pleasing to make this gift to the university during the presidency of Dr. Trotter, under whose able administration such wonderful growth and advancement have been attained.

Trusting that this donation to the university is only the forerunner of others to come from its prosperous graduates, and with best wishes, I remain,

EXPEDITIONS OF THE FIELD MUSEUM OF NATURAL HISTORY

South America will be the field of four out of six scientific research expeditions to be sent out by the Field Museum of Natural History during the next five years. Two of these expeditions will gather geological specimens in the area from Brazil to Patagonia and two, one zoological and one botanical, will study the animal and plant life of Peru.

An archæological expedition will visit the Isthmus of Panama and the State of Columbia, South America, and at the same time an ethnology expedition will go to the Malay Peninsula. All expeditions will be gone by summer and will remain in the field for periods from two to five years.

The department of geology plans to extend its expedition over a period of five years. The first of these will be headed by Dr. Oliver C. Farrington, curator of the department, and will proceed to the gem producing localities of Brazil. One of the objects of this expedition is to secure a full series of minerals associated with the diamond. Two later expeditions under Dr. Farrington's direction will visit the important gold and iron mining districts of Brazil and the silver and copper producing districts of Peru and Bolivia. The latter expedition will also take specimens from the important nitrate and vanadium deposits of Chile.

Specimens of pre-historic vertebrate life will be searched for by the second of the geological expeditions which will visit the Santa Cruz beds of Patagonia, certain areas of the Pampean formation of northern Argentine and some of the cave deposits of Brazil. It is hoped to secure specimens of the great ground sloths, the Pampas horse and other types of vertebrate life of South America. The expedition will be under the direction of Mr. E. S. Riggs, of the department of historical geology.

The zoological and botanical expeditions will work together in the interior of the Sierras of Central Peru and in the region of the sources of the Amazon. The work will take these expeditions from sea level to the highest altitudes where life is found. At times they will penetrate into virtually tropical islands, large areas of land entirely surrounded by snow capped peaks which have developed species of animal and plant life that are found in no other place. Dr. Wilfred Osgood, curator of zoology of the museum will head the expedition which expects to bring back many new specimens of animal life. The botanical expedition will be under the direction of Mr. J. Francis MacBride, assistant botanist of the museum. The region the expedition will cover is almost unknown as far as its plant life is concerned and valuable data will be secured by the expedition.

The archeological expedition under the direction of Dr. J. A. Mason, will endeavor to solve some of the interrelations of the ancient civilizations of the Americas. It will also attempt to establish proof of a connecting link between the ancient Maya and the Inca of Peru. The exploration of Colombia is expected to yield many interesting stone statuettes, clay images and gold ornaments of the ancient civilization that inhabited that country. The Department of Archeology also plans to penetrate the Colorado desert next summer and to work among the Eastern Apache and Navaho Indians.

The expedition headed by Dr. Fay-Cooper Cole will leave in June for the Malay Peninsula to study the origin and migration of the Malay and Negrite races. He will attempt to penetrate into the interior of Borneo by following up one of the rivers that empty into the Java Sea. The expedition will be in the field for an estimated period of two years and for the most part will be in contact with pygmies and the least advanced types of primitive Malays.

Dr. B. Laufer, curator of the department of anthropology, is planning a trip to China to study the aboriginal tribes of the island of Hai-nan. He will also make an archeological survey of the Province of Fu-kien and Manchuria in order to enlarge the Chinese collections of the museum.

THE AMERICAN ENGINEERING COUNCIL

THE American Engineering Council of the Federated American Engineering Societies held its first annual meeting at the Cosmos Club, Washington, on January 5 and 6, Dean Mortimer E. Cooley of the University of Michigan, president of the council, presiding. Officers were chosen, the work of the past year reviewed and discussed, action taken on important matters of public and technical service, new financial arrangements put into effect, committees named, new policies sanctioned and old ones reshaped, and a definite program outlined for the next twelve months. A leading event of the meeting was a dinner in honor of Mr. Herbert Hoover, who, addressing the members of the council and their guests at the University Club, praised the work of the committee on elimination of waste in industry as a great and lasting public service, pointed the way for new engineering effort in the public interest, and expressed renewed devotion to the ideals of the council. Resolutions of apprecition of the service of the new Secretary of Commerce were presented to Mr. Hoover.

On January 1, 1921, the membership of the society was composed of six national and fourteen state and local societies, a total of twenty. On December 31, 1921, there were eight national and twenty state and local societies, a gain of eight member societies representing 1,414 member engineers.

The balloting for officers resulted in the reelection as vice-presidents of Dexter S. Kimball, dean of the College of Engineering, Cornell University, and J. Parke Channing of New York. W. W. Varney of New York was again chosen treasurer. L. W. Wallace was re-elected executive secretary.

The executive board of the council for 1922 is made up as follows: H. E. Howe, Washington, American Institute of Chemical Engineers; Professor C. F. Scott of Yale, L. B. Stillwell and Calvert Townley of New York, J. H. Finney of Washington, William McClellan of Philadelphia, and L. F. Morehouse of New York, representing the American Institute of Electric Engineers; J. Parke Channing and A. S. Dwight of New York, Charles H. McDowall of Chicago and Philip N. Moore of St. Louis, the American Institute of Mining and Metallurgical Engineers; L. P. Alford of New York, E. S. Carman of Cleveland, Dean D. S. Kimball of Cornell, Professor A. M. Greene of Troy, Dean P. F. Walker of Kansas, W. S. Lee of New York, Dean M. E. Cooley of Michigan, American Society of Mechanical Engineers; Professor J. W. Roe of New York, Society of Industrial Engineers; Morris L. Cooke, Philadelphia, Taylor Society; W. E. Rolfe, Associated Engineering Societies of St. Louis; W. W. Varney, Baltimore Engineers' Club.

Regional directors chosen for 1922 are:

District No. 1, W. B. Powell, St. Louis; District No. 2, Gardner S. Williams, Ann Arbor, Mich.; District No. 4, W. J. Fisher, York, Pa.; District No. 5, Paul Wright, Birmingham, Ala.; District No. 6, Lloyd B. Smith, Topeka, Kansas; District No. 7, O. H. Koch, Dallas, Texas.

ASSOCIATESHIP IN THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

In the By-Laws and Rules of Procedure of the American Association, Article II, Section 2, is the statement that "Associates, on payment of five dollars, may be admitted to the privileges of a meeting, except voting." The associateship was planned for those who desire to attend a meeting of the association and to contribute toward the expenses of the meeting but who do not wish to join the organization permanently. Since the adoption of the new constitution, with the new by-laws and rules of procedure, there have been but two meetings, the Chicago meeting of the year 1920-21 and the recent meeting held at Toronto. No associates were registered for the Chicago meeting, but 247 were registered at the last meeting. These were mostly residents of Toronto.

The permanent secretary wishes to call the attention of all members and friends of the association to this, the first entry of associates upon the roll of the association. According to the prescribed rule, associates have all the privileges of the meeting for which they are registered, except voting. These privileges are considered to include the right to present papers at that meeting, but associates do not receive the journal Science, which is sent to members. The funds secured by the payment of associateship fees will be used partly to defray a portion of the expenses of the meeting and partly for sending circulars and invitations to prospective members during the following year. Members will not fail to appreciate the fine spirit shown by associates in making this contribution to the funds available for current expenses. This first roll of associates was secured through the very admirable work of the local subcommittee on membership, Mr. H. V. F. Jones, *chairman,* and the thanks of the association are especially due to Mr. Jones and the other members. It is planned that future publications of the membership list will include lists of the associates registered for each meeting.

Burton E. Livingston,
Permanent Secretary.

SCIENTIFIC NOTES AND NEWS

At the Amherst meeting of the Geological Society of America, Professor Charles Schuchert, of Yale University, was elected president. As vice-presidents were elected: Dr. Henry S. Washington, Geophysical Laboratory of the Carnegie Institution of Washington; Dr. Robert T. Hill, Los Angeles, California; Dr. W. D. Matthew, of the American Museum of Natural History, New York City; Professor T. L. Walker, of the University of Toronto, and Dr. Edmund Otis Hovey, of the American Museum of Natural History.

The American Society of Zoologists, meeting at Toronto, elected as president Professor Harris Hawthorne Wilder, of Smith College. Professor Bennet M. Allen, of the University of Kansas, was elected vice-president.

At the New Haven meeting of the American Association of Anatomists, Professor Clarence M. Jackson, of the University of Minnesota, was elected president, and Professor Harold D. Senior, of New York University, was elected vice-president.

John Ripley Freeman, of Providence, R. I., was elected president of the American Society of Civil Engineers at the first session of its sixty-ninth annual meeting held in New York on January 18. Honorary memberships were conferred upon Charles Prosper Eugene Schneider of Paris, Luigi Luiggi of Rome, Samuel Rea, president of the Pennsylvania Railroad, Howard Swasey and Howard A. Carson.

Dr. Hideyo Noguchi, member of the Rockefeller Institute for Medical Research, was elected to honorary membership in the Society of Dermatology and Venereology of Moscow at its thirtieth annual meeting on October 16.

CHARLES W. GOODALE, of Butte, Montana, was awarded the gold medal of the Mining and Metallurgical Society of America at its annual meeting on January 10, for conspicuous services in safety and welfare work.

THE Crompton Medal, given annually by the Institution of Automobile Engineers for the best paper read during the session, has been awarded to Mr. H. L. Heathcote for his paper on "Ball Bearings."

DR. AUGUST PACINI, of Washington, D. C., was awarded the prize of $1,000 for research work in roentgen-ray experimentation by the American Roentgen Ray Society at its recent meeting in Washington.

SIR GEORGE T. BEILBY, Sir John Cadman and Professor J. S. Haldane have been appointed to represent science on the advisory committee for coal and the coal industry set up under the British Mining Act of 1920.

DR. E. N. MILES THOMAS has resigned the keepership of the Department of Botany of the National Museum of Wales.

DR. S. K. LOY, chief chemist of the Standard Oil Company's refinery at Casper, Wyoming, has been appointed consulting chemist of the Bureau of Mines in connection with the oil shale work.

DR. EMILIUS CLARK DUDLEY has been given leave of absence from the Northwestern University Medical School to accept an invitation from Yale University to give a course in clinical surgical gynecology at the Hunan-Yale College of Medicine, Changsha, China. Dr. Dudley expects to return to Chicago about July 1.

E. F. BURCHARD has been granted a year's leave of absence by the U. S. Geological Survey to undertake private work in oil geology in South America.

PRESIDENT ARTHUR A. HAMERSCHLAG, of the Carnegie Institute of Technology, sailed for Europe on January 17 for three months vacation. During his absence Dr. Thomas S. Baker, the secretary of the institution, will be the acting president.

DR. A. S. HITCHCOCK, systematic agrostologist of the U. S. Department of Agriculture, has returned from a trip to the Orient where he went to study the grasses, especially the bamboos. He visited the Philippines, Japan, central and south China, including the island of Hainan, and Indo-China.

PROFESSOR W. H. HOBBS, head of the department of geology at the University of Michigan, who has been conducting in the Pacific area a study of mountain growth and of the formation of coral reefs and islands, has now reached Europe. As exchange professor with Professor H. A. Brouwer, he will begin his lectures at the University of Delft the first week in February. Dr. Brouwer sailed for America on January 18 and before going to Ann Arbor expects to give an address before the Washington Academy of Sciences.

AT the meeting of the Federal Board of Surveys and Maps, held on January 10, at Washington, D. C., the following officers were elected: *Chairman*: William Bowie, chief, Division of Geodesy, U. S. Coast and Geodetic Survey, and chairman of the American Geophysical Union; *Vice-chairman*: A. D. Kidder, Cadastral Engineer, U. S. General Land Office; *Secretary*: C. H. Birdseye, Chief Topographic Engineer, U. S. Geological Survey; *Members of the Executive Committee*: Colonel G. S. Norvell, Military Intelligence Office, U. S. Army, and Commander W. D. Puleston, Hydrographic Office, U. S. Navy.

AT a recent meeting of the executive committee of the American Astronomical Union, Dr. Ludwik Silberstein, of the Research Laboratory of the Eastman Kodak Company, was appointed chairman of a Committee on Relativity. Other members of this committee are Dr. Edward Kasner, Columbia University, Dr. A. A. Michelson, University of Chicago and Dr. D. C. Miller of the Case School of Applied Science. A meeting of the American Section of the International Astronomical Union will be called some time in the early spring before the delegates sail for Rome, where the National Conference opens on April 20. At this sectional meeting it is hoped to have a report from each of the committees as a basis for instruction to the American delegates.

Before the Philosophical Society of Washington on January 14, an address was given by the retiring president, R. L. Faris, on "Some problems of the sea."

Dr. Edgar F. Smith, president of the American Chemical Society, addressed the Rochester section of the society, December 19, on "A Glance at Early Organic Chemistry."

Ralph H. McKee, professor of Chemical Engineering at Columbia University, spoke before the Franklin Institute, January 12, on "Gasoline from Oil Shale."

Mr. Joseph Barcroft, F. R. S., fellow of King's College, Cambridge, will deliver the sixth Harvey Society lecture at the New York Academy of Medicine on February 11, at 8:30. His subject will be "The raison d'être of the red corpuscle."

Dr. Campbell P. Howard, professor of medicine at the University of Iowa, gave a Mayo Foundation Lecture on December 30, his subject being "Personal Reminiscences of Sir William Osler."

The *Journal* of the American Medical Association reports that Professor Gaffky, who for many years was the director of the Berlin Institute for Infectious Diseases, has been honored with a monument erected over his grave in Hanover, his native city, by his pupils and friends.

As has already been reported in Science, plans are under way in France for the celebration of Pasteur's centenary in 1923. The celebration will chiefly consist in an international exhibition of hygiene and bacteriology which will be held from May 1 to October 31, 1923, at Strasbourg where Pasteur began his epoch-making researches. A monument to Pasteur will be unveiled at the same time. The celebrations are in charge of the University and City of Strasbourg, the Pasteur Institute of Paris and the Pasteur family.

Dr. William Frear, since 1887 agricultural chemist at the Pennsylvania Agricultural Experiment Station, died suddenly of heart trouble at his home in State College, Pa., at the age of sixty-two years.

Dr. Joseph MacDonald, Jr., founder and managing editor of the *American Journal of Surgery*, died suddenly of apoplexy on January 7, at his home in East Orange, N. J., at the age of fifty-two years.

Many libraries doubtless contain duplicates of astronomical periodicals and books that are needed in other institutions. For the purpose of facilitating their purchase, exchange or gift, the National Research Council contemplates the compilation of a list of all duplicates that can be spared. This list will be mimeographed and widely distributed. Those who have duplicates to dispose of are asked to send a list of them to the National Research Council, Division of Physical Sciences, 1701 Massachusetts Avenue, Washington, D. C. It is desirable, but not essential, that it be indicated which of these will be sold, which exchanged, and which donated. A copy of the complete list will be sent on request.

There has recently been issued "A list of seismologic stations of the world" as Vol. 2, No. 15, of the *Bulletin of the National Research Council* (U. S. A.). It was compiled under the auspices of the Section of Seismology of the American Geophysical Union with the cooperation and assistance of the Research Information Service of the National Research Council. This list is incomplete, owing to conditions prevailing generally after the world war. It is desired to correct and complete the information in the files of the Research Information Service in preparation for a revised edition of the publication. To that end, a further, revised questionnaire is being distributed with the printed list. Extra copies of the questionnaire are available and will be freely sent to all who have additional information to contribute. It is requested that every one who notes errors or omissions in the "List" as issued bring these to the attention of the Section of Seismology of the American Geophysical Union, addressing communications in care of the Research Information Service, National Research Council, 1701 Massachusetts Avenue, N. W., Washington, D. C., U. S. A. It is hoped, further, that complete as well as accurate information may be supplied concerning all stations not now fully described.

THE Genetics Division of the California Agricultural Experiment Station is investigating the genus *Crepis* for the purpose of finding favorable material for genetic research. As many as possible of the species in this genus will be grown and tested. Incidentally material will be accumulated for a monograph on the genus. About 35 species from foreign countries are now being grown at Berkeley, but none that are native to North America. The object of this appeal is to interest American collectors in the work so as to secure viable seeds of American species during the present year. Seeds may be sent to Division of Genetics, University of California, Berkeley, California.

DR. C. E. RUBY is making a collection of verse of all varieties, whose subject matter relates to the sciences, with the ultimate purpose of publishing an anthology of such poetry. Readers of SCIENCE are invited to send any verses of this character, which may be available to them, or to send suggestions as to possible sources of such verse to Dr. Ruby, 7 St. Paul Street, Cambridge, Mass. In sending such contributions, it is desirable that the author's name, and other needful details, including the permission to publish the poem (if it is possible for the contributor to include this permission) accompany each poem.

FIRE during the night of January 9 in the laboratories of the department of anatomy, Loyola University School of Medicine, 706 S. Lincoln Street, Chicago, destroyed the collection of reprints and files of journals of Professor R. M. Strong. He writes that he would be grateful to authors who have sent him reprints in the past for any replacements which it may be convenient for them to make. The research material, unpublished drawings and loan collections of the department were essentially untouched.

UNIVERSITY AND EDUCATIONAL NOTES

THE Corporation of Yale University has received an anonymous pledge of $100,000 for the establishment of the William H. Carmalt professorship fund in the School of Medicine. The president was authorized to designate annually a professor of the medical school as the William H. Carmalt professor.

DR. ALLEN FISKE VOSHELL, former resident orthopedist at the Johns Hopkins Hospital, has assumed charge of the department of orthopedic surgery at the University of Virginia Medical School and Hospital.

THE General Education Board has offered $250,000 toward the one million dollars of the Radcliffe Endowment Fund provided that the rest of the million is raised by July 1.

DR. JOHN HEISLER is now carrying on the work of anatomy in the School of Medicine of the University of Pennsylvania, a position formerly filled by Dr. Piersol. Dr. G. P. McHoueh has been appointed a full-time instructor in physiology.

DR. AUSTIN BAILEY, who has recently been employed as superintendent of the apparatus division of the Corning Glass Works, has resigned his position to accept an assistant professorship in the department of physics at the University of Kansas.

MR. HUBERT H. NEWELL, of the Research Laboratory of the Westinghouse Electric and Manufacturing Company, has resigned to accept a position at the Worcester Polytechnic Institute.

E. A. ALLCUT has been appointed associate professor in the department of thermo-dynamics at the University of Toronto.

PROFESSOR J. W. NICHOLSON has been elected to a war memorial fellowship in physics and mathematics at Balliol College, Oxford.

DISCUSSION AND CORRESPONDENCE

DISCOVERY OF GIGANTIC FOOTPRINTS IN THE COAL MEASURES OF KANSAS

ICHNOLOGY still holds an important place in the literature of paleontology, and it is a pleasure for the writer to add a new item to the information already given by Mudge and Marsh, many years ago, concerning vertebrate footprints of the Coal Measures of Kansas.

The literature has been summarized and a description of a large slab of limestone from Osage County, Kansas, bearing footprints has been given by Moodie in his monographic work on the Coal Measures Amphibia of North America. No new information concerning vertebrate footprints in the Coal Measures of Kansas has been published since that work appeared in 1916. The new discovery is thus all the more interesting, and especially so since a huge type of Coal Measures vertebrate, otherwise unknown, is indicated by these tracks. Moodie has likewise described, in the above-mentioned work and elsewhere, skeletal remains of a large labyrinthodont (?) but of a size insufficient to have made the tracks described herewith.

The present discovery relates to a series of eight footprints discovered by the sons of Dr. George Coghill and turned over to the writer for excavation and description. They were discovered in a heavy sandstone, a formation extending generally over eastern Kansas, lying just above the Weston Shales, exposed in a high cliff near the Dightman bridge over the Wakarusa Creek, some five miles southeast of Lawrence, Kansas. The series of tracks extended for a distance of twenty-five feet in a direct line, but several tracks of the series are evidently missing as they average about two feet six inches apart, and wider spaces occur in two places.

The tracks vary slightly in size, due doubtless to the plasticity of the matrix when the imprints were made. They have an average of six inches in breadth, by from six to seven inches in length, and both the front and the hind feet appear to be represented, as two of the imprints distinctly show the presence of four toes, while three of them show five toes.

One impression seems to indicate that the hind foot was placed over the impression of the front foot. These footprints, if properly interpreted, indicate the largest Coal Measures vertebrate so far known. A more detailed account, with photographs, will appear in a later paper on the subject.

H. T. MARTIN

PALEONTOLOGICAL MUSEUM,
UNIVERSITY OF KANSAS

LIESEGANG RING FORMATION

RECENTLY, I advanced a theory to explain Liesegang's rings.[1] Unaccepted theories were not discussed.[2] Bradford[3] objects to my theory, and to the omission of literature.

That I am unaware of some work on banded precipitates is possibly correct. However, I disagree with the chemical analysis[4] on which his adsorption theory is built. I agree with him that bands of lead chromate can be obtained in gelatine, also with silver nitrate in the gelatine and bichromate in aqueous solution. Further, I think that banding is the normal formation of precipitates, and may occur in any solution. The function of the gel is to fix—relatively—one of the ions, and render banding visible. Ordinarily the reaction between the ions is so violent and the field of the reaction so stormy that bands are destroyed. In my theory, *relatively fixed* was used, except in one place, and the discussion shows that an absolutely fixed state was not intended. In fact an absolutely fixed state of one ion, or a relatively fixed state of both ions —as in superimposed gelatine layers of $AgNO_3$ and $K_2Cr_2O_7$—tends to prevent banding. Bradford states that the ionic attraction of silver and chromate is insufficient to explain banding in gelatine and not in agar. However, silver chromate bands form in agar quite readily, and revision of the theory is unnecessary to explain banding in this gel. I agree with him that bands of lead chromate can be obtained in gelatine with proper concentrations of lead acetate and potassium bichromate. Direct reversal of the solutions, however, without change of concentrations is not a reliable method.

Band formation is beautifully illustrated in the growth rings of trees. Rings in gels are formed similarly.

[1] SCIENCE, July 22, 1921.

[2] Bancroft, "Applied Colloid Chemistry," 1921, p. 259.

[3] SCIENCE, Nov. 11, 1921, p. 463.

[4] *Biochemical Journal*, 1916, X, p. 173.

To quote briefly without essential change from my previous paper:

In a gelatine solution containing bichromate, when silver nitrate is added, concentric rings are formed because the ion in the gelatine is relatively fixed. The silver ion wanders out and forms a ring by precipitation. A region on the chromate side of the ring is freed from the chromate ion, and a corresponding region on the silver side is freed from the silver ion. Growth stops until the silver again wanders out through the precipitate, and comes within range of the chromate ion when the process is repeated. The essentials of this interrupted growth theory are given in the previous article. Holmes'[5] theory closely resembles mine. Bradford's assumes unnecessary facts to explain the phenomenon. Later, I expect to give a more detailed account of this common phenomenon.

HUGH A. McGUIGAN
UNIVERSITY OF ILLINOIS,
COLLEGE OF MEDICINE,
CHICAGO

[5] Holmes. *Journal American Chemical Society*, 1918, XL, p. 1187.

SPECIAL ARTICLES

THE IDENTITY OF CERTAIN YELLOW PIGMENTS IN PLANTS AND ANIMALS

LITTLE attention seems to be paid, from the physiological standpoint, to the fact that the yellow pigments in certain animal organs have been shown to be chemically identical with the yellow pigments common in plants.

Some cases of the identity of lipochromes (yellow pigments of animals) with carotinoids (carotin, xanthophyll, lycopersicin, and fucoxanthin of plants) have been known for several years,[1] and the list has recently been greatly extended. The lipochromes of the following animal tissues are now known to be either chemically identical or isomeric with carotinoids—the ear lobes, beaks, shanks, body fat and blood serum of fowls, and the yolks of their eggs;[2] and the fat of the body, blood serum, corpus luteum and milk of the cow.[3] It seems probable that the same is true of the nerve cells of some animals and of the blood plasma and body fat of the human body.[4] These pigments are not synthesized by the animals, but are merely taken up from their food.

It is well known that carotin ($C_{40}H_{56}$) is a highly unsaturated hydrocarbon. It has been shown[5] that part of the unsaturated linkage of its molecule is of a type that can be easily satisfied by direct addition of oxygen. Xanthophyll is carotin dioxide ($C_{40}H_{56}O_2$). Lycopersicin has the same empirical formula as carotin. Fucoxanthin ($C_{40}H_{54}O_6$) contains more oxygen than the others. The first two of these pigments are widely distributed in plants. Not only do they always accompany chlorophyll, but they are also found in flowers, fruits, seeds, and subterranean organs, and also in fungi.[6]

The physiological significance of the carotinoids has, of course, not been wholly neglected. It is commonly pointed out[7] that the tendency of carotin to unite with oxygen may be significant in connection with photosynthesis, which is a reduction process. Steenbock[8] has suggested that the fat-soluble vitamine is identical with some of the carotinoids, while Palmer[9] has cited cases that seem to cast doubt on this view. Years ago Schunck[10] suggested the question as to whether xanthophyll, being present in connection with both chlorophyll and haemoglobin, may not be of physiological importance in both cases.

Emphasis is commonly laid on the chemical similarity between the chlorophyll molecule and the hæmoglobin molecule, though similarity of function between the chlorophyll of plants and the haemoglobin of animals does not seem to have been definitely shown. An examination of half a dozen recent and standard works deal-

[1] Proc. Roy. Soc. London, 72: 165. 1903. Z. Physiol. Chem., 74: 214. 1911-12.

[2] Jour. Biol. Chem., 23: 261-279. 1915.

[3] Ibid., 17: 191-263. 1914.

[4] Jour. Amer. Med. Assn., 74: 32-33. 1920.

[5] Thatcher. The Chemistry of Plant Life. 1921.

[6] [7] Palladin's Plant Physiol. Livingston. p. 19.

[8] Sci. N. S., 50: 352-353. 1919.

[9] Sci. N. S., 50: 501-502, 1919, and Jour. Biol. Chem., 46: 559-577, 1921.

[10] Proc. Roy. Soc., London, 72: 176. 1903.

ing with the chemical phases of plant and animal physiology indicates general interest in the similarities between chlorophyll and haemoglobin. It would seem that the identity of lipochromes and carotinoids is worthy of equal attention.

The investigation of what the carotinoids of plants and lipochromes of animals have in common physiologically would seem to be a hopeful line of work. The fact that they may readily take up oxygen seems to furnish a starting point for thought and work, which will be important, whether the results prove positive or negative.

Geo. B. Rigg
University of Washington

RATE AND MODE OF SOIL DEPOSITION IN THE PALOUSE AREA OF WASHINGTON AND IDAHO

During the last eight years the writer has had the opportunity to observe the formation of soils on the Columbia Plateau by the wind. The soils are often a hundred feet deep or more, and are virtually great dunes of silt brought sometimes for great distances. The area where these dunes lie is locally called the "Palouse," well known for its deep and very fertile soils.

Dust storms are frequent, and, curiously, the dust deposited is generally not raised near the place of deposition. It comes from an area of widely different characteristics. This accords strictly with Richtofen's theory of loess. The loess is formed when the wind moves particles of silt from an arid or semiarid area and deposits them in a more humid one. Once deposited upon the moister land, the silt particles are not raised again but become a permanent acquisition to the more humid area. Two factors cause the permanency of the deposit, first the moisture in the soil causes coherence in the deposited mass, and secondly the heavier vegetation forms an entangling mesh. Shaler noted the same conditions prevailing in the formation of loess on the upper course of the Missouri River in Montana.

In the Palouse great dust clouds flying high in the air often nearly obscure the sun at a time when the soils for many miles around are too damp to be blown. A rain or snow fall then clears the atmosphere, carrying the dust particles to earth, and they do not rise again. At the present time drifting seldom takes place but in the past it must have done so. Otherwise the dune shaped hills extending at right angles to the direction of the prevailing winds can not be explained. Thus the deep soils over the lava plains between the Columbia Valley and the Bitter Root Mountains have been formed at the expense of the drier eastern slope of the Cascade Mountains and the Columbia Valley.

To measure accurately the amount of soil brought into an area annually is well nigh impossible. Only under particular conditions is it possible to measure that brought in by a single storm. To do so it is necessary that the soils upon which the deposit takes place be not moved by the wind bringing in the dust. Once deposited, the material must not be lifted again by the same wind, and that brought to earth must be kept separate from older deposits.

A particularly favorable situation for making measurement was presented over the eastern part of the Palouse on January 29, 1917, and at that time a series of collections was begun at Moscow, Idaho, by the writer. From that date to March 23 four dust falls took place, upon all of which measurements were possible. On the afternoon of January 28 a fall of pure white snow took place. The following morning it was covered with a coat of chocolate brown dust of variable thickness. At the time practically the whole area was covered with snow. The dust therefore must have been carried nearly a hundred miles and probably was carried twice that distance.

Measurement of the amount of material deposited was made by collecting the dust covered snow from five different areas of average contour, each of four square feet in area. The snow was melted, the water evaporated and the dust weighed. From the result the deposit upon an acre was calculated as 140 pounds. Similar dust falls occurring on March 21, 22, 23 brought, respectively, 196 pounds, 184 pounds and 585 pounds per acre as measured in the same way. The total for the four dust falls is 1,105 pounds in 55 days or approximately

7,500 pounds per acre per year. This deduction of course assumes that the dust falls occur with equal frequency throughout the year. Recognizing that such an assumption is not warranted, we have made careful observation for the last three years to estimate whether the calculated amount might be below or above the actual. And though accurate measurements have been impossible we are convinced that at least the amount given is deposited in this way each year. The annual accumulation, however, does not differ widely from this figure. Many times repeated determinations of the weight of an acre foot of this soil show it to be very close to 2,450,000 pounds per acre. At the rate of accumulation just given it would require 326 years for the deposition of one foot, or approximately four inches is deposited in one century. This is four times as much as estimated by Free. If no erosion took place during deposition, according to this estimate, 25,000 years were necessary for the deposition of the seventy-five feet of soil that covers the lava beds on this plateau.

Considerable further work has been done by the writer along this line but does not bear directly upon the mode and rate of formation of this soil. The work is now to be discontinued unless some one else will take it up. A fine problem is presented in historical geology or physiography, and it is hoped that some person remaining in the vicinity of these interesting deposits will find time to take up a study of them. A measurement of the depth of the soil and more accurate measurements of the rate of deposition are problems that will lead to extremely interesting deductions regarding the age of the various lava outflows.

P. P. PETERSON

IDAHO FALLS, IDAHO

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

REPORT OF THE TREASURER FOR 1921

IN conformity with Article 15 of the Constitution and by direction of the Council, the treasurer has the honor to submit the following report for the period December 23, 1920, to December 19, 1921, both inclusive.

The total of cash receipts during the year is \$7,064.65. Disbursements made in accordance with directions of the Council amounted to \$7,959.93. These include \$2,172.36 for purchase of \$2,500 of the United States Second Liberty Loan bonds for the association and held as an investment.

The total amount of funds of the association consisting of cash, cost value of securities purchased, and appraised value of securities received from the Colburn estate is \$121,414.77.

A detailed statement is appended.

ROBERT S. WOODWARD,
Treasurer.

WASHINGTON, D. C.,
DECEMBER 19, 1921

BALANCE SHEET—DECEMBER 19, 1921

ASSETS

Investments:		
Securities (Exhibit "A")		\$121,414.77
Cash in banks		5,585.90
		\$127,000.67

LIABILITIES

Funds:		
Life and Sustaining Membership:		
438 at \$ 50	\$21,900	
16 at \$100	1,600	
6 Sustaining	6,000	
		\$ 29,500.00
Jane M. Smith Fund		5,000.00
W. Hudson Stephens Fund		4,381.21
Colburn Fund		77,755.74
Accumulated Investments		4,777.82
Unappropriated Interest		5,585.90
		\$127,000.67

CASH STATEMENT

RECEIPTS

1920		
Dec. 23—Balance from last report		\$ 6,481.18
Interest from securities	\$5,834.24	
Interest from bank balance	30.41	
Revertment of grant made to Theo. Hough	100.00	
11 life commutations, 1921	1,100.00	
		7,064.65
		\$ 13,545.83

DISBURSEMENTS

Investments:		
\$2,500 U. S. Second Liberty Loan:		
Purchase price	\$2,170.80	
Interest purchased	38.07	
Commission	1.56	
		\$ 2,210.43
Grants:		
Gerald L. Wendt	\$ 200.00	
Graham Edgar	200.00	
Sebastian Albrecht	200.00	
Caroline E. Furness	200.00	
Frank B. Taylor	300.00	

Seismological Society of America	200.00	
P. W. Whiting	200.00	
N. A. Cobb	450.00	
Geo. B. Rigg	300.00	
T. R. Garth	150.00	
E. G. Boring	150.00	
A. L. Kroeber	200.00	
Frank A. Hartman	150.00	
W. E. Garrey	200.00	
Carl J. Wiggers	150.00	
W. F. G. Swann	150.00	
H. M. Randall	250.00	
Walter G. Cady	200.00	
Paul F. Gaehr	100.00	
A. L. Foley	100.00	
Helen H. Roberts	150.00	
Solomon Lefschetz	150.00	
Frank P. Knowlton	150.00	
		4,500.00
Subscriptions to Science on account of life members: 343 members at $3		1,029.00
2 life memberships from Jane M. Smith Fund		200.00
Rental of safe deposit box		20.00
Foreign exchange		.50
		$ 7,959.93
Cash in banks:		
Fifth Avenue Bank, N. Y.	$4,345.57	
U. S. Trust Company, N. Y.	1,240.33	
		5,585.90
		$ 13,545.83

(Exhibit "A")

SCHEDULE OF SECURITIES

SECURITIES PURCHASED

Par Value		Purchase Value	
$ 10,000	Chicago & Northwestern Railway Co. general mortgage 4 per cent. bonds, due 1987	$ 9,425.00	
10,000	Atchison, Topeka & Santa Fe Railway Co. general mortgage 4 per cent. bonds, due 1995	9,287.50	
10,000	Great Northern Railway Co. first and refunding mortgage 4.25 per cent. bonds, due 1961	10,050.00	
10,000	Pennsylvania Railroad Co. consolidated mortgage 4.5 per cent. bonds, due 1960	10,487.50	
10,000	Chicago, Burlington & Quincy Railroad Co. general mortgage 4 per cent. bonds, due 1958	9,350.00	
10,000	Union Pacific Railroad Co. first lien and refunding mortgage 4 per cent. bonds, due 2008	9,012.50	
10,000	Northern Pacific Railway Co. prior lien railway and land grant 4 per cent. bonds, due 1997	9,187.50	
10,000	New York Central & Hudson River Railroad Co. 3.5 per cent. bonds, due 1997	8,237.50	
100	U. S. First Liberty Loan bonds	91.25	
10,500	U. S. Second Liberty Loan bonds	10,172.36	
2,000	U. S. Third Liberty Loan bonds	2,000.00	
2,000	U. S. Fourth Liberty Loan bonds	2,000.00	
6,500	U. S. Victory Liberty Loan bonds	6,373.66	
			$ 95,674.77

BONDS FROM COLBURN ESTATE

		Appraised Value	
20,000	Acker, Merrall & Condit Co. debenture 6 per cent. bonds	$13,600.00	
7,000	Buffalo City Gas Co. first mortgage 5 per cent. bonds	1,540.00	
8,000	Park & Tilford Co. sinking fund debenture 6 per cent. bonds	6,400.00	
42,000	Pittsburgh, Shawmut & Northern Railroad first mortgage 4 per cent. bonds, due Feb. 1, 1952	4,200.00	
			25,740.00
$178,100			$121,414.77

All of the above named securities except those from the Colburn Estate are registered in the name of the association.

I certify that I have audited the accounts of the Treasurer of the American Association for the Advancement of Science for the period December 23, 1920, to December 19, 1921; that the securities representing the investments of the association have been exhibited and verified; and that the income therefrom has been duly accounted for.

The financial statements accompanying the Treasurer's report are in accord with the books of the association and correctly summarize the accounts thereof.

HERBERT A. GILL,
Auditor.

Dated, December 19, 1921.

FINANCIAL REPORT OF THE PERMANENT SECRETARY FOR THE FISCAL YEAR 1921

(October 1, 1920, to September 30, 1921)

DR.

To balances from last account:		
Checking account	$ 4,344.04	
Savings account	4,227.34	
Petty cash	13.21	
		$ 8,584.59
To receipts from members:		
Annual dues previous to 1920	$ 5.00	
Annual dues 1920	1,563.01	
Annual dues 1921	48,190.44	
Annual dues 1922 (paid in advance)	348.00	
Admission fees	630.00	
Life and sustaining memberships	2,100.00	
		52,836.45
To other receipts:		
Sales of publications	$ 1,955.91	
Misc. receipts, including subscriptions for journals for life members from Treasurer, postage, exchange, overpayments, etc.	1,385.69	
Unexpended balance of funds secured by Local Committee of Chicago meeting	157.40	
Interest on bank account	127.75	
		3,626.75
		$65,047.79

CR.

By publications:		
Publishers SCIENCE		$31,353.15
By Division and Academy Expenses:		
Division	$ 1,140.00	
Academies	355.00	
		1,495.00
By Expenses Washington Office:		
Salary, Permanent Secretary	$ 2,500.00	
Salary, Assistant Secretary	750.00	
Salary, Executive Assistant	2,490.00	
Usual clerical help	1,612.98	
Special clerical help on membership list	1,313.27	
Travel expenses	1,475.61	
Office supplies	217.66	
Stationery and printing	3,521.74	
Telephone and telegraph	124.29	
Postage	1,026.21	
Benjamin collection of portraits and autographs of association presidents	300.00	
Refunds on account of overpayments	154.98	
Life and sustaining membership fees	2,350.00	
Bad checks	16.15	
Exchange on checks	21.91	
Miscellaneous	1,274.49	
		19,149.29
By Expenses, Chicago Meeting:		
General program	$ 1,002.50	
Preliminary announcement	955.36	
Refund for expenses incurred by Section Secretaries	277.48	
Miscellaneous	82.53	
		2,317.87
By Expenses, Grants Committee		29.47
Special Grant appropriation		500.00
		$54,844.78
By new balances:		
American National Bank:		
Checking account	$ 5,840.11	
Savings account	4,355.09	
Petty cash	7.81	
		10,203.01
		$65,047.79

I certify that I have audited the accounts of the Permanent Secretary of the American Association for the Advancement of Science for the fiscal year 1921; that they were found correct, and that proper vouchers covering disbursements were exhibited.

HERBERT A. GILL,
Auditor.

Washington, D. C.,
November 26, 1921.

THE AMERICAN SOCIETY OF NATURALISTS

THE thirty-ninth annual meeting of the American Society of Naturalists was held in the Medical Building of the University of Toronto on December 29, 1921.

At the business meeting the treasurer's report was presented, audited, and approved.

The terms of the representatives of the society in the Division of Biology and Agriculture of the National Research Council were, by vote, extended six months, so as to end on June 30, which is the end of the fiscal year of the council. Dr. Sewall Wright was elected a representative of the society in the division, for a term of five years, to succeed Professor H. S. Jennings. The other representatives are Professor Leon J. Cole (four years), Professor Bradley M. Davis (three years), Professor Ross G. Harrison (two years), and Professor George H. Shull (one year).

A communication was received from a conference of officers of various biological societies, called by the National Research Council to consider the feasibility of a federation of biological societies, requesting that the American Society of Naturalists appoint its president and secretary as delegates to an inter-society council which is to be charged with formulating plans for such federation. By vote the president and secretary were authorized to represent the society in such a council.

Professor V. E. Shelford, by authority of the Ecological Society of America, requested the American Society of Naturalists to assume part of the burden of a survey of primeval areas in the Americas. This request was referred to the executive committee with power.

The committee on genetical nomenclature, of which Dr. C. C. Little is chairman, and which made recommendations at the Chicago meeting, in 1920, was continued.

Upon recommendation of the executive committee Professor E. B. Wilson was elected to honorary membership in the society. The following persons were elected to membership: Professor E. C. Case, University of Michigan; Dr. O. F. Cook, Bureau of Plant Industry; Professor Vera Danchakoff, Columbia University; Dr. H. D. Goodale, Massachusetts Agricultural College; Professor Robert F. Griggs, Ohio State University; Professor Joseph Grinnell, University of California; Professor C. H. Kauffman, University of Michigan; Professor F. L. Landacre, Ohio State University; Professor I. F. Lewis, University of Virginia; Professor A. D. MacGillivray, University of Illinois; Professor George J. Peirce, Leland Stanford Junior University; Dr. Wm. E. Safford, U. S. Department of Agriculture; and Professor E. C. Stakman, Minnesota Agricultural Experiment Station.

The committee on nominations presented the name of Professor W. M. Wheeler for president, and that of Dr. A. H. Sturtevant for vice-president. These nominees were declared elected. The other officers for 1922 are as follows: *Treasurer,* Dr. J. Arthur Harris; *Secretary,* Professor A. Franklin Shull; additional members of the executive committee, Professor Bradley M. Davis, Dr. Jacques Loeb, Professor E. M. East, and Professor Henry E. Crampton.

The following program of papers was presented:

Thursday morning:

Are the effects of prolonged rotation in rats heritable? (Moving pictures). C. R. GRIFFITH, University of Illinois. (Introduced by J. A. Detlefsen.)

Dominance in the albino series of allelomorphs of guinea pigs. SEWALL WRIGHT, Department of Agriculture.

On interspecific sterility in Drosophila. (Read by title). A. H. STURTEVANT.

The gamete lethals of Œnothera. GEORGE H. SHULL, Princeton University.

Chromosome assortment in triploid Daturas. JOHN BELLING and A. F. BLAKESLEE, Carnegie Institution.

Chromosome relationships and genetic behavior of Drosophila willistoni. CHARLES W. METZ, Carnegie Institution.

Further data on size inheritance in rats. HEMAN L. IBSEN, Kansas State Agricultural College.

The effect of temperature on dominance. CHARLES ZELENY, University of Illinois.

Two new mutations in the house-mouse, allelomorphic to color, and their genetic behavior. J. A. DETLEFSEN and S. L. CLEMENTE, University of Illinois.

Homologous genes in pigeons and doves. LEON J. COLE, University of Wisconsin.

Thursday afternoon: Symposium on the origin of variations.

Variation in uniparental inheritance. H. S. JENNINGS.

Variation in Datura due to changes in chromosome number. A. F. BLAKESLEE.

Variation due to changes in individual genes. H. J. MULLER.

The origin of variations in sexual and sex-limited characters. C. B. BRIDGES.

The nature of bud variations as indicated by their mode of inheritance. R. A. EMERSON.

Serological reactions as a probable cause of variations. M. F. GUYER.

The annual dinner was held Thursday evening at the King Edward Hotel, with one hundred and twenty-five in attendance. The president, Professor Bradley M. Davis, gave the annual address on the topic "Species, pure and impure." After this address, Professor William Bateson spoke in personal and reminiscent vein, to the great delight of his audience.

A. FRANKLIN SHULL,
Secretary.

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SPECIES, PURE AND IMPURE[1]

There has come about in recent years a profound modification of our conception of a species in that the botanist, at any rate, is compelled to recognize the fact that Nature presents large numbers of successful kinds of plants that reproduce their types either wholly or in high percentages, but which clearly have germinal constitutions of a hybrid character. These forms may legitimately be described and classified as species and they are frequently virile lines of evolution making up groups of individuals that readily maintain themselves in suitable habitats. As assemblages of like individuals, hybrid as to their germ plasm, they present subjects of study that were not differentiated by the earlier naturalists from the populations of species as they viewed them.

The test of a species, in addition to the characters that distinguish it, has always been the evidence that it breeds true to its peculiarities or so nearly true that variations from the type may be passed over in the descriptive writings of the systematist as exceptions of little importance to the mind seeking for order and rebellious of mental disturbance in his efforts to express this order in accounts of faunas and floras over the earth. There are, then, chiefly as the result of genetical studies of the near present, two conceptions of species.

There is the *pure species* breeding true because its germ-plasm in the diploid condition carries two similar sets of factors, each set contributed by one of the parents and each set having the same genetic make up except for those factors responsible for sex and for sex-linked characters. The pure species was in the main the concept of Darwin and the older naturalists, and it was assumed to be representative of species. As viewed by the cytologist, confident that chromosomes carry

[1] Address of the president of the American Society of Naturalists, thirty-ninth annual meeting, Toronto, December 29, 1921.

the factors or genes responsible for inheritance, the pure species owes its characteristics to the fact that parents contribute chromosomes of identical factorial constitution and therefore give to the zygote pairs of homologous chromosomes with the exception that genes which differentiate sex can only be present in single sets. Expressed in the terminology of the geneticist the pure species is homozygous for all genes responsible for the species' characters other than those of sex, and for sex characters the germ-plasm is heterozygous in either the male or female individual at least where animal forms are under consideration. The problems of sex determination from the diploid sporophyte generations of plants are not yet fully solved. Aside from the possibilities of factorial mutations and of mutations due to irregularities of chromosome distribution a pure species must develop gametes identical for all genes other than those of sex, or linked with sex, because the homologous chromosomes during the reductions divisions separate from one another. Some authors would strictly limit the term species and accept that definition of Lotsy (1914), "A species is the total of all individuals of the same hereditary composition, forming but one kind of reproductive cell." I cannot agree with this opinion since the definition calls for what is almost an abstraction in higher animals and plants, the absolutely pure race.

In contrast to the pure species as defined above is the *impure species*, the germ-plasm of which in the diploid condition carries different sets of genes affecting characters other than those associated with sex. With respect to these genes the germ-plasm is heterozygous and through the reduction division there must take place a segregation of genes with the result that the impure species cannot produce a uniform set of gametes, that is, gametes identical in their germinal constitution. If the diploid germ-plasm is heterozygous for one pair of chromosomes other than the sex chromosomes there would be developed through the separation of the different chromosomes of such a pair two classes of gametes of each sex provided that reduction proceeds in a normal manner. If heterozygous for two pairs of chromosomes there would be developed under normal conditions of meiosis four classes of gametes of each sex, and the theoretical possibilities when larger numbers of heterozygous chromosome pairs are present may be calculated by the well known genetical formula (2^n) when $n =$ the number of heterozygous chromosome pairs.

The impure species is therefore clearly hybrid in its genetical constitution but there is this peculiarity in its breeding behavior that it frequently shows little or no evidence of a segregation of contrasting genes. There is in such cases no obvious splitting off of classes through its progeny, but, on the contrary, the impure species breeds true or nearly true to its type. The true breeding of an impure species must be due to the fact that only favored types of gametes are able to produce in conjugation vigorous zygotes capable of successful development. Furthermore, such favored gametes must carry between them those genes which in combination will reproduce the impure heterozygous germinal constitution of the parent stock.

It is well understood from various plant material that the failure of a hybrid to produce a diverse progeny may be due to irregularities at a number of different points in the life history. The death, the sterility, or the failure of maturation of classes of gametes will eliminate the possibilities of development of whole groups of segregates. Even when viable classes of gametes are formed some may leave no progeny because in conjugation they fail to produce zygotes able to develop a succeeding generation. In plants the length of style, or the nature of its tissues, or of its stigma secretions may operate to check or to limit pollen tube growth or the speed of such growth for some classes of pollen grains and at this point in the life history prevent the functioning of pollen tubes carrying particular types of gametes. Pollen and ovule abortion in greater or less degrees is a very common phenomenon and is responsible at times for the elimination of entire classes of gametes. High degrees of seed sterility and the weak germination of seeds express the failure of certain types of zygotes to develop a succeeding generation. Explanations for all of these conditions may be offered by postulating lethal factors, as suggested by the work on Drosophila, but it is well to understand for plants how various are the ways in which lethal factors may block the course of development and how numerous are the points at which they may operate.

The significance of the impure species and the importance of its place in certain natural groups is not yet appreciated. Curiously the plant most conspicuously brought to the front as one giving rise to new species by mutation has become one of the forms most thoroughly studied as an example of an impure species. I refer of course to the plant *Œnothera Lamarckiana.* Presented by De Vries as the best illustration of his view that pure species at times pass through periods when they actively produce by large saltations new species, the status of *Œnothera Lamarckiana* from the first became a subject for sceptical examination on the part of a body of naturalists who hesitated to accept De Vries' conclusions, and sought for other hypotheses to account for its remarkable behavior. Bateson was the first to suggest that the fifty per cent. or more of pollen sterility in *Lamarckiana* indicated a hybrid constitution. Jeffries pushed this argument with force through comparisons of pollen sterility in *Lamarckiana* with similar conditions in various known hybrids. Workers with Œnothera now generally recognize for most of their material the presence of very high degrees of sterility both gametic, as indicated by bad pollen and abortive ovules, and zygotic, as shown by large proportions of seeds incapable of germination. Renner has recently taken the subject of pollen analysis to a new level by showing that genetic classes of pollen may be distinguished in *Lamarckiana* and in some other œnotheras by differences in the form of the starch grains within the pollen cell and pollen tube. Cytological studies of Gates, Lutz, Stomps, Hance, van Overeem and others have shown that certain of the variants thrown by *Lamarckiana* differ from the parent type in having higher chromosome numbers due to non-disjunction. This non-disjunction seems correlated with a loose association of chromosomes in *Lamarckiana* and other œnotheras that favors irregularities of chromosome distribution at meiosis such as may be expected in hybrid material. Much breeding evidence, chiefly from the work of De Vries, has made it clear that *Lamarckiana* and other œnotheras develop two or more classes of fertile pollen grains which give in various crosses sets of hybrids in pairs, in threes and in fours, good evidence of hybrid behavior. I have shown that with care in the selection of parent stock it is an easy matter to synthesize a large-flowered vigorous hybrid with so many points of resemblance to *Lamarckiana* that it would be difficult to separate in descriptive botany the hybrid from the assemblage of biotypes that pass under the name *Lamarckiana* which, as Heribert-Nilsson has so well brought out, represents a collective species. Furthermore, this hybrid, an impure synthetic species, which I have called *neo-Lamarckiana*, has thrown in each of six generations from selfed seed similar sets of marked variants, and, as pollen parent in appropriate crosses, gives twin hybrids thus paralleling in essentials the characteristic performance of *Lamarckiana.* It is of interest that among the variants from *neo-Lamarckiana* there appear occasional triploid and quadriploid forms comparable to *semi-gigas* and *gigas*. There is no reason to expect that *neo-Lamarckiana* will ever be other than an impure species no matter how close may be the inbreeding and selection to type. It breeds true through only a small proportion of its progeny and we can see nothing that might change this habit so long as the line lives. Finally, against the assumption that *Œnothera Lamarckiana* is a pure species is the fact that the plant is unknown as a wild species and there is strong probability that it arose as a hybrid in England about the middle of the last century.

These are some of the reasons why geneticists rather generally have come to the conclusion that *Œnothera Lamarckiana* is representative of an impure species which reproduces its heterozygous constitution because the viable zygotes produced are for the most part only those resulting from the union of two different types of gametes, which in combination reproduce the heterozygous *Lamarckiana* complex. Renner in 1914 presented this point of view, after studies on seed sterility in several species of Œnothera, and the conception of impure Œnothera species was rather fully discussed in my paper "The test of a pure species of Œnothera" published in 1915. Thus certain workers with Œnothera were fully aware of the possible significance of gametic and zygotic mortality in relation to problems of Œnothera genetics some years before Morgan and Muller in 1918 discussed the findings of balanced lethals in Drosophila. Renner deserves particular mention as an investigator quick to bring the facts of gametic and zygotic sterility into relation with the peculiarities of Œnothera breeding. As the result of his studies and those of other investigators we have reason to feel confident that most of the œnotheras that have been the subject of experimental study are impure species, that is to say, heterozygous in their genetical constitution.

I am, nevertheless, confident that pure species of Œnothera do exist but it will require much patience in observation, in cytological analysis, and in experimental crossing to establish them. The most promising form in my experience is a line of *Œnothera franciscana,* which has almost perfect pollen and produces seed about ninety per cent. viable. This line I have selfed for eight generations without finding a single departure from the type. The last generation, grown during the past summer, was a culture starting with 1,425 seedlings from seeds experimentally forced to complete germination, a germination percentage of 87.3 per cent. In this large culture 1,373 plants survived the vicissitudes of the season, a loss of only 52 plants mostly as seedlings. This culture was large enough to bring out variants if present in the proportions thrown by *Lamarckiana,* which for some variants is as high as one per cent., but the culture gave no exception to the type. Also, crosses have been made with *biennis, muricata* and *grandiflora* and, when *franciscana* was the pollen parent, the results have been uniform F_1 generations, indicating that the pollen grains of *franciscana* are all alike in genetical constitution. Finally, a cytological study of pollen formation now in progress by my former student R. E. Cleland shows a regular pairing of chromosomes during meiosis in contrast to the loose association of chromosomes characteristic of the same stage in *Lamarckiana* and such other œnotheras as have been studied with the exception of a race of *grandiflora.* Thus the evidence of high fertility, uniform progeny when selfed, uniform F_1 generations when used as the pollen parent, and regularity of chromosome pairing during meiosis all point to the genetic purity of this race of *Œnothera franciscana.* I present this line as the purest Œnothera material known and safer than the race of *grandiflora* that I selected twelve years ago and which satisfied fairly well the tests of a pure species except that it threw occasional weak dwarfs. This isolation of an apparently pure species of Œnothera is a matter of satisfaction and of some importance for the future of genetical studies in this group of plants since in the past we have had no standard material of unquestioned purity with which forms could be mated in tests of cross breeding. My apparently pure race of *Œnothera franciscana* is vigorous, easily grown in cool latitudes, and has a long flowering season, qualities important for experimental work, and I confidently offer it to students of Œnothera as a plant worthy of their attention.

The interpretation of the breeding behavior of *Œnothera Lamarckiana* on the hypothesis of its impure germinal constitution has received important and most substantial support from the investigations of Muller on material of Drosophila which led to his theory of balanced lethals. The condition of balanced lethals results when two different lethals are present, the first in one chromosome and the second in the other chromosome of a pair. Thus each lethal is present in a single dose and the genetical constitution is therefore heterozygous for each lethal but the two lethals are in different chromosomes of a synaptic pair. Since the lethals operate when in double doses close breeding in such a race will result in a succession of generations repeating the heterozygous genetic formula because the homozygous associations of either lethal block further development. Such a factorial situation would maintain a state of constant heterozygosis, the fixed hybridism of an impure species. The genetical impurity will be passed from generation to generation and in this respect the hybrid will breed true until the relative positions of the lethals are changed by a crossover, or the genetical constitution in these respects is altered by a mutation. A crossover frees at once recessive characters which were suppressed by lethals in homozygous condition and the sudden appearance of such recessives will simulate mutations although in reality they are manifestations of a process of segregation.

The theory of balanced lethals offers such a satisfactory interpretation of the behavior of certain Drosophila material, behavior similar in nature to that of *Œnothera Lamarckiana*, that Muller was quick to suggest the application of his results to Œnothera problems. It should be noted that De Vries as early as 1911 offered a hypothesis essentially similar to the theory of balanced lethals to account for the peculiarities of the double reciprocal crosses between *Œnothera biennis* and *Œnothera muricata,* forms which, on strong evidence from the studies of Renner, we now believe to be impure species. Investigations of my own, published in 1917, on these hybrids and on others support the conclusions that lethals are common in Œnothera material, but I believe that conditions are more complex than indicated by the conclusions of De Vries and Renner. De Vries in recent papers has also made free use of lethals in offering hypotheses to cover certain results of his breeding studies with Œnothera.

Although it is not my purpose to discuss the mutation theory of De Vries it does seem important to examine critically the position of this theory as it is affected by the evidence for the existence of impure species that are held to a behavior of pure breeding or almost pure breeding by lethals which suppress the appearance of segregates. Lethals are not rare in Drosophila and Œnothera material. There is reason to suspect that they are common manifestations of irregularities in the mechanism of the organism of so serious a nature that they interfere with vital processes at some point in the life history, finally bringing the machine to a standstill with death as a result. The workers with Drosophila seem inclined to believe that much of the phenomena simulating mutation in their material is in reality the appearance of characters set free by the breaking of lethal adjustments which held the characters latent. Well known workers have arrived at similar conclusions for Œnothera material and are not content to accept as evidence of mutations the behavior of *Lamarckiana* and some other forms when they throw their marked variants.

An entirely new conception of mutation phenomena has grown up with meaning very different from that of the past. Œnothera material selected by De Vries on the assumption that it illustrated mutation in a pure species proves to be highly impure and in genetical constitution exceedingly complex. Progress in the study of mutations must follow the usual course in genetical research and rest upon intensive studies of particular characters, analyzed and traced through experimental cultures and tests of cross breeding, with the assistance of cytology at critical points in the life history, and with constant attention to phenomena of infertility and sterility. From the later writings of De Vries it would seem that the master recognizes the newer trend. Logically mutations appear to be more likely from hybrid stock than from pure lines since heterogeneity of germinal constitution obviously invites chemical and physical modifications that might lead to the origin of new genes or to such changes in old genes as would result in different expressions of former characteristics. Of particular import is the expectation that lethals most frequently owe their presence to heterozygous conditions since the mixing of diverse germ-plasms seems likely to lead to the breaking down of delicate and vital adjustments in proportions relative to the degrees of protoplasmic confusion, and this means chemical and physical disturbance. The intensive study of specific mutations with its effort at analysis to the last degree is a very different matter from that care-free attitude of former years which permitted any marked variation not easily interpreted to pass as a mutation. Mutation has become intimately a part of that most fundamental and illusive problem of biology, the origin of variation, and mutations apart from the study of their causation are of secondary interest.

Œnothera material and lines of Drosophila were not the first representatives of impure species to be isolated by the geneticist. The blue Andalusian fowl which cannot be fixed, yellow mice that never have the double dose for yellow, Vilmorin's dwarf wheat which throws talls but fails to produce homozygous dwarfs, single stocks never homozygous for singleness, these and other cases are well known and proven examples of impure species heterozygous in their germinal constitution. Certain of them, as the blue Andalusian fowl, throw two homozygous types, in this case the black and white "wasters." Others produce one viable homozygous type. Some impure species rarely and perhaps never throw homozygous segregates. All agree in this respect that the heterozygote, which breeds true to its proportion of the progeny, can not be fixed by selective inbreeding although as an impure species it reproduces itself with exactness.

We have briefly reviewed conclusions from the intensive study under experimental conditions of lines which genetical investigations have established as representatives of impure species. Some of the material is obviously of the sort that would not hold its own under conditions of open competition in Nature, but much of it has been derived from forms not far removed from wild species. There is a broader aspect of the subject of the hybrid deserving of examination, namely, the study of the possibilities of the impure species as a definite component of faunas and floras.

First of all it is important to bear in mind that if we accept the current theory which places the determination of sex as a function of the reduction or segregation divisions, all unisexual animals are heterozygous for sex factors and for such genes as are responsible for sex-linked characters. For higher animals this means that either the male or female carries in single dose a chromosome which is not paired with an equivalent chromosome. For higher plants we should expect the diploid sporophyte generation to be heterozygous for sex determining chromosomes, a condition for which as yet we have cytological evidence from only one type, the liverwort Sphærocarpos studied by Allen and his students, although there is experimental evidence for this condition in other liverworts, in some unisexual mosses, and in certain seed plants, *e. g.*, Melandrium. The behavior of sex-linked characters may then be believed to follow an orderly system in inheritance except as such linkage is broken or as point mutations appear in sex chromosomes.

But accompanying the sex chromosomes are those groups of chromosomes, the autosomes, responsible for characters not of sex or sex-linked. The unisexual state precludes the possibility of that closest form of inbreeding possible through hermaphroditism and leaves the way open to outbreeding subject only to physiological limitations and to conditions whereby lethals prevent reproduction. That Nature has made extensive use of this encouragement of outbreeding in various degrees cannot be doubted, and this is best illustrated in man, the most mixed and varied of all animals in the assortment of genes carried by the individual. It is impossible to believe that any human is homozygous for the complex of factors responsible for his individuality.

Even when, as in most higher plants, the diploid sporophyte generation is bisexual, there have arisen in many lines of evolution conditions that make for very high degrees of genetic impurity. There was a time in the history of botany when workers, following the lead of Darwin, devoted themselves to the study of devices to secure cross-pollination and many and remarkable are the arrangements described to encourage outbreeding. Volumes have been written on this subject and the facts in general are freely admitted. In wind-pollinated forms there is even greater opportunity for promiscuous pollination unless the shedding of pollen takes place at such a time that stigmas are dusted and the ovules self fertilized before outside pollen has had an opportunity to reach the pistil. Perhaps the best examples of wind pollinated types very freely open to outside pollination are the numerous races and forms that make up the collective species *Zea Mays.* The studies of East and Jones, Emerson, Shull, G. N. Collins and others, extending over many years, show conclusively that corn is usually a hybrid composite with so many characters represented by genes in single doses that purification of material by selective inbreeding is a matter of much time and patience. There could hardly be a greater contrast in genetical behavior than that between lines of wheat which, because they rarely outcross, breed very true, and races of corn that can only be kept reasonably true by constant watchfulness, practiced selection, and a never-ending elimination of products departing from the types.

Self-sterility and the production of weakened generations following inbreeding, as factors leading to the establishment of impure species, have not as yet received recognition proportionate to their importance. Genetical studies seem likely to show that there are large groups of bisexual plants the individuals of which are either infertile when selfed or produce progenies in successive generations distinctly inferior in vigor to the wild types. In such material the species represented in Nature must be very largely, if not wholly, made up of individuals cross-bred and genetically impure. It is significant that these conditions should have been found in that most successful assemblage, the Compositæ, frequently cited as the climax group of plant evolution. The recent studies of Stout on chicory have shown the extensive presence of self-sterility, and that the wild populations must consist chiefly of outbred and probably heterozygous individuals. Investigations of J. L. Collins on Crepis indicate that species of this genus are impure since progeny from selfed lines show marked deterioration from the wild stock as segregation proceeds and forms approaching purity of germinal constitution are isolated. Crepis seems likely to prove an assemblage of impure species similar to that assemblage of impure races called *Zea Mays,* and will probably show the same parallelism of behavior in reduced vigor and the production of abnormal types as inbred lines are separated from the wild population. The interpretation for Crepis is likely to be that of East and Jones for maize, namely, that inbreeding gives deleterious results through the segregation of types with fewer genes for characters associated with physiological vigor of expression. These studies are tending towards conclusions well established for many cultivated fruits, as apples, pears, plums, cherries, etc., where self-sterility among the varieties proves to be the rule and cross-pollination is necessary for sexual reproduction through impure lines. It is hardly possible that chicories and species of Crepis are outstanding exceptions to conditions in the Compositæ and we may safely predict that studies in this immense assemblage will reveal wide-spread the presence of impure species. Self-sterile lines among the grasses have also been reported, *e. g., Lolium perrene.*

There is another type of impure species not represented in the animal kingdom but common in certain groups of plants and therefore of particular interest to the botanist. This is the hybrid which perpetuates itself by vegetative means and thus establishes populations in the wild when its characters are favorable to survival under the scrutiny of natural selection. The well known principle of hybrid vigor, or heterosis, may in itself be expected to give to such hybrids marked advantage. These impure species hold true to their characters through asexual reproduction although by their seed they may produce a large variety of segregates. This principle of the maintainance of a hybrid by vegetative reproduction is applied in agriculture when selected lines of potatoes are propagated from slices of the tubers and strawberries from plants developed by the runners, and in fruit culture by the grafting of choice hybrid varieties.

There have been two notable systematic studies in America on groups of wild species in which hybrids are found well established as impure species. Brainerd's investigations on the violets and blackberries show the possibilities of critical studies on the status of species, making use of the experimental garden and basing results on genetical analyses. Favored hybrid blackberries, spreading readily by prostrate branches that root at the tip, may easily establish themselves in extensive growths. In a recent classification of the blackberries of New England Brainerd and Peiterson isolate 23 hybrid species of the 12 primary species that are recognized, and they give an additional list of 32 suspected hybrids. Violets do not spread so prolifically as brambles but there are a number of hybrids known which maintain themselves in Nature by vegetative growths. Other groups of plants readily propagating from stems are likely to show similar proportions of impure species as they are more thoroughly studied.

With the data before us on the widespread occurrence in Nature of impure species we wonder what will be the reaction of systematic botany. It will be impossible for the manuals to include the many hundreds of lines which the geneticist may isolate as impure species although they may be definite units of floras. There will be little satisfaction in attempts to identify in the field races which can only be established by experimental studies of the garden. Are these impure species to be grouped for convenience as collective species regardless of their true positions and relationships? Truly the paths of the systematist and ecologist have not been made easier by the progress of genetics.

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THE TREND OF EARTH HISTORY[1]

II

Through the millions of years represented by the Tertiary period the mammals differentiated slowly along the conventional lines which had been previously marked out in large measure by the reptiles. Some became adapted to life on the dry plains, others in the forested river flats, others in the high mountains, the tree-tops and the tropical jungles. A few of them learned to fly more or less successfully, some burrowed under ground and still others became aquatic. In a general way they did what the various kinds of reptiles had done before them in the Mesozoic era, but, on the whole, they seem to have done it better.

Finally, about the end of the Tertiary period or later, the next great advance was made by the genus *Homo*—an offshoot of one of the most insignificant groups of mammals. In consequence of this achievement, the entire group has been dignified with the name of *Primates*. From this offshoot so many surprising things have developed that it is hard to say which one was fundamental. Undoubtedly, one of the first new habits of the human genus was the use of tools. We may reasonably suppose that only one of the less specialized types of mammals, a creature possessing flexible fingers and hence the power to grasp a stone or a club in the hand, could acquire such ability. Possibly it was this initial power that gave the first impetus to the higher progress of the pre-human stock. Be that as it may, the progress of the human race seems to have depended largely on the ability to invent and use other things, such as fur-covered skins for clothing, the spear and bow-and-arrow for the chase, the fish hook, the needle, the potter's wheel and so on through the long list of human contrivances. As Bergson has remarked, each human tool and machine serves as a new and additional bodily organ and so multiplies our functional activities to a wonderful degree. The development of higher intelligence went on side by side with this multiplication of inventions, doubtless, on the one hand, being stimulated by it and, on the other, making possible its continuation.

Looking back over the great contributions which the various animal groups have devised and elaborated in the vast stretches of geologic time, and omitting only that of the human race—which is too new to be impartially judged—it will be observed that, although each of these innovations has brought temporary success and domination to its holders, it has never been able to insure the permanency of the exalted position so attained. Experimentation seems to be nature's endless pastime. Her appetite for it is insatiable; and, no matter how interesting the results of the trials already made, there are always more to come. As John Burroughs once said, "Nature hits the mark, because she shoots in all directions."

In that part of the history of man which is sufficiently well known, we perceive a series of subsidiary waves of rise, culmination and decline. Each race or nation seems to have its day in turn. The causes of such temporary rises are complex, but in each instance it appears that some new plan or system or way of doing things is tried out and its value, whether great or small, determined. Part of the new plan may prove to be good; it may be retained and adopted by succeeding dominant races. Other parts of the system prove faulty and eventually cause the downfall of the race. The injurious features are not likely to be copied by those that follow.

Without implying that the factors selected are the only ones, or even the most important ones, I may draw illustrations from the well-known histories of nations. The great expansion of wealth and domination among the ancient nations around the Mediterranean Sea was due to many and complex causes. Its industrial basis of energy was largely animal power—the labor of beasts of burden and of men. Expanding civilization created a demand for more and more power. To meet this demand slavery was increased to a point probably never equalled before or since. To-day we rely chiefly on fuel power and hence have been able to dispense with slavery, but in the days of Rome no other available source of energy was known. Metals were mined and smelted by slaves, ships were propelled by slaves, food crops were raised by slaves, and even the revenues of government were supplied in large measure by unwilling tribute from conquered tribes. For the master people this scheme produced wealth and power and enabled them to maintain control for centuries. It contained within itself, however, a fatal seed of weakness in the opposing self interests and disloyalty of the slaves. Given a good opportunity, both the oppressed tribe and the enslaved man were ready to overthrow their oppressors and make an end of them.

In the Chinese civilization, which has long dominated eastern Asia, one of the central influences seems to me to be ancestor worship. Other religions have been tolerated and partly adopted by the Chinese from time to time, but for the most part they have been merely grafted upon the ancient stem, forming non-essential modifications. The requirements of ancestor worship had many advantages. It is not hard to trace to this ancient and firmly held code much of the industry of the Chinese, their solid, steady qualities, strong family ties, admiration for personal achievement and culture, and their respect for authority. Yet ancestor worship has not proven an unmixed blessing. It has tied men each to his own locality. It has made for over-population with the attendant evils of poverty, ignorance and even starvation. Above all, it has turned the faces of the Chinese people towards the past and inspired them with little interest in the future. One may well regard this as one of the most potent factors in making China the backward nation she has been these many centuries.

The modern peoples of the Atlantic region—our so-called western nations—are now contributing to the museum of human experiments that system of living which may be called "Industrialism," whereby through machinery and extreme specialization of labor each member of society is multiplied in activity, wealth is produced and distributed at an unprecedented rate, new inventions follow each other with bewildering rapidity, and material "progress" is the watchword. Although this curve has probably not yet reached its culmination, its more serious defects have already revealed themselves. Life in the cities is becoming more and more artificial and unnatural. Physical degeneration of the most civilized nations is making headway. If carried out to its logical destiny, industrialism as a scheme of life will doubtless fail like its predecessors. There are plentful signs that this failure is not far off unless we develop and effectively apply wisdom enough to modify present dangerous tendencies before it is too late, and thus save the best of the system for still further advancement.

It would be strange if, from all we know concerning the past history of the earth and its inhabitants, we could not discern some general scheme or underlying principle which would help us to fit more successfully into our environment, and perhaps even to make a shrewd guess about the future—not of ourselves as individuals, but of our remote descendants and the earth on which they are to live. It is obvious that a geologist is on safer ground if he confines his thoughts to the domain of geology; and there are some who may adopt the attitude that it is not fitting for him to digress from the pursuit of his strictly geological facts and theories. With that opinion I frankly disagree. It seems to me that there are times when the geologist should consider the relation of his own science not only to other sciences but to the affairs of his country and the world at large. I shall therefore venture to comment upon certain aspects of those relations which seem to me worth considering on such an occasion as this.

The old anthropocentric attitude of mind, which characterized even the more progressive nations up to very recent times and is still prevalent among humans in general, exaggerated the importance of man. All things were regarded as being intended for his use, benefit or punishment. The rain was sent to mature his crops; the forests covered the land in order that he might have wood; the fishes of the sea had been thoughtfully provided for his subsistence; and coal had been formed in the rocks to give him warmth and power. Within the last few decades this attitude has been supplanted to some extent by the evolutionary view, which had been incubated long before the time of Darwin, but was by his cogent marshalling of facts given great impetus in the world of philosophy. Even to-day this point of view is generally modified by a prejudice, which is understandably subtle in its appeal and extremely difficult to cast out. Many were disposed to accept the theory of evolution as applying to the ordinary plants and animals, but with reservations when it came to the genus Homo. Man was supposed somehow to be an exception, more or less exempt from those laws which had governed all organisms for hundreds of millions of years up to the time of his advent. It would be interesting to know how widely this view prevails to-day even among that minority of human kind who are considered well educated and philosophically minded. It is tacitly assumed in certain widely used text-books of geology, which were current within a score of years.

Unquestionably we do differ from all other animals in that some of us have learned to do things in a high degree which other animals do only in very low degree or not at all. The faculty of invention, which can be traced as a mere rudiment in some of the other mammals, we have developed in wonderful measure. Communication of thought by sound and gesture—a power possessed by many other mammals as well as birds—we have improved until we are able to communicate ideas accurately and in the finest shades of meaning by our vocal language. Many other animals remember their experiences and profit by such recollections, but it is the human species that has vastly increased the store of such remembered ideas and uses them as material for thought. Above all, man is the reasoning animal, fabricating new ideas out of present observations and the records of the memory. This is doubtless the greatest innovation presented to the world by the human species. Can we impartially estimate its value?

It has often been assumed that these wonderful powers of the mind are fast giving to the human race control over its environment to such an extent that henceforward many of the laws of evolution which have hitherto governed the careers of animals and plants will be abrogated or greatly modified, so far as concerns man. It has been supposed, in short, that we do or will effectively dominate other organisms and can readily adapt ourselves to those environmental factors, such as climate, which we cannot directly control.

In some measure this is true. We have lately become so accustomed to triumphing over the lower animals and circumventing the once impassable barriers of the oceans, the upper air, and the frozen polar regions, that it may be opportune to raise the question whether either domination or adaptation are destined to go as far as is commonly believed, and to what extent they are to last—for the geologist cannot regard anything as permanent. It is a truism among us that the only permanent thing in the universe is change.

In most parts of the world we have by this time conquered wild beasts to such a degree that in the more civilized temperate zone countries we give no thought to them, although in some parts of India they are still a constant menace to the ordinary man. But at the other end of the biologic series are the much more numerous and more dangerous micro-organisms which assail us on every side. When all the circumstances are favorable we can now control insects, protozoans and bacteria, which are the carriers or causes of many of our most dreaded diseases. But it is a hard struggle to dominate such scourges as plague, typhus, cholera and yellow fever. They never sleep, and if, like Russia to-day, a nation finds itself temporarily unable to maintain the needed precautions, its boasted control soon vanishes.

We have learned to overcome the isolation of space on land and sea, to move about more rapidly than any other animal, to fly higher than any bird has ever gone, and to maintain summer heat in the coldest winters; but in order to do so and by virtue of this expansion of our activities, we are rapidly depleting the earth's storehouse of materials. We are assured by those who have most carefully studied the subject that the liquid energy of petroleum will not serve us adequately beyond this generation; copper for our wonderful electrical systems should last somewhat longer; and coal some centuries or even thousands of years. But what is ten thousand years in the life of a race? Other sources of energy are known and we may yet learn to use them profitably; but it is well to remember that the continuance of our type of civilization on anything like its present scale is absolutely contingent upon the success of such attempts. It is not merely a hope but a necessity, that should convince even the dullest mind of the need of incessant and extensive research with such objects in view.

We have organized manufacturing, trade and commerce to such an extent that millions of people may now be supported in towns and cities, and the average population per square mile multiplied far beyond what was possible only a few centuries ago. Through the application of science we have almost banished many diseases and have greatly reduced the usual death rate; and now we are hopefully attempting to do away with war. Yet these achievements can hardly be said to have rid us of our problems, for a crop of new ones has sprung up—the problems of the feeble-minded, the degenerate, the insane—to mention only a few of the most obvious. For the old diseases, many of which have been partly conquered, we have a great complementary increase in cancer, pneumonia and various functional and nervous ailments, which are aggravated by the crowding, the stress, intensity and sedentary nature of modern industrial life.

No doubt most of us believe that the algebraic sum of these gains and losses is a real advance toward a better state of things. Perhaps to question the lasting quality of this advance may not be so presumptuous as we usually have supposed.

The entire history, not only of the human race, but of its predecessors from the earliest known times, has been marked by constantly increasing complexity of bodily structure, function and activity. This increase has not been steady, but pulsating. Evidently we are to-day witnessing an acceleration of the normal increase in the complexity of human relations and action. As our modern civilization becomes more and more specialized and diversified, our relations to our environment become more and more complex and our adjustments more delicate. One thousand years ago, who cared whether economic depression prevailed in countries across the sea; yet in our present highly specialized condition such matters have risen to paramount importance. In the complexity of modern life wide-spread hardship and loss are caused by the temporary shutting down of a great electric system or by the closing of the coal mines; while a general railroad strike quickly brings on a paralysis of activity that can not be endured for more than a brief time without actual disaster. Yet one hundred years ago not one of these problems existed. They would have been difficult even to imagine.

The impetus of development seems always to carry the process of specialization onward without hesitation until a stage is finally reached where it is impossible to go farther. Eventually it would seem that our western civilization should reach a point when its continued dominance would depend upon the effective working of all parts of a machine, grown far more extraordinarily complex even than we know it to-day. It is under just such conditions that slight changes of environment—using that term in its broadest sense—may most readily bring about the stoppage of the entire mechanism. In the hand-operated printing press used by Benjamin Franklin less than two centuries ago there was almost nothing to get out of order. Compare it with the highly complicated modern printing press which might cease to function if a single small screw or gear should fall out of place.

Furthermore, there seems to be a general tendency for development to go too far—to exceed the average capacity of the race at that stage of its evolution. Human history itself is full of illustrations of this principle. Many an ancient king of unusual executive and organizing ability has easily maintained a great empire during his own life-time. After his death, his responsibilities passed on to men of lesser ability, and the empire soon crumbled into as many petty states as before. The Greek Empire of Alexander and the Mongol Empire of Kublai are familiar examples. The greatest empire of ancient times, that of the Romans, was expanded beyond the dimensions which apparently were suited to that stage of human progress. Without the ready communication afforded by the modern telegraph and the efficient transport service of the railroad and the steamship, the highly developed administrative and military system of the Romans was strained beyond the limit of safety. It functioned for a time while conditions were favorable, but it was unable to survive much hostile pressure. No doubt the solution of many of Rome's problems is embodied in the modern British Empire. Thanks to the progress of civilization in the last few hundred years, the British have been able to maintain control over a far wider expanse of territory than any ancient empire.

To-day we see something of the same tendency at work in our huge industrial organizations, generally built up during the lifetime of one man and in large measure as a result of his exceptional ability. That more of these do not fail after the death of their organizers is due probably to our better system of democratic selection of successors trained under the master himself, whereby the ablest men are apt to be chosen. Nevertheless, it often happens that no one of sufficiently large caliber is available, and hence the enterprise suffers to a greater or less degree and in some cases drifts into disaster. There is some reason to think that our industrial, political and commercial undertakings are even now reaching a point where they are growing so vast, so difficult to handle, and requiring so high an order of ability at various points that they are becoming ineffective largely because a sufficient number of men of first-rate ability can not always be supplied. It is entirely conceivable that as this process becomes even more pronounced, the whole structure will in time collapse of its own weight on account of this factor.

Even if our own particular civilization does in time collapse and pass into the stream of history, like the careers of Greece and Rome, there is no apparent reason why other civilizations should not be slowly developed in its stead. It is probably safe to infer that such later civilizations will be founded on somewhat different principles, enabling these successors of ours to avoid some of the most serious difficulties with which we are now struggling. Perhaps they will achieve better success in those moral and social affairs, which are too often overlooked in our modern order. But there is no reason to suppose, however, that they will not make other mistakes just as disastrous, or in general that they will be exempt from the inexorable natural law which has brought about the ultimate decline of every previous civilization, each in its turn.

Eventually, after all the latent possibilities for advancement possessed by the human species have been exhausted, the race may conceivably sink back to the general level of the lower savages, which are but little above the other mammals. In that state it could perhaps maintain itself for a long period of time, even though relegated to the less favorable parts of the world.

Without transcending the path already laid out in previous geologic periods, we may logically imagine also, that in due course of time —probably to be measured in millions of years, an entirely new and more highly organized animal may spring from some ancestral stock now relatively obscure, and rise, at first slowly and then more rapidly, to even greater heights of achievement than anything which lies within the capacity of the human species.

We have briefly examined the sequence of physical events in the earth's history and have found but scant indication of a definite trend toward an objective point. In the history of man and other organisms we seem to see, on the other hand, an evolution from the lower to the higher—from the simpler to the more complex. To that extent there has been quite evidently a general upward curve. It seems probable, however, that the quantity of organic life has remained more or less the same since very early times. There has been the age-long tendency for each species to multiply until its possible habitat was fully stocked with individuals. As periods came and went new types appeared and extended their realms, like wave-circles on the still surface of a pond, but compensating extinctions of older types left room for them. One may picture even the organic world as a stream, unchanging in volume, though ever changing in composition; and its end is to us still as invisible as its beginning.

ELIOT BLACKWELDER
HARVARD UNIVERSITY

THE AGRICULTURAL MUSEUM OF THE ARGENTINE RURAL SOCIETY

MUSEUMS devoted strictly to agriculture are rare. The only one in the Western Hemisphere, founded and organized as such, is located in the metropolis of the Argentine Republic. An illustrated pamphlet of fifty pages describing the museum and briefly outlining its collections has been published [1]. It is in a series of publications issued by the museum, and forms the basis of this communication.

Argentina is preeminently an agricultural country. More than half its cultivated area, 64,225,000 acres, is devoted to the growth of wheat, Indian corn, oats and flax (for seed). Its vineyards occupy 345,800 acres while 24,700,000 acres are in alfalfa. Cattle and other domestic animals number about 92,300,000 and in 1918 Argentina exported 1,479,618,000 pounds of meat.

The collections made to illustrate the agricultural resources of the country at the centennial exposition, held in Buenos Aires in 1910, were so extensive and valuable that a permanent museum was established in which to preserve them. The success which has attended the foundation and organization of the museum is due chiefly to the foresight and untiring energy of Sr. Carlos D. Girola, agricultural engineer, who has been its honorary director from its origin. He has built up, without guide or precedent, an institution of the greatest value in promoting the agricultural interests of his country. The museum now contains more than 30,000 specimens, covering the entire field of agriculture and is one of the most comprehensive of its type in the world.

The collections are classified in seven groups or divisions as follows:

1. *Natural Products*, such as woods, native medicinal and forage plants, minerals, soils, mineral waters, etc.

2. *Agricultural Products*, including everything produced on the farm such as wheat and other cereals, vegetables, narcotic and aromatic plants, fiber plants, etc. In this group the museum contains 6,000 specimens.

3. *Products of Animal Origin*, wool, hides, leather, etc.

4. *Products of Agricultural Industry*, flour, sugar, tannin, dried and canned fruits and vegetables, etc.

5. *Products of Animal Industry*, milk, butter, cheese, bees and bee products, poultry and

[1] Museo Agricola de la Sociedad Rural Argentina ''Fundacion Organizacion Muestrarios,'' Ing. Agr., Carlos D. Girola 1910-Director Honorario-1921. Publicacion Museo Agricola S. R. A. No. 25.

poultry products, silk culture, game, fish, diseases of animals, etc.

6. *Agricultural Machinery*, tools and appliances used in agriculture.

7. *Rural Engineering*, under which are placed all subjects relating to farm buildings, construction of granaries, etc.

In the organization of the museum provision is made for the holding of agricultural congresses or meetings for the purpose of discussing subjects relating to agriculture, and for the issuing of publications and making exchanges. Up to the present time the publications include twenty-five titles, most of which have been prepared by Sr. Girola. Among the subjects treated are: "Studies of Cotton," "Observations on samples of wheat from the Territory of Pampa," "The Cultivation of Wheat in Argentina," "Spineless Cactus," "Cultivation of Flax in Argentina," "Cultivation of Indian Corn in Argentina," "Notes on Argentine Fruit Culture," etc. For the most part these papers are based on the collections of the museum.

The supervision of this museum is under the directors of the Argentine Rural Society. The museum staff consists of the honorary director, curator, assistant curator and two caretakers.

The museum building is located on the grounds of the Rural Society, in a very attractive section of Buenos Aires, overlooking Plaza Italia. It is 300 feet long by 90 feet wide and originally cost $100,000.00. The interior which is well lighted, consists of a main floor surrounded by a broad balcony.

The annual attendance at the museum, which is open to the public two days each week, exceeds 100,000 not including the 30,000 students which visit it from the schools of Buenos Aires. These figures demonstrate the interest which the museum has aroused and the need for such an institution.

The illustrations in the pamphlet before us include the museum building, its floor plan and twenty full page views of the interior, showing many of the exhibits and the manner in which they are installed. The collections have far outgrown their present accommodations, and plans have been prepared for additional building to take care of the agricultural machinery and other new material.

Besides the agricultural museum at Buenos Aires there are the Danish Agricultural Museum at Lyngby, near Copenhagen, established in 1888; the Agricultural Museum at Petrograd, about which little is known at the present time; the large and well-equipped museum at Berlin, and the attractively located and wonderfully interesting museum at Budapest. The buildings of this museum at Budapest, constructed at a cost of $480,000.00, are so designed as to illustrate the Renaissance and medieval periods of architecture of Hungary. Their interiors are superbly finished, and the collections, which may be said to include the agricultural features of museums of art, history and anthropology, natural history and commerce, are appropriately and beautifully installed in the many well-lighted rooms into which the Renaissance and Gothic buildings are divided.

The museum at Buenos Aires should not be compared with those institutions which have been built and liberally supported by the state. Great riches are not indispensable. An agricultural museum properly located for meeting its purposes would, by well directed effort and with the friendly cooperation of those engaged in agricultural industries, quickly secure collections. With such collaboration an equipment may be acquired that will equal or possibly excel in practical importance that which money could buy.

Like Argentina in South America, Hungary in Europe is essentially an agricultural country, and it is interesting to note that in the one case the material and exhibits that formed the basis of its collections were assembled for an exposition commemorating the hundredth anniversary of the country's existence as a nation—in the other instance the collections commemorated its thousandth anniversary, the National Millennial Exposition held at Budapest in 1904. Our hundredth anniversary, commemorated by the exposition held at Philadelphia in 1876, has passed. Argentina has outstripped us in its agricultural development by the establishment of a permanent agricultural museum. Without any reflection upon the progress and present status of agriculture in Hungary, which is most commendable, let us hasten to follow the example of our sister Republic in South America and not wait for our milennial anniversary before establishing a great American Museum of Agriculture.

F. Lamson-Scribner

Washington, D. C.
October 21, 1921

SCIENTIFIC EVENTS

THE WILLIAM BARTON ROGERS SCIENCE HALL OF THE COLLEGE OF WILLIAM AND MARY

An advisory committee of prominent men, most of whom are trustees or alumni of the Massachusetts Institute of Technology, has been formed in the interests of a movement to provide for the erection at the College of William and Mary, in Virginia, of the William Barton Rogers Memorial Science Hall, in honor of the William and Mary graduate who founded the Massachusetts Institute of Technology.

The members of the committee are T. Coleman DuPont, Wilmington, Del., Charles W. Eliot, Cambridge, Mass.; Samuel Morse Felton, Chicago, Ill.; Francis Russell Hart, Boston, Mass.; Charles Hayden, New York, N. Y.; Otto H. Kahn, New York, N. Y.; Hugh MacRae, Wilmington, N. C.; Eliakim Hastings Moore, Chicago, Ill.; James P. Munroe, Boston, Mass.; Henry Smith Pritchett, New York, N. Y.; Charles Augustus Stone, New York, N. Y.; Gerard Swope, New York, N. Y.; Elihu Thomson, Swampscott, Mass.; Charles Doolittle Walcott, Washington, D. C.; Edwin Sibley Webster, Boston, Mass.

The College of William and Mary is the second oldest college in the United States, yielding only to Harvard University in this respect. President Harding, on a visit to the college on October 19 last, in company with Secretaries Hughes, Hoover, Mellon and Weeks, of his cabinet, was greatly impressed with the traditions and present progress of the venerable institution. He referred to the college as 'the Spartan of American universities," having in mind, no doubt, the successful effort of William and Mary to endure after its burning in the Civil War, in 1862, shortly after Dr. Rogers had established in Boston the great technical school.

William Barton Rogers was one of four brothers, who were educated at William and Mary, each in later life achieving great distinction in a chosen field of science. He, himself, as a geologist, was noted in Virginia long before he went to Boston. He was the introducer of the laboratory method of teaching science in this country, according to Dr. Charles W. Eliot, who was one of his original faculty at the Institute of Technology. The three other brothers were Henry D. Rogers, who became regius professor of natural history in the University of Glasgow, Scotland; James Blythe Rogers, professor of chemistry in the University of Pennsylvania; and Robert Empie Rogers, professor of toxicology in the Jefferson Medical College of Philadelphia.

The sum of $200,000 has been set as the amount needed for building the Science Hall, which is designed to commemorate the bond of friendship between the South's oldest college and the North's foremost institution of technology. Contributions may be sent to E. B. Thomas, alumni director, 331 Madison Avenue, New York City.

RETIREMENT OF PROFESSOR ALBERT W. SMITH OF CORNELL UNIVERSITY

The following minute has been adopted by the University Faculty of Cornell University on the occasion of the retirement of Professor Albert W. Smith:

In the retirement from his academic functions of Albert William Smith, dean of Sibley College and acting president of the university, this faculty suffers a heavy loss. Few have been so universally, so deeply, so deservedly loved. An alumnus of Cornell in the first decade of her career, he was from early in his undergraduate days a leader both in study and in manly sports, and one whom his fellows delighted to honor. Returning to Cornell in 1886 for graduate study, he was not again suffered to depart from academic life. From 1887 to 1891 he taught engineering at Cornell, in 1891-1892 at the University of Wisconsin, from 1892 to 1904 was head of the work in mechanical engineering at Stanford. Since 1904, when he was called back to Cornell to succeed Dr. Thurston in the headship of Sibley College, he has remained with his alma mater, adding to his directorship the chair of power engineering; and in 1920, at the retirement of Dr. Schurman, he became acting president of the university.

With what loyalty and efficiency he has discharged these functions is known to us all. As an engineer he has stood high in his profession, and, in conformity with a principle which he has urged on his colleagues, he has never allowed himself to fall out of touch with its practical side. As a teacher and a writer on technical subjects he has had the power to make intelligible and clear the abstrusest of problems, and outside the class room he has not lost touch with his pupils. As an administrator even his colleagues know his promptitude, his patience, his considerateness, his remarkable sympathy with the students.

But behind and above all these activities has been to us ever the loftiness of his character and the exceptional breadth of his culture. He has been not more engineer than poet; and his love of literature, his sensitiveness to art, his fine ethical enthusiasm, his rare modesty and courtesy, have set their mark on all his work, on all his views. In his teaching there has been nothing of the pedagogue, in his administration nothing of the martinet. We shall remember him, as do his students, primarily as man, as friend; and, while we lose him with regret, we rejoice with him in the new freedom to which he brings such rich resources.

THE AMERICAN SCHOOL OF PREHISTORIC STUDIES IN FRANCE

This school enters on its second year of activity in July, 1922, under the joint auspices of the Archeological Institute of America and the American Anthropological Association. It makes its appeal for students on the same footing as the American schools at Athens, Rome, Jerusalem and Santa Fé.

Both men and women are admitted either for the period of one year or for a shorter one. The work is divided into three parts: excavations in a Paleolithic site given the school by Dr. Henri-Martin, of Paris, to last about three months; excursions in fall and spring to the most famous caves, rock-shelters and neolithic sites of France. These include the Dordogne, the Pyrenees and the megaliths of Brittany. The last six months or so of work in Paris include lectures freely offered by the Ecole d'Anthropologie, museum excursions under the lead of the director of the school and library research.

For those who enter for the whole year, two scholarships are offered for competition, one of five thousand and one of two thousand francs; the former will suffice to keep a student through the year in France, if he can pay his way thither and back. There may be established a small loan fund, and there are occasional opportunities of earning money abroad while continuing work, but this method is not advised. At the end of the year a certificate is awarded, and a thesis should be written and presented by the student.

The excavations have this advantage that the students get into the ground themselves and do their own picking, for it is this rather than digging. Their duty is to learn what they are looking for and to understand it when found.

Flint implements, bones of the reindeer, horse, bison and mammoth occur, and many of them bear marks of contemporary work with flint implements; this is rather a "specialty" of the site of La Quina, where the American site is situated.

It is hoped that many will take advantage of this offer, and apply for entry to the school. All such applications as well as those for the scholarships should be sent as soon as possible to

Charles Peabody

Chairman of the Governing Board,
Peabody Museum of Harvard University,
Cambridge, Massachusetts

THE HISTORY OF SCIENCE AT THE ST. LOUIS MEETING OF THE AMERICAN HISTORICAL ASSOCIATION

For the third consecutive year the subject of the history of science received the attention of the members of the American Historical Association at their recent annual meeting at St. Louis. The session especially devoted to the subject took the form of a luncheon conference at which Professor Lynn Thorndike of Western Reserve University presided. Interesting informal addresses were given by Professor James H. Breasted, director of the Haskell Oriental Museum of the University of Chicago, on the state of research concerning the science of ancient Egypt; by Professor Charles H. Haskins, of Harvard University, on the opportunities for research in the history of science in European libraries; and by Professor Archer B. Hulbert, of Colorado College, on American history and the natural sciences. Further discussion followed, and it was proposed that the association establish a committee to facilitate the photographing of material in European manuscripts for the use of investigators in this country. The question was also raised of the relations between the American Association for the Advancement of Science and the Historical Association. The fact that this year the two bodies are to meet, respectively, at Boston and New Haven should provide the opportunity for a joint session or sessions on the history of science and perhaps for future common action or cooperation.

Papers of interest to students of the history of science also were read at other sessions at St. Louis. At the conference in Medieval History Professor Louis J. Paetow, of the University of California, treated of "The Twelfth and Thirteenth Centuries in the History of Culture," and Professor Lynn Thorndike, of "Guido Bonatti, an Astrologer of the Thirteenth Century mentioned by Dante," while at the conference on the History of Civilization Professor Breasted gave an account of the new Edwin Smith Medical Papyrus.

REPORT ON MEMBERSHIP OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE following tabulations present the status of membership in the association at the ends of the fiscal years 1920 and 1921, and on January 14, 1922. The tabulation for 1920 is incomplete on account of incomplete records, the present system of records not having been installed till the spring of 1920.

	At end of fiscal year 1920 (Sept. 30, 1920)	At end of fiscal year 1921 (Sept. 30, 1921)
Active life and sustaining members	353	349
Annual members in good standing	9,649	9,811
Total of members in good standing	10,002	10,160
Members in arrears for one year	993	682
Members in arrears for two years	447	705
Total of members on roll	11,442	11,547

Loss in membership during the fiscal year:	
Dropped at beginning of fiscal year (more than two years in arrears[1])	447
By death	44
By resignation	326
Total loss	817
Total gain in membership (new members):	
Sustaining members	1
Life members	11
Annual members	910
Total gain	922
Net gain in membership	105
Loss from October 1, 1921, to January 14, 1922:	
Dropped October 1, 1921	705
By death	46
By resignation	220
Total loss	971
Gain from October 1, 1921, to January 14, 1922:	
Reinstatements	16
New life members	11
New annual members	870
Total gain	897
Net loss from October 1, 1921, to January 14, 1922	74
Total of members on roll January 14, 1922 (11,547 less 74)	11,473
Total of members in good standing January 14, 1922	8,381
Associates for the second Toronto meeting (not included above)	247

It is to be noted that there were 158 more members in good standing on September 30, 1921, than there were on the preceding September 30, and that the total enrollment was greater on the latter date by 105. The total enrollment suffered a sudden decrease (of 705) on October 1, 1921, by the dropping of the names of all whose period of arrearage became over two years on that date, and this loss has since been increased, by deaths and resignations, to 971. To offset this, 881 new members were enrolled up to January 14, and 16 members were reinstated.

It is gratifying to note that the annual dues have been paid much more promptly this year than ever before. Of the 11,473 individuals whose names were on the roll January 14, 8,381 had paid their dues for the current year and were therefore in good standing.

BURTON E. LIVINGSTON,
Permanent Secretary.

[1]As provided in By-Laws, Article X.

SCIENTIFIC NOTES AND NEWS

The Rockefeller Institute for Medical Research on January 20 celebrated the twentieth anniversary of its foundation with a reception at which brief speeches were made by Mr. John D. Rockefeller, Jr., of the Board of Trustees, and Dr. William H. Welch, of the Board of Scientific Directors.

Dr. Henry C. Cowles, of the University of Chicago, was elected president of the Botanical Society of America at the Toronto meeting.

Dr. Hugh M. Smith, who has been United States commissioner of fisheries since 1913, has tendered his resignation. Mr. Herbert Hoover, secretary of commerce, has written to Dr. Smith: "I believe your service for thirty-six years, rising from the bottom to the top, in one of our great scientific bureaus, is unique in the history of the government. The whole country is under an obligation to you for so long and faithful a service."

British New Year honors include knighthood conferred on Professor C. S. Sherrington, president of the Royal Society and of the British Association and on Professor W. A. Herdman, recently president of the British Association.

Emmanuel De Margerie, Strasbourg, director of the Geological Survey of Alsace, has been elected correspondent of the Geological Society of America.

Mme. Curie, having been proposed for membership in the French Academy of Medicine, the academy, which has hitherto included no woman, has voted that she is eligible, and it is expected that she will be elected at the next meeting.

Dr. N. Antoni, of Stockholm, has been awarded the Lennalm prize for 1921 by the Swedish Association. He is the author of a number of works on clinical neurology.

The Paris Academy of Sciences has awarded to M. Georges Claude the Le Conte prize, amounting to 50,000 francs, for his discoveries in the field of industrial chemistry. M. Claude, in a letter expressing his gratitude, announces that he has decided to divide the amount of the prize between the Société de secours des amis de la science and the research laboratories of the Collège de France.

Dr. Albert Hassall, of the Zoological Division of the Bureau of Animal Industry, has been awarded the Steel Memorial Medal for 1921 by the Council of the Royal College of Veterinary Surgeons. Dr. Hassall has been in the Bureau of Animal Industry for the last thirty-five years, and in the course of that time, in addition to publishing numerous papers on parasitology, has built up a complete index catalogue of medical and veterinary zoology.

Dr. A. G. Ireland, associate professor of hygiene and public health at the University of Kentucky, has been appointed state supervisor of physical education and health by the Connecticut State Board of Education.

Dr. Frank P. Eldred, for twenty years director of the scientific division of Eli Lilly and Company, of Indianapolis, has resigned to engage in consulting work.

Warren R. Sholes, of the School of Mines, University of Utah, has received an appointment as mineral examiner in the Utah field division of the United States Land Office.

Dr. Robert N. Nye, former research assistant to Dr. Frank B. Mallory, has been made assistant director of the division of biologic laboratories of the Massachusetts State Department of Public Health.

Mr. S. Kruse, associate electrical engineer at the Bureau of Standards, who has been engaged in radio development work at the bureau, has been granted a year's leave of absence and has accepted a position with the Hammond Radio Research Corporation, Gloucester, Massachusetts.

Professor Ralph S. Hosmer, of Cornell University, who has been studying forest conditions in Europe, is returning to the University.

Fred P. Baker, for the past year and a half assistant director of the Boston station of the school of chemical engineering practice of the

Massachusetts Institute of Technology, has resigned to accept a position with the Proctor and Gamble Company, Cincinnati, Ohio.

DR. RAYMOND W. WOODWARD has resigned as physicist and chief of the section of mechanical metallurgy of the Bureau of Standards, to become chief metallurgist for the Whitney Manufacturing Company of Hartford, Connecticut.

DURING December, Dr. George Joannovich, professor of pathological anatomy, and Dr. Radenko Stankovich, professor of internal medicine of the medical school of the University of Belgrade, paid a visit to London as guests of the Rockefeller Foundation. They had previously made an extensive tour in Canada and the United States, studying methods of medical education and public health administration.

THE course of three Stewart lectures was given in November before the University of Melbourne on "The Modern Psychology," by Dr. R. J. A. Berry, professor of anatomy in the university.

CAPTAIN ROALD AMUNDSEN visited the Department of Terrestrial Magnetism of the Carnegie Institution of Washington on January 16, in order to complete arrangements with regard to cooperative work in terrestrial magnetism and atmospheric electricity between the Department and his forthcoming expedition to the Arctic regions. During the Northeast Passage, 1918-1921, the Amundsen Expedition made a series of highly valuable magnetic observations at somewhat over 50 different points. Captain Amundsen's chief scientific assistant, Dr. H. U. Sverdrup, has been associated with the Department of Terrestrial Magnetism since last October in order to complete the reduction and publication of the magnetic observations thus far obtained by the expedition. He will rejoin the *Maud,* Captain Amundsen's vessel, early in March at Seattle. It is expected that Captain Amundsen will resume his Arctic expedition about June 1. During his brief stay in Washington, Captain Amundsen also paid a visit to the non-magnetic ship *Carnegie.* In the evening he met at the Cosmos Club a number of the scientific men of Washington with whom he discussed the plans of his Arctic expedition, the chief object of which is to obtain scientific data relating to geography, oceanography, meteorology, gravity, terrestrial magnetism and atmospheric electricity.

THE annual meeting of the British Association will be held in the university buildings at Glasgow on July 21-28 next. The first three days of the meeting will be taken up by the annual representative meeting, and in the evening of July 25 the president, Sir William Macewen, will deliver his address. Presidents of sections are: Medicine, Professor T. K. Munro (Glasgow); Surgery, Professor Alexis Thomson (Edinburgh); Pathology, Professor Robert Muir (Glasgow); Ophthalmology, Mr. A. S. Percival (Newcastle-on-Tyne); Neurology and Psychological Medicine, Dr. George M. Robertson (Edinburgh); Obstetrics and Gynæcology, Professor Ewen J. Maclean (Cardiff); Microbiology (including Bacteriology), Dr. R. M. Buchanan (Glasgow); Diseases of Children, Sir Herbert F. Waterhouse (London); Public Health, Dr. A. K. Chalmers (Glasgow); Physiology, Professor J. A. McWilliam (Aberdeen); Dermatology, Dr. Leslie Roberts (Liverpool).

AT the last ordinary scientific meeting of the Chemical Society, London, held on January 19, Professor Arthur Smithells gave an account of Dr. Langmuir's theory of atomic structure, and exhibited models. Sir Ernest Rutherford's lecture on "Artificial Disintegration of Elements" will be given on February 9.

DR. LUDWIK SILBERSTEIN of the Research Laboratory, Eastman Kodak Company, lectured before the Franklin Institute on Thursday evening, January 26, on "An optical experiment in connection with the rotation of the earth."

DURING the week of January 9, Dr. H. H. Love, of the Department of Plant Breeding of Cornell University, delivered a series of lectures before the faculty of the School of Agriculture of the Pennsylvania State College on the importance of biometrical methods in interpreting experimental results.

Professor Edgar James Swift, head of the department of psychology and education in Washington University, gave an address on "The psychology of testimony and rumor" at the Naval War College, Newport, R. I., on January 26.

The annual meeting of the Society of Heating and Ventilating Engineers was held at the Hotel Pennsylvania from January 24 to 26. Among the papers presented were: "The Control of Blower Motors", by Henry H. Issertel, and "The Underfeed Stoker," by Frank A. De Boos.

The Mathematics Club of the University of Southern California, which the late Professor Paul Arnold helped to found, proposes to establish as a memorial to him the Paul Arnold Library of Mathematics.

A committee has been formed with Mrs. Mary K. Bryan, of the Bureau of Plant Industry, as chairman, to establish a memorial to Miss Eunice R. Oberly, librarian of the bureau from 1808 until her death on November 5. It is planned that the money given by her friends shall be used to establish a prize to be awarded for the work in which Miss Oberly was interested.

Sir German Sims Woodhead, professor of pathology in the University of Cambridge, died on December 29, at the age of sixty-six years.

Dr. Reginald Farrar, of Harrow, England, died on December 29, of typhus fever at Moscow, whither he had gone to assist Dr. Nansen in organizing arrangements for famine relief in Russia, under the auspices of the League of Nations and the League of Red Cross Societies.

Dr. George Stewardson Brady, F. R. S., who died at Sheffield on December 25, in his ninetieth year, was engaged in the practice of medicine and in 1875 became professor of natural history at Armstrong College, Newcastle, retiring as professor emeritus in 1906. He had done much useful work on the material gathered by the *Challenger* Expedition, having published reports on the ostracoda and copepoda. He also wrote a monograph of the free and semi-parasitic copepoda of the British Islands, and collaborated in a monograph of the ostracoda of the North Atlantic and Northwestern Europe.

The annual joint meeting of the American Geographical Society and the Association of American Geographers will be held in New York City on April 28 and 29. The program will be published about April 1. All interested are invited to attend the sessions to be held at the building of the American Geographical Society.

The Royal Institute of Public Health will hold a congress in Plymouth from May 31 to June 5. In addition to conferences on various matters there will be four sections: (1) state medicine and municipal hygiene; (2) naval, military and air; (3) bacteriology and biochemistry; (4) women and public health. The Harben lectures will be given during the meeting by Dr. T. Madsen, director of the State Serum Institute, Copenhagen.

The thirteenth annual meeting of the Paleontological Society was held at Amherst, Mass., from December 28 to 30, as the guest of Amherst College, in affiliation with the Geological Society of America. The special meetings of the society were held in the Geology-Biology building, while the members were comfortably lodged in the fraternity houses on the campus. Seven new members were elected at the meeting, making the membership at the end of 1921 total 214. The officers elected for 1922 were as follows: *President,* W. D. Matthew, New York City; *First Vice-President,* E. S. Riggs, Chicago, Illinois; *Second Vice-President,* E. W. Berry, Baltimore, Maryland; *Third Vice-President,* B. L. Clark, Berkeley, California; *Secretary,* R. S. Bassler, Washington, D. C.; *Treasurer,* Richard S. Lull, New Haven, Connecticut; *Editor,* Walter Granger, New York

The Russian Academic Group held its first annual meeting on January 12. The group consists of scientific men and women from Russia living in the United States. They have organized with the purpose (1) of studying the social, economic and industrial problems involved in the further development of Russia; (2) of effecting a closer contact between scientific and educational institutions of America and Russia, and (3) especially of helping the reconstruction of the academic life of the Russian universities and bringing relief to their members.

A letter has been received from the Attorney-General of the United States by the University of Chicago in appreciation of Professor Henry C. Cowles, of the department of botany, for his ecological investigations along the Red River for use in connection with a suit between the states of Oklahoma and Texas in the Supreme Court of the United States. "Dr. Cowles' investigations and testimony," the letter states, "have been of great value to the government, and, I am informed, to the cause of science in that they bring to the aid of engineering and physiographic investigations the comparatively new science of ecology, whereby the approximate time of the occurrence of changes in rivers, their flood plains and banks, is now definitely determined."

UNIVERSITY AND EDUCATIONAL NOTES

In addition to previous gifts to the building fund totalling $800,000, Mr. Samuel Mather, of Cleveland, has announced to the trustees of Western Reserve University that he will provide funds for the erection of the new building of the School of Medicine. The estimated cost of the school building is $1,910,000, of the animal house $93,500, of the power house $473,000, and of connecting tunnels $53,700, totalling $2,529,700. Plans and specifications are complete and construction will begin in the near future. The medical school building is the first of a group, to be followed by the construction of the Children's Hospital, the Maternity Hospital and the Lakeside Hospital, all of which are affiliated with the School of Medicine. The entire group will be situated on the university campus.

A bequest of $150,000 to Wesleyan University is contained in the will of Mrs. Dexter Smith of Springfield, Mass. The money will be available either towards erection of a new library building or for the general endowment fund at discretion of the trustees.

E. I. du Pont de Nemours and Company have authorized the continuance of the du Pont chemical fellowships of the total value of $15,000 in twenty colleges and universities throughout the United States for the academic year of 1922-3. The fellowships are for post-graduate work.

Morland King, who went to Lafayette College last year from Union College as associate professor of electrical engineering, has been made professor and head of the electrical engineering department.

A. L. Pitman has been appointed assistant director of the Bangor Station of the Massachusetts Institute of Technology's school of chemical engineering practice.

H. R. Thealton, lately with Stone & Webster in Boston, has been appointed assistant professor of engineering at Dalhousie University, Halifax, Canada.

Dr. R. H. Aders Plimmer has been appointed by the senate of London University to the university chair of chemistry, tenable at St. Thomas's Hospital Medical School, beginning with the new year. At present he is head of the biochemical department of the Rowett Research Institute at the University of Aberdeen.

DISCUSSION AND CORRESPONDENCE

ABRAHAM COWLEY AND THE AGRICULTURAL COLLEGE

I have recently come upon a very interesting piece of history relating to agricultural education, while re-reading the essays of Abraham Cowley. The paper on agriculture in volume II of the 1707-1712 edition of his works contains one of the first recorded recommendations that I can find regarding the organization of agricultural colleges. In that essay he has the following to say:

> Did ever a father provide a tutor for his son to instruct him betimes in the nature and improvements of that land which he intended to leave him? . . . I could wish (but can not in

these times much hope to see it) that one college in each University were erected, and appropriated to this study, as well as there are to Medicine, and the Civil Law. There would be no need of making a body of scholars and fellows, with certain endowments as in other colleges. It would suffice, if after the manner of Halls in Oxford, there were only four professors constituted (for it would be too much work for only one Master, or principal as they call him there) to teach these four parts of it. First *Aration,* and all things relating to it. Second, *Pasturage.* Thirdly, *Gardens, Orchards, Vineyards,* and *Woods.* Fourthly, All parts of *Rural Œconomy,* which would contain the government of Bees, Swine, Poultry, Decoys, Ponds, etc., and all that which Varro calls Villaticas Pastiones, together with the sports of the field and the Domestical Conservation and uses of all that is brought in by Industry abroad. The business of these Professors should be . . . to instruct their pupils in the whole method and course of this study, which might be run through perhaps with diligence in a year or two.

The above essay was written about the year 1659 to 1665, and it is very interesting to note that till more than a century after, in 1796, was a Department of Rural Economy organized at Oxford, and Professor John Sibforth elected to be the first head of the department. We do not find references to agricultural colleges again, however, till the beginning of the nineteenth century. It will therefore be observed that Cowley was distinctly in advance of his times. Bacon had suggested schools for experimental research, but did not suggest the idea of an agricultural college. We do unquestionably notice Bacon's influence on Cowley in many respects, and especially in his "Proposition for the Advancement of Experimental Philosophy." In the organization of the Royal Society in 1662, Cowley evidently saw a partial realization of his philosophy as outlined in the "Proposition," and he became one of the original members of the society.

Heretofore we have known Cowley the poet and Cowley the essayist, but he has not before been known as Cowley the scientist, and Cowley the educator. A modern critic has said of him that he had "delicacy of feeling and unfeigned enthusiasm for the nobler and purer joys of life, for great literature, friendship, science, and nature." In this fair estimate by Dr. Gough, we have Cowley the *scientist,* as well as the *poet* and *essayist.*

In reviewing the early agricultural literature, I find references to a "Colledge of Experiments," by Gabriel Plattes in 1639, and "An Essay for Advancement of Husbandry Learning: or Proposition for the erecting Colledge of Husbandry, etc.," by Samuel Hartlib in 1651. In this last the writer had no such clear conception of the proposition as Cowley had. Adolphus Speed in his essay "Adam out of Eden," 1659, suggests "Diverse excellent Experiments Touching the Advancement of Husbandry."

If the readers of SCIENCE have more detailed information on this matter I should like them to offer it to the public through these columns. A study of these books on English husbandry has renewed my interest in Cato, Varro and Columella on Ancient Husbandry, and I, for one, would like to see these valuable treatises on agriculture brought out in such a series as the Loeb Classical Library.

R. J. H. DeLoach
The Armour Corporations,
Chicago

THE LOST FOXHALL JAW; ROBERT HANHAM COLLYER

Since the note concerning Dr. Collyer printed in the issue of SCIENCE for January 20 was written, the records of the Berkshire Medical College have been searched and they indicate that Dr. Collyer was not of American birth, as supposed by Mr. J. Reid Moir and the writer, but of English birth, inasmuch as the registration entry is: "To the President and Professors of the Berkshire Medical College. This Thesis [on the Progression of Animal Life] is respectfully dedicated by R. H. Collyer, A.B.—of the Isle of Jersey, British Channel, Pittsfield, Massachusetts, November 1st, 1839." This registration renders it unlikely that further records of Dr. Collyer himself will be found in the United States. Mr. Moir is now searching the British university records, also the records of the Isle of Jersey. In the forthcoming number of *Natural History* (November-December) appears a full account of Dr. Collyer's discovery.

Henry Fairfield Osborn
January 16, 1922

THE RUSSIAN BUREAU OF APPLIED BOTANY

TO THE EDITOR OF SCIENCE: It might be of interest to the American scientific workers, engaged along agricultural and botanical lines, to know that Professor N. I. Vavilov, director of the Bureau of Applied Botany of Petrograd, Russia, who recently visited this country, has established a permanent New York office, which represents the Bureau of Applied Botany of the Agricultural Scientific Committee, and of which the undersigned is now in charge.

The object of this office is to secure seeds and other material needed for the work of the Russian Bureau of Applied Botany. We hope to widen and permanently maintain the cordial contact recently established with American institutions and individuals in corresponding lines of research work, as well as with the various seed concerns. The office has already been in existence for three months, and during this short period was in a position to forward nearly 5,000 packages of seeds to Russia for the experimental stations; also, several boxes of agricultural and scientific literature received from various American institutions.

Professor N. I. Vavilov expects to return to Petrograd in February, 1922, after a brief visit to England, Sweden and Germany. Since mail is now being accepted for Russia, all letters to Professor Vavilov may be addressed directly to him at the Bureau of Applied Botany, Morskaja, 44, Petrograd, Russia. Books and parcels should be addressed to Mr. D. N. Borodin, 110 West 40th Street (Room 1603), New York City.

D. N. BORODIN,
Agricultural Explorer.

NEW YORK CITY

MEMORIAL TO WILHELM WUNDT

PROFESSOR PFEIFER, the sculptor, tells me that the sum of Mk. 25,000 is still needed for the execution in marble of his monumental bust of Wundt. Family and friends all approve the bust, which was shown last June in the Aula of the University of Leipzig, and hope that it may be transferred from plaster to the more durable material and placed permanently in the Psychological Laboratory. Subscriptions (a thousand marks may now be sent for about six dollars) will be received by Professor Felix Krueger, Psychologisches Institut der Universität (Johanneum), Leipzig, Germany.

E. B. TITCHENER

CORNELL UUIVERSITY,
JANUARY 24, 1922

THE RHODESIAN SKULL[1]

Of greatest interest was the discussion of the recently unearthed Rhodesian skull at a recent meeting of the Anatomical Society of Great Britain. I do not know whether the American papers or scientific journals have published an account of it up to this time or not. You have probably had some information, but I thought you might like to have some first-hand, whether it be additional, or merely a repetition of what you have read.

The skull, along with some other human bones and many bones of animals, and some very crude instruments in flint and quartz, was found by the miners of the Broken Hill Mining Company in a cave which they unearthed some 60 feet below the surface in one of the mines in southern Rhodesia. It finally found its way into the British Museum here, and of course its investigation became the happy privilege of Dr. Smith-Woodward, who gave the description and showed the skull and other fragments of bone found with it, to the Anatomical Society.

The skull is in some features the most primitive one that has ever been found; at the same time it has many points of resemblance to (or even identity with) that of modern man.

Fortunately, the face is perfectly preserved. The supra-orbital region is astonishingly gorilla-like, in its enormous size and its unusually great extension laterally; the cranium is almost flat on top, extending backward from the huge supra-orbital ridges, rising only a little above the level of their upper borders. It is very broad in the back, however, so that its total capacity is surprisingly large. At

[1] Extract from a letter written from England to an American scientific man.

least one prominent authority thinks that this man had quite as much gray matter as the average modern man.

Another striking thing to be seen at the back of the skull is the evidence (in the size of the ridges and the contrasting deep impressions), of the tremendous and powerful mass of neck muscles the creature must have had. This is one of the points upon which is based the opinion that the skull is the most primitive yet found.

But to get back to the face! Dr. Smith-Woodward pointed out the fact that the suture of the nasal with the frontal bone is in a straight line rather than at a definite angle as in the apes; he also called attention to the small tubercle of bone in the mid-line of the nasal fossa which he says is distinctly a human trait. The zygomatic process is small. All of the bone of the face below the orbit is relatively undeveloped, but the *length* from the floor of the orbit to the alveolar border of the maxilla is phenomenal, as is also the length from the floor of the nasal cavity to the alveolar border of the maxilla. The palate is beautifully arched, and the teeth form a perfect horseshoe at its border. The wisdom tooth is reduced in size—another point in common with modern man and never found before in a fossil skull.

Unfortunately, the mandible was not found; the closest approach that could be found in the British Museum to the type this man had, was the Heidelberg jaw, but it is a bit too short and too narrow, though the ramus is too broad.

Another thing that has shocked the anthropologists is the unmistakable evidence of dental caries, and even of abscesses at the roots of the teeth. Now I guess we will have to lift the blame for caries off the shoulders of modern civilization. Won't we?

In contrast to the Neanderthal man who is supposed to have walked in a crouching position (because of the rather curved femur and other bits of evidence), this man is believed to have maintained the upright position, because the femur is relatively straight and when fitted to the tibia (which was also found) presents a perfectly good, straight leg.

But it would be altogether foolish for me to attempt any speculation on what I've seen! Of course, the scientific world here is much excited and many of its members are in danger of letting their imagination run away with them, but Dr. Eliot Smith at least is quoted as leaning to the belief that further study will reveal the fact that "the missing link" in the ancestry of man is represented in this individual—referring, of course to European man. The Neanderthal man would then represent a branch off of the main ancestral tree.

SPECIAL ARTICLES

A PRELIMINARY ATTEMPT TO TRANSMUTE LITHIUM

If an electron could be introduced into the nucleus of a lithium atom, a nucleus would be obtained which would possess the same resultant charge as a helium nucleus; if two electrons were introduced the nucleus that resulted would have the same charge as a hydrogen nucleus. Both of these products are gases the spectroscopic tests for which are of exceeding delicacy. It consequently does not appear entirely futile to subject lithium to bombardment by a stream of electrons traveling with a high velocity in the hope of causing some of them to penetrate the lithium nucleus. Experiments to this end were undertaken by the writer three years ago in the laboratory of Inorganic Chemistry of the Department of Chemistry, Cornell University. At that time it was hoped to be able to pursue the subject further with more powerful apparatus; that possibility now seems far distant so that it may not be amiss to record briefly the results of the preliminary experiments then made.

The experiment consisted essentially of bombarding either metallic lithium or some salt of lithium with as powerful as possible a stream of electrons, absorbing all of the gases present after the bombardment except hydrogen and helium, compressing this unabsorbed residue into a capillary Plücker tube and examining it spectroscopically. Such a procedure introduced many serious experimental difficulties. In the first place if metallic lithium was used, it is so readily volatile that it could not be subjected to more than momentary bombardments. If, on the other hand, a salt of lithium was employed, it evolved gas rather copiously so that these experiments likewise had to be intermittent. At the time these experiments were made the writer did not have at his disposal either an alkaline earth oxide electrode nor a tungsten spiral to serve as source of electrons. As a consequence the pressure of gas in the bombardment tube had to be maintained within rather narrow limits. The procedure finally adopted as most satisfactory under the existing conditions consisted in introducing the requisite amount of oxygen gas into the thoroughly evacuated tube containing the lithium, which was present as oxide, and subsequently absorbing the oxygen in heated copper. Small quantities of other gases found to be present were absorbed by suitable reagents. The voltage then available, which was obtained from a very large spark coil, probably did not exceed 150,000 volts. With a bombardment chamber so designed that metallic lithium could be cooled by liquid air, or other refrigerant, while being subjected to a less concentrated beam of electrons from a tungsten filament electrode, it is probable that the bombardment could proceed indefinitely.

As a result of these bombardments a small unabsorbed residue showing strongly the spectrum of hydrogen always remained. Because of the excessive difficulty of removing last traces of water vapor from the surface of glass, there is no good reason for supposing that the hydrogen came from another source than water liberated and decomposed as a result of the bombardment. On the other hand it must be remarked that in view of the well known masking effect which hydrogen possesses over the development of the spectrum of helium, small quantities of helium that might have been present would not have been detected. Means were not at hand for entirely separating this hydrogen from any helium and searching for the latter by itself.

The purpose of this discussion is to suggest that with improved and more powerful apparatus there would be considerable hope of pursuing them to some sort of a definite conclusion.

For much advice in its design and for blowing many of the more difficult parts of the glassware of this apparatus, the writer was under great obligation to Dr. Harold S. Booth.

Ralph W. G. Wyckoff
California Institute
of Technology
Pasadena, Cal.

THE EFFECT OF SODIUM HYDRATE UPON THE DIGESTIBILITY OF GRAIN HULLS

Numerous experiments have been made during the last few years, particularly by German investigators, in attempts by various treatments to render more digestible the straws of the different cereals, legumes and cruciferæ. Among the methods employed for this purpose may be mentioned (*a*) the heating of finely ground straws under atmospheric pressure, (*b*) the treating of the fine straw with 3½ and 7 per cent. of sodium hydrate under 5 atmospheres, (*c*) cooking the straw in open kettles or cement ovens with 8 per cent. sodium hydrate for 12 hours, and (*d*) the treating of ground straw with cold sodium hydrate of various strengths for different lengths of time. The action of sodium hydrate as well as of calcium hydrate has proved effective, and the

DIGESTION COEFFICIENTS
Average Two Sheep

	Dry Matter	Ash	Crude Protein	Fiber	Extract Matter	Fat
Oat hulls untreated	36	00.00	0.00	53	34	0.00
Oat hulls treated	81	65	0.00	91	79	0.00
Rice hulls untreated*	5	10	0.00	12	5	0.00
Rice hulls treated	29	?	0.00	28	38	0.00

*One sheep only.

digestibility of some of the materials treated has been increased fifty or more per cent.

At the Massachusetts Experiment Station studies of the effect of quite dilute sodium hydrate upon the digestibility of oat and rice hulls have been completed and gives a preliminary statement of the results.

It is evident that the action of the soda did improve the digestibility of the oat hulls to a marked degree and of the rice hulls to a limited extent. A thorough study is being made of the chemical composition of oat, barley, rice and cottonseed hulls, and of flax shives, and of the action of different strengths of sodium hydrate and of other chemicals in improving their digestibility.

J. B. LINDSEY

MASSACHUSETTS AGRICULTURAL
EXPERIMENT STATION,

THE AMERICAN CHEMICAL SOCIETY

(*Continued*)

DIVISION OF FERTILIZER CHEMISTRY

F. B. Carpenter, *chairman*
H. C. Moore, *secretary*

The briquetting of mineral phosphates a promising method of conservation: WILLIAM H. WAGGAMAN and H. W. EASTERWOOD. In connection with research work on the volatilization of phosphoric acid in a fuel fed furnace, preliminary work has shown that briquetting is a factor of prime importance. Samples from old phosphate deposits were found to be sufficiently high grade and contained enough natural binder (clay) to lend themselves to briquetting purposes. Also much phosphate rock from waste heaps could be used. It is only necessary to reduce the material for briquetting purposes to a point where it will pass a ten-mesh sieve and incorporate the necessary water into the mixture to give it the required plasticity. Where the composition of the material is such that sand must be added it was found that the necessary water could be added to the sand and coke and then this moistened mixture incorporated with the phosphate material. Coal presents a very promising possibility as a reducing agent in such briquettes since the volatile matter contained therein does not cause the briquettes to split open or disintegrate when heated.

Cyanamid in some fertilizer mixtures: W. S. LANDIS. A study of the behavior of Cyanamid in some fertilizer mixtures and in several standard brands of mixed fertilizer. The rapid conversion of cyanamid into urea and other salts was noted, but no dicyandiamid was found in any of the mixtures studied. Reactions with ammoniated base of both cyanamid and dicyandiamid were studied and unidentified complexes found to occur in such mixtures. Cyanamid when added in the proportions recommended for formulating this material did not change to dicyandiamid, and dicyandiamid intentionally added as such disappeared on mixing in such goods.

Comments on the formation of dicyandiamid in fertilizers: J. E. BRECKENRIDGE.

The value of the alkaline permanganate method: CHAS. S. CATHCART.

Remarks on the permanganate methods for the determining of availability of organic nitrogen: J. E. BRECKENRIDGE.

Ten years experience with the neutral permanganate method in South Carolina: R. N. BRACKETT.

The composition of cotton seed: THOS. C. LAW.

Cultivation and nitrogen fertilization: H. A. NOYES, J. H. MARTSOLF and H. T. KING. A study of the comparative effects of different degrees of cultivation shows that with proper cultivation the average soil contains enough organic matter to stimulate bacterial activities and allow nitrates to accumulate during the growing season. Virgin soil rich in available organic matter gives nitrates in great excess of those needed by the growing plants. In early spring soils are depleted of nitrates and an early application of available nitrogen fertilizer is desirable and beneficial to stimulate plant growth until such a time as the soil has warmed up and responded to cultivation in increased bacterial activities. In no case studied have the authors been able to find the need for a second application of nitrogen fertilizer later in the season unless the soil did not receive proper cultivation. Nitrate production and accumulation resulting from and associated with thorough cultivation have a money value more than equal to the cost of the second application of nitrogen fertilizer.

The effect of fertilizers of various compositions on the reaction of soils: J. J. SKINNER. The hydrogen ion concentration and lime requirements of soil fertilized with mixtures of various compositions are reported. In a fertilizer experiment with grass on the Hagerstown loam soil, acid phosphate, sodium nitrate, and potassium chloride was used singly, in combinations of two and in combinations of three. The fertilizer constituents in the mixtures varied in ten per cent. stages, and is based on the triangle system. The soil has been fertilized annually for eleven years, using fifty pounds per acre of the constituents, P_2O_5, NH_3 and K_2O. The plots receiving mixtures of acid phosphate and potassium chloride have become acid, having a lower p_H value and a higher lime requirement than mixtures of acid phosphate, potassium chloride and sodium nitrate. The higher the p_H value and the smaller the lime requirement of the soils. Where the high nitrogen fertilizers were used, the subsoil has a lower p_H value than where high phosphorus acid mixtures were and the subsoil is more acid than the surface soil.

The present tendency of fertilizer experimentation: Oswald Schreiner.

Greensand as a source of fertilizer potash: R. Norris Shreve. A process is described whereby the enormous resources of potash now latent in the greensand beds of New Jersey are made available for fertilizer use. The process involves treating greensand with milk of lime at about 470° Fahr. for one hour. Caustic potash is the initial product but it is easily changed into other potash compounds. Potassium nitrate is shown to be the best form in which to produce the greensand potash for the fertilizer industry. Attention is called to the combination of two fertilizer essentials, namely, nitrogen and potash, in the one chemical with the consequent saving in transportation charges.

The development of accuracy in fertilizer analysis and some pitfalls in methods: P. McG. Shuey. Greater accuracy may be attained in the determination of oxide of iron and alumina by precipitation of aluminum phosphate either alone or in conjunction with ferric phosphate by having acetic acid present in the precipitating medium. A higher degree of accuracy is also reached by determining the metals separately. It is shown that by obtaining the weight of the combined phosphates and simply dividing by 2, results may be appreciably high. There has been a great development in the accuracy of nitrogen determinations in organic materials such as cottonseed meal, peanut meal, etc., within the last few years, as shown by the results obtained by the American Oil Chemists' Society. However, more accurate determinations are needed for nitrogen where nitrates are present.

The determination of free acid in ammonium sulfate: C. G. Atwater.

On the preparation of hydrochlorplatinic acid by means of hydrogen peroxide: Paul Rudnick. A solution of hydrochlorplatinic acid of the concentration required for the official Lindo-Gladding method of the A. O. A. C. for determining potash is readily prepared by converting the waste platinum from all sources into platinum black by any convenient means, dissolving the wet, well washed black by means of 30 per cent. hydrogen peroxide (free from organic preservatives) and hydrochloric acid gas, converting into potassium chlorplatinate and using only the pure potassium chlorplatinate so obtained as the starting point for the final solution. The chlorplatinate is dried and weighed, reduced with the purest obtainable sodium formate in alkaline solution, the resulting black washed by decantation only and without drying or igniting is suspended in 30 per cent. hydrogen peroxide and brought into solution by introduction of hydrochloric acid gas. Pyrex glass serves quite well for concentration of peroxide and for solution of the platinum black.

Various details in the determination of ammonia in cotton seed meal as summarized from eighty-six replies to a questionnaire sent to members of American Oil Chemists' Society: H. C. Moore.

Wool scouring wastes for fertilizer purposes: F. P. Veitch. More than 60,000 tons of fertilizer material combining the equivalent of 96,000 tons of kainit and 3,600 tons of tankage are now annually wasted in scouring wool. The U. S. Department of Agriculture has been making a careful study of the recovery and utilization of wool scouring wastes. A large number of samples of all grades of unscoured wool, of which this country uses more than 600,000,000 pounds annually, have been examined and it has been found that potash (K_2O) varies from 2 per cent. to 6 per cent. and averages approximately 4 per cent. for all grades; nitrogen varies from 3 per cent. to 0.9 per cent. and averages one half per cent., while grease varies from 3 per cent. to 30 per cent. and averages 15 per cent. for all grades. Both the potash and nitrogen are water soluble and therefore readily available to growing plants. Commercial base goods from concentrated wool scouring wastes and other wastes are rich in nitrogen. The "base goods" contained 6 per cent. of water soluble potash (K_2O) and 6 per cent. of nitrogen, was in excellent mechanical condition both for manufacturing and for application to the soil. The concentrated wool waste offers no difficulty in mixing with other fertilizer materials giving to the finished fertilizer a good dark color and a strong odor, both of which are desirable properties for a fertilizer. The author is confident that this heretofore unused large store of fertilizer material can be made available to the fertilizer manufacturers and to the farmer and the damage and expense occasioned by the present practice of draining these wastes into the waters of the country can be greatly diminished.

The recovery of potash as a by-product in the blast furnace industry: Wm. H. Ross and Albert R. Merz. The weighted average of the potash in the ores, coke and limestone used in the blast furnace industry amounts to approximately 0.2 per cent. for each material, which is less than one third as great as that found for the raw mix used in the cement industry. In the case of the ores, the potash ranges from 0.05 per cent. for Mesaba ores to over 2 per cent. for certain foreign ores. As the consumption of high potash ores is relatively small as compared with low potash ores, the weighted average of the potash in the ores consumed is less than the mean average found for different ore samples. On the basis of the weighted average the total potash in the ore, coke and limestone used in blast furnaces amounts, respectively, to 7.6, 1.8 and 4.5 lbs. per ton of pig iron, or to a total of 13.9 lbs. The potash in the slag amounts to 8.5 lbs., which leaves a balance for the potash volatilized of 5.4 lbs. per ton of pig iron. This amounts to a total for all plants of about 100,000 tons of potash as compared with 87,000 tons for the cement industry.

A historical review of the research showing the fertilizer value of sulphur: L. S. Bushnell. The writer proves the error of the last two of the following statements of Conn in "Agricultural Bacteriology": "In general, much less is known about the transformations of sulphur than of those of nitrogen. The reason for this is that sulphur is almost never deficient in soils, and the subject has never been considered of sufficient practical importance to justify extensive investigation." Results of research work conducted by various state experiment stations are cited where increase in yields from 50 to 1,000 per cent. were obtained when sulphur was used with alfalfa and other leguminous plants. It is shown that there is a decided loss of sulphur in soils cultivated for a number of years when compared with the corresponding virgin soils, and that the value of ammonium sulphate and acid phosphate as fertilizers is sometimes due to the sulphur and not to nitrogen or phosphorus. Attention is called to the faulty interpretation by others of Wolff's analyses of the ash of plants. Since large quantities of sulphur are lost by volatilization, the sulphur found in the ash is sometimes as little as one half per cent of the amount the plant contains.

Studies of the availability of organic nitrogenous compounds: C. S. Robinson. Various types of organic nitrogenous compounds containing definite atomic groupings were treated with alkaline permanganate solution according to the official method. The same thing was done with proteins and some organic base goods which were also analyzed by Van Slyke's method. Information was thus obtained as to specific groups ammonified by the permanganate method.

The preparation and composition of neutral ammoniun citrate solutions: C. S. Robinson. The work was divided into three parts as follows: (1) The preparation of solutions having definite compositions or reactions; (2) The relation between composition and reaction; (3) The relation between the reaction of the solution and its solvent action on calcium phosphate. It is shown that it is difficult to prepare a strictly neutral solution of ammoniun citrate with the usual indicators as ordinarily used. Physical chemical methods give accurate results but are not suitable for routine use. Analytical methods can be used to prepare any solution whose composition is fixed. The so-called colorimetric method using phenol red as the indicator is convenient and accurate. With citrate solutions ranging in reaction from pH 6.6 to 7.8 the magnitude of the variations in analytical results is usually small.

The potash situation: H. A. Huston. The potash situation was discussed from the standpoint of the relative quantities of soluble potash salts estimated by geologists to exist in the United States, France and Germany and development of these resources in the different countries. The geologists estimate that for each ton of soluble potash salts in the United States there are 10 tons in France and 6,000 tons in Germany. The estimated productive capacity of the existing potash properties in terms of actual potash is 80,000 tons for the United States, 250,000 tons for France and 3,850,000 tons for Germany. France has 13 completed shafts and 3 mills; Germany has 204 completed shafts and 17 mills. The ore suitable for producing sulfate of potash is not found in France.

Charles L. Parsons,
Secretary

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THE PAST AND THE FUTURE OF THE MEDICAL SCIENCES IN THE UNITED STATES[1]

AT the 1919 meeting of the American Association for the Advancement of Science, held in St. Louis, the association adopted a new constitution which included among other modifications a change in the name of this section from "Physiology and Experimental Medicine" to "Medical Sciences." In the same year, the National Research Council of the United States in effecting its "permanent organization" on a peace time basis changed the name of its "Medical Division" to "Division of the Medical Sciences." Thus in a single year the term "Medicine" disappears as the substantive from the titles of what may fairly be regarded as the two most important organizations on the continent whose main function it is to further the interests of science in general and to stimulate research, to yield up its primary position to one secondary in importance to the term science. There can be no doubt but that these changed designations are indicative of a changed attitude in the United States toward medicine as a science, and it therefore seemed fitting that the first chairman of the section thus newly designated upon retiring from office should essay an analysis of the factors that seem to him to be responsible for the change, in an effort to ascertain the significance of the implied trend. An additional reason for selecting this general topic for discussion is the rather unusual and intimate insight into the conditions at present prevailing in the departments of the medical sciences in the United States which the speaker was enabled to gain through his connection with a study of the supply of assistants in pre-

[1] Address of the vice-president and chairman of Section N—Medical Sciences, American Association for the Advancement of Science, Toronto, December, 1921.

clinical departments, carried out under the auspices of the National Research Council.

The statements from the laboratories of the country collected for the purposes of that investigation have been analyzed elsewhere with a view to securing from them the information relating to the question then in hand. But they contain in addition a wealth of material bearing on the broader topics of the present status and future prospects of the medical sciences in this country which this paper proposes to discuss. From this material the speaker has drawn freely in developing certain of the phases of his subject; owing to the circumstances of its collection, though, it has not been possible always to indicate to whom credit is due. And finally, it should be added that the views to which expression is given in this address may apply best, possibly only, to the branch of science in which the speaker himself works, namely physiology, and with which he consequently has a certain degree of familiarity. He is inclined to believe, though, that they will apply to the other medical sciences also; to some rather closely, to others perhaps somewhat more remotely.

In order to gain a vantage point from which to survey the field of medical science as it has been cultivated in the United States and from which to ascertain the direction in which it is moving, it becomes necessary first to trace in a cursory way the development of the subject from its beginning down to the establishment of its modern trend. Contributions to science have been made ever since man acquired the ability to hand on his experiences with nature; but in the case of medical science, at least, such advances as were made down to the fourteenth century were upon the whole unimportant, and for the most part casual. It should be borne in mind, though, that whatever of value was then gained formed the basis upon which subsequent advances were built. Every now and then these occurred in rapid sequence through the efforts often of single individuals or of groups of individuals stimulated by an innate desire to ascertain the relation between cause and effect, and endowed with the genius to see those relations.

With the revival of learning in Italy systematic studies by the scientific method here and there began to be made of the more obvious of the natural phenomena. The structure of the human body mainly, but occasionally its functions also, both normal and abnormal, collectively then known under the name of anatomy, and the structure of the universe were amongst the first of the problems to be attacked with any degree of success. At this time, and indeed in one and the same year, there appeared the *"De revolutionibus orbus cælestrum"* of Copernicus and the *"De corporis humani fabrica libri septem"* of Vesalius, the epoch making works in their respective fields; medical science and physical science employing in effect the same methods are here seen advancing together as they have ever since, because of their related habits of thought and their mutual helpfulness. Progress in the experimental phases of medical science, however, was slow. The faint glimmer of light in this direction that became discernible during the Renaissance, in the succeeding four centuries every now and then broke forth momentarily into a brighter flash when some keener intellect such as Harvey, Malpighi, Mayow, Boyle, Haller, Hales, Spallanzani, Hewson, Lavoisier, Wolff, Hunter, Young, Morgagni and others, gentlemen of leisure, clergymen, lawyers, physicians, rarely scientists by vocation, compelled by an inborn spirit of inquiry and working for the most part in private laboratories, made brilliant contributions to the slowly and sporadically growing accumulation of medical science.

Partly in consequence of the rapidly widening confines of knowledge, but especially as a result of the recognition of underlying differences in technical methods, a tendency to separate the functional from the structural phases began to develop, the former leading to physiology, the latter retaining the designation, anatomy. At about the same time, a distinction began to be more clearly drawn between the normal and the abnormal, both in structure and in function, and a tendency to appreciate more fully the value of organic chemistry in the study of biological phenomena became obvious; although biological chemistry came to be recognized as a distinct science at a somewhat later period. It would seem, however, that there is no simple formula that is sufficiently general to account fully for the sequence in which the independence of the several medical sciences became established.

Toward the close of the first quarter of the last century, this sporadic and localized growth of medical science became more consistent and eventually general, though still somewhat uneven, throughout the whole of western civilization. The initiative in this new growth is attributed mainly to the influence of two men, viz., Johannes Müller, professor of anatomy and physiology at Bonn and Berlin from 1830 to 1858, and François Magendie, professor at the Collège de France from 1836 to 1855; and it was fostered by a recognition of the fact that medicine is nothing more nor less than a part of science. I do not believe, however, that I am mistaken when I maintain that in previous epochs of the history of science there have been individuals, even groups of individuals, who have employed the experimental method, and quite as successfully, to advance medicine, and who have regarded medicine in exactly the same light. It would seem, therefore, that some new and fructifying influence must at this time have been brought to bear upon such efforts as were being made toward progress. Why, we might ask in this connection, did the new growth develop more vigorously in Germany than in France? Certainly not because the Germany of that time occupied an advanced position in science or in medicine; for, as a matter of fact, medically, Germany then stood at the foot of the world. Nor was it due to any superiority of Müller over Magendie as an exponent of the experimental method in medicine; for it is now generally conceded, excepting, perhaps, in Germany, that the latter made "the experimental method the corner stone of normal and pathological physiology and pharmacology" (Welch) and that "his method of work and his points of view are the ones that were subsequently adopted in physiology" (Howell). Furthermore, the progress of science up to this period proves that it was not any superior qualities of the Teutonic mind that determined Germany's part in the new growth of science. Rather it would seem that the development was more rapid, more continuous and more even there than elsewhere, unquestionably because it was an *organized* development. The state early recognized the advantages to be gained by leading the world in science, and, by establishing and supporting, generously for those times, laboratories of the medical sciences in the universities, which it owned and controlled, by offering to their medical schools the free use of their state owned hospitals for teaching and investigation, and by exercising a liberal and *laissez faire* policy in their dealings with men of science, the conditions were supplied which not alone were conducive to scientific investigation but also attracted into university careers those best able to contribute by investigation to the advance of medicine.

The world's history affords numerous examples of a comparable influence of far-seeing monarchical aid upon the advance of science. The first gleam of organized science in the world (Wells) shone from the Lyceum at Athens where a liberal endowment by Alexander the Great put Aristotle in a position to make a comprehensive collection of material to serve as a basis of his natural history. Again, the professors and fellows of the Museum at Alexandria were appointed and paid by the Ptolemys (Wells) and when their patronage ceased its scientific energies became extinct. And into Russia anatomy, then practically the comprehensive medical science, was forced by the arbitrary will of Peter the Great when he founded a medico-surgical school at Petrograd and left plans for the establishment of the Academy of Science where anatomy has since been cultivated, under very satisfactory conditions, by some of the greatest of its students (Bardeen).

Surrounded by the very best of working conditions, with an almost virgin field to work in, Germany needed only the time necessary to imbue its student body with the spirit and the possibilities in order to gain the ascendency in medical science. Workshops for different sets of problems, physiological, biochemical, pathological, pharmacological, hygienic, with professional workers in charge, gradually replaced the private laboratories that were usually conducted merely to satisfy an avocation. The pupils of Müller and their contemporaries, in charge of these laboratories, soon attracted to them the attention of the world, and medical students flocked to work in them as they once had to Italy during the revival there.

Though the spread of modern scientific medicine for the most part can thus be traced either directly or indirectly from Germany, sight should not be lost of the fact that in all of the more enlightened countries of the world the spark of independent genius has ever continued to add by its own methods to the realm of knowledge. There never has been a more brilliant worker in physiology than Claude Bernard, the pupil and successor of Magendie; and 'the story of the rapid sequence of Pasteur's brilliant discoveries in science ever of crucial importance and establishing a new principle, has . . . . . no parallel in biology, or, for that matter, any other science" (Pearce). Furthermore, though the start was made in Germany, in some localities the transplanted method has led to a growth that has been quite as splendid as in the land of its original cultivation. This is true, for example, of the development of physiology in England (Hopkins).

In the United States, with which the rest of this paper deals, a beginning was made in medical science before the dawn of the classical period of the modern development in Germany, and the start was quite auspicious. Just before the American Revolution medical schools began to be founded in connection with universities; with the College of Philadelphia in 1765; with King's College in 1768; and somewhat later with Harvard, 1783; Dartmouth, 1798, Yale, 1810, and Transylvania, 1817. The model of these schools was the medical department of the University of Edinburgh, which in turn represented a development of the idea of the great Italian universities, handed down through the Dutch university of Leyden (Welch).

These schools were founded by men who had received their training mainly in the proprietary schools of London and in the University of Edinburgh. Of the medical sciences descriptive anatomy alone was cultivated. Apparently the contact which many of the teachers in these schools had had with that master of experimentation, John Hunter, and with Charles Bell failed to transmit the spark; for they contributed nothing to the development of experimental medicine. The reason for this seems to have been that whatever of the scientific spirit these pioneer university schools may have had was soon crushed out through competition with the great crop of private schools of anatomy and of proprietary schools of medicine that grew up about them. In the absence of any guiding spirit practically all schools became commercial enterprises, conducted rather for the professional reputation and pecuniary benefit of their faculties than with a view to training good physicians or to advancing the science of medicine. There were, to be sure, exceptions to this rule. Some proprietary schools were founded by high minded men and were maintained for the purpose of supplying well trained physicians to a rapidly expanding country which was neither rich enough nor settled enough to support university schools properly so called. An outstanding example was the so-called Medical Fund Society, the holding corporation of the St. Louis Medical College, now the Washington University School of Medicine, through whose devotion and self sacrifice the St. Louis Medical College eventually came to be supplied with a permanent endowment, and was enabled to become one of the first medical schools west of the Atlantic seaboard to establish a scientific laboratory (under W. T. Porter in 1886). But even the more ethical of these schools, dependent, as they were, almost entirely upon fees from students, failed to supply the elements that are necessary to lead any but a self sacrificing genius to interest himself in and devote himself to medical science.

In consequence of these conditions, following the American Revolution and for a period of almost 100 years medical science in the United States rather receded than advanced. Excepting certain individual and for the most part casual contributions, such, for example, as those by Beaumont, made in the back woods and despite every kind of obstacle, and those by S. Weir Mitchell, both entirely American trained, nothing was accomplished toward the development of the science. It should be added, though, that both Beaumont and Mitchell were influenced to some extent by the progress in Europe. Interesting proof of this is found in the marginal annotations in Beaumont's private copy of Magendie's "Summary of Physiology," now a part of the Beaumont collection in the library of the Washington University School of Medicine.

It is clear, then, that the more enlightened of the American profession were not unfamiliar with European progress in medical science. Many of them indeed had been abroad, attracted mainly to the France of the early nineteenth century by her prowess in clinical medicine. But, with the exception of Spain and possibly one or two of the smaller European states, the United States has been the slowest of the enlightened nations of the world to participate in the scientific productivity of the modern era. For this tardiness a number of factors seem to have been responsible. One of them, the main one, viz., the low estate of medical education of the time, has been mentioned. It is possible that preoccupation with the affairs of a rapidly expanding country, which gave little opportunity for leisure, and the distractions centering around the attempts to settle the institution of slavery, culminating in the Civil War just about at the time the peak of the progress in Europe was being reached, also were factors. The influence of the Civil War in retarding progress is indicated by the history of the first laboratory for experimental medical research to be established on this side of the water. Henry P. Bowditch had just been graduated from Harvard College when the Civil War broke out. Upon resigning from the army at the close of the war he took up the study of medicine, graduating in 1868, and then went abroad, where he worked in the laboratory of Claude Bernard, but especially in that of Carl Ludwig. Immediately upon his return to this country in 1871 he created the physiological laboratory at Harvard. In the same year, it might be added, Harvard instituted laboratory instruction, though not research, in histology and pathology.

Five years elapsed before any further progress in this direction was made. Then, in 1876, through the wise use of an opportunity to make a wholly new start, there was established the first institution in the country, the Johns Hopkins University, to raise productive scholarship in all of its departments to the plane it occupied in European universities. Newell Martin, Michael Foster's assistant at Cambridge, primarily a physiologist, was called from England to fill the chair in biology. From this laboratory and from the laboratory established at Harvard a considerable number of physiologists and experimental biologists have since gone forth, and through the incentive of these two institutions physiological laboratories were established in quick succession in the more progressive of the medical schools of the country.

Without running through the gamut of the laboratories of the medical sciences that were then established, it may be stated merely that in the period extending from the introduction of the scientific spirit into the study of medicine at Harvard in 1871 down to the beginning of the present century the more advanced of the medical schools and especially those connected with universities voluntarily filled their chairs with men who were drawn into the work by the spirit of research and who looked forward hopefully to the future of their profession in their country. To this natural development of the medical sciences there has more recently been added a forced and rapid growth, the result of propaganda for the elevation of standards conducted by the Council of Medical Education of the American Medical Association, by the Association of American Medical Colleges, and by the General Education Board through their reports on the status of medical education made by Flexner, and through the elevation by State Boards of Medical Examiners of the requirements for admission to practice. Along with this development of science departments, there has occurred a great increase of interest in what has come to be called the science of clinical medicine, which Meltzer, its first exponent in the United States, has defined as the "science of the natural history of diseases, their physiology and the pharmacology." Contributions to this phase of medicine until quite recently had been made almost solely by clinicians in such time as they could snatch from teaching and practice. Through the organization of clinical departments, in some schools, upon the same basis as the preclinical departments there is now an opportunity open to men so inclined to devote themselves wholly to the advancement of the science of clinical medicine. Other recent developments have consisted in the establishment of research laboratories in connection with a few of the better hospitals and in the foundation of medical research institutions both in connection with and independent of universities.

This tremendous growth in the number of full time laboratories of medical science has necessitated a corresponding increase in the number of men devoting themselves to the subject. I am sure that something of interest would come of a careful study of the rate with which this increase has occurred; but the information necessary to accomplish it satisfactorily is not at hand, and even if it were, far more time would be required to make it than I have had at my disposal. But I do happen to have some data bearing on the rate of increase in the membership of the American Physiological Society. Starting in 1887 with a charter membership of 28, the membership in 1896 amounted to only 68, but by 1921 had increased to 292. If to this be added the membership of the societies that have grown out of the Physiological Society, namely the societies for biochemistry, formed in 1906, for pharmacology in 1908, and for experimental pathology in 1913, the total membership excluding duplicates now amounts to 469. These figures give some idea of the rapidity of the development during the present century. In order to gain some idea of the number of men now devoting themselves to the science of medicine, I have had an estimate made of the medical scientists exclusive of those following "medicine" and "surgery" listed in American Men of Science; conservatively the total is in the vicinity of 1,200. And in order to gain some notion of the number of these connected with medical schools supporting full time laboratory departments it has been assumed, again conservatively, that in each of the 68 Class A schools there are 10 full time men devoting themselves to medical science, or a total of 680.

The first journal to be published in America to serve primarily as an outlet for research in the medical sciences was the *Journal of Morphology,* which began its career in 1887; and the first journal devoted to experimental medical science, the *Journal of Experimental Medicine,* appeared in 1896. Then to care for the increase in the volume of research conducted by the greatly augmented personnel came in fairly rapid succession special journals devoted to physiology, 1898, to anatomy, 1900, to biochemistry, 1905, to pharmacology, 1907, etc., etc., so that now there are some 17 titles devoted practically exclusively to the medical sciences. In the same period there has also been an increase in the number of journals devoted to clinical science. Owing, however, to the difficulty of distinguishing between those maintaining a high scientific standard and those less particular in the quality of the papers accepted for publication, it is difficult to estimate accurately the development in this direction.

The increase in journal titles does not exactly parallel the increase in the volume of published work; for there has been in some cases an increase in the number of volumes issued per year and often also an increase in the size of the volume. Furthermore, prior to the publication of American science journals a certain number of scientific papers which would have found a place in them appeared in the clinical journals, a certain number also were sent to foreign periodicals for publication. However this may be, a rough estimate of the volume of work now published may be formed merely by counting the number of volumes issued by the American journal, exclusive of the clinical journals, during the year 1920. This totalled 35.

Viewed in the abstract, the tremendous increase in the number of work shops of the medical sciences, in the band of workers and in the volume of their published work that has occurred in the United States during the course of the fifty years that have elapsed since cognizance was first taken on this side of the water of the existence of a science of medicine, might be regarded by some as sufficient grounds for a feeling of complacency on our part. But after all, such matters are largely relative; accomplishment in these directions can be gauged only by comparison with what has been and is being done elsewhere. Before assuming a self-satisfied attitude it would be well to make a few inquiries: "Are we doing as much work in medical science as the number of men engaged ought to accomplish?" "Does the United States occupy in the realm of medical science the position it now holds in the political and commercial world?" "Are we doing as much as a country should which stands first in point of wealth and first amongst the western nations, with the exception of disorganized Russia, in point of population?" But above all, "How does the quality of the work we are doing measure up with that which is being done elsewhere?" In a material way the United States is one of the first countries in the world; what is her position in the realm of medical science?

Satisfactory answers to these questions can be obtained only by providing some standard for comparison. Without making any apologies, and for reasons which will become clear as we proceed, we propose to compare our accomplishment with that of Germany. It has been stated that there are in the United States at the present time at least twelve hundred men devoting themselves to preclinical science. Comparable data relative to Germany are not available. We do know, however, that in 1921 in her 22 medical schools there was a total of 312 full time men in the departments of the preclinical sciences, to which for our purposes might be added the number of full time preclinical instructors in the three medical schools of German Austria, bringing the total to 387 (compiled from Minerva). It was stated above that 35 volumes of medical research are now published annually in the United States in 17 journals. This is the product of the labor of approximately 1,200 men, some 680 of whom are connected with medical schools. Germany publishes 44 journals of similar scope and comparable as regards standards with the 17 of the United States, the total of volumes amounting to 72. There is no convenient way of ascertaining the number of professional men of science contributing to the German journals for the reason that they cater not alone to Germany and to Austria but also, to a certain extent, to some of the other European states that have no media for their own papers. It seems rather unlikely, though, in view of the ratio of the number of university instructors in Germany to the number of university instructors in the United States as computed above, that the number of professional contributors to German periodicals exceeds the number of professional scientists in the United States.

But even if it were true that the volume of scientific work in the United States has increased to the point of equaling that produced by Germans, it is not the amount of productive scholarship that counts, but its quality. It is just here that judgment becomes difficult. Individual opinion on a question of comparative merit is worth but little. Of somewhat greater value is the judgment of world courts, but even these are not infallible judges. Bearing this in mind, let us review the findings of foreign academies and of the Nobel Prize Commission. In 1909 Pickering found that of the 87 scientific men who were members of at least two foreign academies only 6 were American as compared with 17 from Prussia, 13 from England and 12 from France. To be sure this exhibit is of the fruit of a generation ago; it is possible, furthermore, that this disproportion no longer obtains. Indeed, news reports would seem to indicate that during the past two or three years a considerable number of Americans have been the recipients of foreign honors. While to a certain degree this new movement may be the result of a tardy recognition of scientific achievement, there is no doubt but that diplomacy also enters as a factor. So even if present figures should be found to be less disproportionate, it might be safer to accept the decision of the earlier ratio than that which a new statistical study might reveal. These difficulties do not apply, not at least in the same degree, in the case of the awards by the Nobel Prize Commission. There have been in all 18 awards of the prize for eminence in medical science. Four times it has gone to Germany and once it has come to America. And it may not be entirely irrelevant to our theme to add that the recipient in America is foreign born and foreign trained.

Accepting this verdict of the world on the quality of medical research in the United States it behooves us to search for the causes of our shortcomings in the hope that a way to improvement may be found. The first thought the situation raises is that our failure to measure up favorably in productive scholarship with the best that has been accomplished elsewhere possibly is to be ascribed to the recentness of our entrance into the field. This is scarcely possible. Germany required the time of but one generation to acquire her pace. We are now well along in the second generation, almost indeed, at the beginning of the third, and while, as has been said, we have developed more workshops and more posts than now exist in Germany, not alone have we not caught up with her, but she seems still to be gaining on us, though perhaps at a diminishing rate. By way of illustration we need to refer only to the 19 new journals of medical sciences which she has launched in the last 20 years, in comparison with our 15.

No, the difference in our relative positions continues to exist not because of the tardiness of the manifestation of our interest in medical science, but for several reasons of which the first consists in our failure as yet to provide sufficiently or sufficiently generally, the ideal academic relations both material and personal which the German government could and did supply from the very beginning, and which, as has been pointed out, made possible her phenomenal start. To further embarrass the healthy development of medical science in the United States new conditions have developed which I would not presume to mention were it not for the importance attributed to them in so many of the statements submitted to the committee on pre-clinical assistants. Due to the rapid, in part forced, spread of the medical sciences through the professional schools of the country, for which but few could make adequate provision; due further, to a depreciation in the purchasing power of money, more rapid than the advancing scale of emoluments, which were rather meager even at the beginning, aggravated by a concomitant elevation of the general scale of living permitted by industrial prosperity; and due to the establishment of university clinical departments upon endowments permitting a more adequate support than is possible in any preclinical department; due to all of these and to other factors to be mentioned later, it is becoming increasingly difficult for preclinical departments to secure recruits of any kind, let alone recruits who have given evidence, or even promise, of being able to make noteworthy contributions to the advancement of science. In some quarters the view is held that these conditions are merely temporary and consequent upon the war. As a matter of fact, however, they were beginning to make themselves felt years before, and not alone in this country but in Germany even. In 1911 Barker writes, "when the financial rewards of most of the lines in medicine are distinctly alluring, only a vein of eccentricity or idealism can induce a young man of ability to enter a career which assures a comfortable living for but a few fortunate leaders"; while Abraham Flexner in 1912 states that "assistants are scarcer (in Germany) than formerly when the deprivations attendant on a scientific career were less deterrent than they now appear to be." The investigation carried out by the National Research Council in 1920 demonstrated unmistakably that the scientists themselves now regard the situation just as did the clinician and the educator ten years ago. I have been told that after reading the report of the National Research Council a certain financier, presumably a university trustee, concluded from the statements of departmental heads quoted therein that university men had lost their idealism. Be this as it may, it is futile to deny that scientific men are any less, or ever have been any less, under the influence of the incentives which spur on human beings in general to give of the best that is in them. These incentives are the opportunity for achievement—achievement of worldly goods, achievement of position or achievement of fame. Under any circumstances there must be provided for men entering scientific careers an opportunity to gain by their own efforts the prerogatives and comforts which now can be acquired in other walks of life by any one of similar attainments who meets with a fair degree of success. Position in the scientific world can be attained only through scientific accomplishment and, innate ability aside, its attainment depends in large degree upon the provision of certain conditions, amongst which may be mentioned freedom of action, opportunities for research and often a certain, though not excessive, contact with students. It may not be superfluous to state that medical scientists have been known to decline at great financial sacrifice proffers from institutions of excellent repute but which were not in a position to supply the last only of the conditions just outlined. It can not be denied, however, that the financial incentive seems to be gaining in importance. And the reason seems to be that in times like the present, when fundamental discoveries are rather infrequently made and scientific achievement therefore is relatively slow, the hope of gaining distinction as an investigator alone is not sufficiently strong to induce assistants to put up with "the deprivations attendant on a scientific career." It is as true now as when Cannon stated it in 1911, that "the satisfactions of a life devoted to investigation like the satisfactions of other careers, arise from a profitable use of one's powers."

The recent movement to increase the support of clinical departments which in some places includes putting them on a full university basis, has had the effect of adding still further to the difficulty of the preclinical departments in securing assistants. In the physiological, the chemical and the biological divisions of the clinics men who desire them are given opportunities to devote themselves to any branch of medical science and at salaries usually in excess of those paid preclinical investigators in the same stage of advancement. These posts do not, as do the preclinical posts, preclude contact with clinical medicine; it therefore happens that incumbents in the former may at one and the same time, fit themselves for university careers or to step out into practice. It is obvious under these circumstances that such departments rather than the preclinical departments will have first choice of any such men as may wish to devote themselves to experimental medicine. The so-called full time movement unquestionably is a step in the right direction. But unless the disparity in compensation be removed, and unless, in general, appointments to the science posts in the clinical departments be conditioned, as they logically should, upon an apprenticeship in the preclinical department of the subject which later is to have the candidate's attention in the clinic, the fundamental departments will be ruined and will drag down clinical science with them.

This brings us to the last of the difficulties we desire to discuss which stand in the way of a healthy development of medical science in the United States. It is obvious that in so far as departments are inadequately provided for and that in so far as able men cannot be induced to take up preclinical science as a career, these conditions in turn will stand in the way of securing strong men. "If a department has a professor, an assistant professor and several instructors who are well trained, active investigators, they by contact with the students are able to interest them in investigation and thus increase their chances of becoming permanently attached to investigation as a pursuit. Just because we have an inadequate or ill qualified personnel we continue to have such a personnel."

It seems clear then that the United States is not accomplishing all that it should toward the advancement of medical science; that in part this is due to the absence of that complete fusion of hospital with the research laboratory, that permits the free transfer of problems from laboratory to hospital and from hospital to laboratory, but in larger part to a failure to provide in sufficient measure those conditions that serve to attract able thinkers and men of action to the work. One can not in this connection avoid asking as to whether or not the American mind really possesses the qualities that make for scientific acumen. There can be no question but that it does. If proof of this is needed it is furnished by the development of astronomy in the United States. Astronomy is a science that appeals strongly to the popular mind and on that account early won the support of American philanthropies. That this confidence was not misplaced is indicated by Pickering's figures which show that of the six American men of science who, as has been said, are members of two or more foreign scientific academies, three, or one-half the number, are astronomers. If Americans can become prominent in astronomy, why not in medical science also?

In explanation of the present difficulties it has been suggested that we are not providing a suitable course of training for those who otherwise are adapted to a career in medical science. This is entirely aside from the subject discussed above of the quality of present day teachers. The training calculated to give the best preparation for the pursuit of medical science is so different for the several sciences that within the limits of this paper it will be possible to discuss the subject in general terms only. In preparation for any of the sciences, with the possible exception of pathology, the training may be either medical or philosophical. In most of our better universities, either of these preparations may be and has been pursued, with the result that there are today in the chairs of our more prominent laboratories of physiology, for example, almost as many doctors of philosophy as doctors of medicine. There is nothing obvious in the careers of the two groups thus differently trained that leads to the conclusion that one set has had any decided advantage over the other. To be sure, those entering the field of preclinical science through the medical gateway, are less apt to have received instruction in physical chemistry or in advanced mathematics and physics, subjects which are helpful in all types of experimental work, especially in physiology. But at the risk of making a trite remark, it may be said that training does not end upon the receipt of a degree. All of us in the course of our careers have seen young men of talent rise to the occasion and acquire the mathematics or the physics, or what not, that happened to be necessary to provide them with the power to solve the problems of their choosing. It seems obvious, therefore, that it is more the quality of the brain than any particular training that makes for success in investigation.

In connection with the establishment of research laboratories for physiology, chemistry, biology, etc., manned by full time investigators, in direct connection with the clinics, the question of the advisability of a division of labor has arisen. At one extreme it has been maintained (Cole) that these clinical laboratories must be complete in every detail, and absolutely independent of the departments of the "contributing sciences"—"anatomy, physiology and pharmacology" though if necessary "to give advice . . . . specialists in the various branches of science can always be *employed* (italics mine) . . . . to give advice"; while at the other extreme are those (Henderson) who feel that these clinical laboratories should be in direct charge of the fundamental departments after which they are named. It would seem, however, that the best policy to pursue is not to adopt any particular system, but merely to provide equal opportunities for the two groups of workers, one interested primarily in the fundaments, the other in their clinical applications. Neither group should nor would be debarred from poaching on the other's domains; there is no devotee to pure science who knowingly would fail to at least point out any practical application of the results of his investigations; neither should a clinical scientist be frowned upon if perchance his research should lead him into the realm of general principles. But in general, and in the interests of a helpful division of labor, a full time surgeon, for instance, would be expected to devote himself to surgery, perfecting himself first in the technique of diagnosis and treatment of surgical conditions and then, in his laboratory, concerning himself with the development of methods of surgical diagnosis and treatment. In other words, the surgeon ordinarily devotes himself to surgery, just as the physiologist ordinarily devotes himself to physiology. When border line work is undertaken there should be provided an opportunity for cooperation between departments either by means of direct help or through advice.

In the development of our theme it has been furthest from our intention to give the impression that the effort made in the United States to contribute to medical science has been futile; as a matter of fact, we are now accomplishing as much as a great many other countries. But it is clear that we are not doing as much as we should and our purpose has been to ascertain the causes of our backwardness in the hope of pointing the way to their removal. In Germany, it has been seen, the ascendancy was gained through wise action of a paternal form of government in supplying the conditions that are most conducive to securing *men*. In a democracy, such as the United States, the same end can be gained only by the much slower process of education. Not alone is it necessary to obtain the interest of men capable of supplying brains for the development of medical science, it is equally necessary to educate the enlightened public up to the point of understanding that just as in the case of astronomy, or of physics, or of chemistry, it is only by the diligent employment of the scientific method that progress is possible; that by that method alone will an understanding ever be gained of the manner in which the human body functions in health and disease. The adoption of the designation "Medical Science" for this division of the American Association and for what formerly was the "Medical Division" of the National Research Council is taken to indicate that the value of science in medicine is coming to be appreciated by scientific men and presages a recognition of its worth by the enlightened public at, let us hope, not too remote a date. When that has come about, and not until then, will medical science in the United States come into its own.

But is the goal still worth fighting for? Is it possible, to quote Herter, that the "golden nuggets that are near the surface of things have been for the most part discovered?" In a general sense this figure unquestionably represents conditions as they now are. It is incomplete, however, in that it applies only to the working of claims already staked out, and fails to allow for the possibility that venturesome spirits from time to time may succeed in opening up new territories in which surface mining may again bring forth rich yields. And it fails to allow for the possibility of an improvement in machinery which may make deep mining as profitable as placer mining. Great as is the headway that has been made, it does not require a very intimate acquaintance with medicine to realize that such unopened domains still exist. But whatever the future may have in store for us we must, I think, in the interests of progress, if for no other reason, maintain that a way will be found by which to explore them. One has only to recall in this connection the remarkable development of the sciences of bacteriology and immunology that has occurred in a little over one generation; or, to go outside of medicine, to consider the revelations in radio activity in our own time and the remarkable influence they have had upon our fundamental conceptions of matter and force, conceptions which have as yet scarcely made themselves felt in medicine, in order to realize that there still must be plenty of opportunity for revelations in medical science if only it could be recruited with master minds capable of reading the signs which still elude us. If the United States is to supply her share of the progress that is to come a way will have to be found of bringing into the field of medical science the talents which, in the opinion of those best able to judge, are most likely to see the light.

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SUBSIDY FUNDS FOR MATHEMATICAL PROJECTS[1]

HERETOFORE little attention has been given to the question of subsidy funds for mathematical projects, quite unlike the case with some of the more spectacular sciences. The presumption is prevalent among non-mathematicians that mathematics is an organized and crystallized body of necessary conclusions drawn some decades or centuries ago from certain intuitional concepts of number and form, and that no special provision for equipment or funds is necessary for carrying on mathematical work.

On the contrary, it is the purpose of this paper to show that mathematics, as a live and active subject, is in need of funds for its promulgation as much as any other science. For example, the following needs may be mentioned:

(1) A revolving book fund for the publication of mathematical treatises. It has not been possible, on account of economic conditions, for an author to secure the publication of a mathematical treatise by one of the commercial publishing houses for several years past and, apparently, will not be possible for some time to come. It is well known that such treatises of worthy character are awaiting publication, but that not even second or subsequent volumes will be accepted by publishing houses which have already printed the preceding volumes. The only remedy for this most unfortunate situation is a subsidy fund which may be drawn upon to guarantee the cost of publication, such guaranty to be returned, in whole or in part, to the fund whenever the sales may so warrant. A lump sum of $25,000 could be wisely used at once for this purpose and should be handled through the American Mathematical Society.

(2) A mathematical dictionary in English. There is no mathematical dictionary in any language that is even approximately up to date. Students and workers of all kinds in mathematics, and in fields in any way related to mathematics, should have the benefit of the best dictionary in the English language that can be made. The Mathematical Association of America has already considered this matter in great detail, even to the careful estimating of the scope and size of such a publication and of the cost of its preparation. A lump sum of $100,000, or of $20,000 per year for five years, will be needed for the preparation of the manuscript. Such a work would be monumental in character and would insure great honor to any donor.

(3) Publication of a historical journal in English. As is well known, the only mathematical journal in the historical field, the *Bibliotheca Mathematica,* has been entirely suspended on account of economic conditions. Its venerable editor, Mr. G. Enestrom, has appealed to friends in this country to assist in continuing this journal as an American publication. The *American Mathematical Monthly* has recently made a serious effort to secure funds for combining the *Bibliotheca* with the *Monthly,* but so far without success. A fund of $2,000 per year, or an endowment of $40,000 would be needed in order to appropriately perpetuate the long and honorable record of this journal, and to do this would not only render assistance in a most worthy cause, but would bring honor to America and to any donor who should make it possible.

(4) Enlargement of our mathematical research journals. It is a distressing fact that all of our mathematical research journals are in crying need of more space for the publication of scores of articles already accepted. The *American Journal of Mathematics,* the *Annals of Mathematics,* and the *Transactions of the American Mathematical Society* should all be brought up to at least five hundred pages per volume and the latter could well be extended to six hundred pages. But this could not be done at present, and probably not for a long time to come, without a subsidy fund of at least $2,500 a year or an endowment of $50,000. In addition to this space, the *Transactions* would need a whole extra volume, at a cost of about $4,000, in order to catch up with available worthy contributions.

[1] A paper presented to the joint meeting of the American Mathematical Society and the Mathematical Association of America at Toronto, Ontario, December 29, 1921.

(5) Expansion of the *American Mathematical Monthly*. It has long been the hope of those in charge of the *American Mathematical Monthly* that it might become possible to publish two extra numbers (in July and August of each year) to be devoted entirely to expository and historical articles of an elementary character suited to the needs of students and teachers of mathematics in the normal schools and colleges throughout the country. This need is great and the service thus rendered would be of inestimable value. The regular volume of the *Monthly* should also be expanded by eighty pages in order to handle matter pressing for publication. For these purposes an annual subsidy of $2,000 would be needed, or an endowment of $40,000.

(6) Publication of mathematical monographs. A subsidy fund has recently been donated to the Mathematical Association of America by Mrs. Mary Hegeler Carus, as trustee of the Edward C. Hegeler Trust Fund, for the purpose of publishing a series of mathematical monographs which shall provide in convenient and readable form, and at low cost, expository presentations of all the great subjects in pure and applied mathematics. This gift is in the form of an annual subsidy of $1,200 for five years with the promise of capitalizing this income in perpetuity if the project proves successful. Such an endowment would need to be $24,000 on a five per cent. basis.

(7) A mathematical abstract journal. A journal in the English language of abstracts of mathematical publications has long been needed and became very urgent during and subsequent to the world war, when foreign abstract journals were suspended or were hopelessly in arrears. Such a journal of the high character and efficiency contemplated by the committee of the National Research Council and the American Mathematical Society could only be produced and maintained with a liberal subsidy—at least $15,000 annually or with an endowment of $300,000.

(8) A bibliography of bibliographies in mathematics. The National Research Council has proposed as one aid to efficiency in scientific work to publish a bibliography of bibliographies in each of the various sciences, which shall combine in one volume all the bibliographies obtainable in a given science whether published hitherto or not. The council will bear the cost of publication and clerical expense, but the work involved in preparation of the manuscript will be extensive and should be covered by a lump sum of $5,000.

(9) Prizes and research fellowships. Something seems to be wrong when a poem or a short story may bring its author adequate financial reward, while the author of a mathematical article of the highest merit, on which he may have spent weeks or months, not only receives no financial return but actually has to pay cash for a few reprints. The only means apparently available to offset this injustice is through prizes and fellowships of liberal value. One bequest of $10,000 and one or two small funds for prizes (none of which are operative as yet) constitute the sum total of effort to date in this country. An annual fund of $25,000 or an endowment of $500,000 would be only a fair estimate of the need in this line and such an annual expenditure could be used to the utmost advantage with the greatest degree of justice to the workers in the field of mathematics. Fortunately some farsighted and loyal individuals are thinking of these things and are contemplating liberal provisions in wills toward this end. One such will is already definitely known to be made.

(10) Honorary stipends for executive officers. Time was in most scientific societies when one or two permanent executive officers worked like slaves for the upbuilding of these organizations, with no financial return and sometimes even without adequate clerical assistance. Those days of pioneering should be gone forever. In some societies, the membership is large enough, or includes those with large incomes outside the teaching profession, so that the annual dues may be made adequate to cover salaries to their executive officers; but those societies whose members are almost entirely teachers in the universities and small colleges cannot raise their dues beyond certain maximum amounts without shutting out large numbers to whom the organizations are of the utmost value. The only other alternatives seem to be either to continue the old pioneer methods or else to secure adequate subsidy funds with which to give these hard worked permanent

officers respectable honorary stipends. In the American Mathematical Society and the Mathematical Association of America there are four such officers to whom honorary stipends of at least $1,000 each should be given annually. For this purpose an endowment of $80,000 is needed. In this case again farsighted and loyal individuals are contemplating bequests, and one or two such wills with liberal provisions are known to be already made. Also a special gift toward this end has just been promised to the association for the coming year.

It will be found that the totals of the above ten items, as estimated, are as follows: For lump sums $134,000; and for annual subsidies $51,700, or, if capitalized at five per cent., an endowment of $1,034,000. As stated under (6) the provision for mathematical monographs is already made, and under (9) and (10) beginnings have been made by bequests provided for in wills or by special cash gifts. Also in connection with (2) it should be said that the proposition is under favorable consideration by a prospective donor. A donation of this magnitude would, indeed, be a monument worthy of great honor to the donor, and would render a service of untold value to the cause of education. The same may be said in varying degrees of all the items enumerated. It is believed that when information concerning these needs becomes sufficiently widespread there will be liberal responses in supplying the funds.[1]

In this connection, attention may be called to the fact that an important and urgent need of mathematics has already been recognized and met by the General Education Board of the Rockefeller Foundation in financing the work of the National Committee on Mathematical Requirements, a committee working under the auspices of the Mathematical Association of America. This work has extended over a period of three years and the funds supplied will total over $65,000 when the exhaustive report of the committee is published in a volume of five or six hundred pages.

H. E. Slaught

Chicago, January 2, 1922

[1] As this article goes to the printer a donor offers to provide the items of $4,000 mentioned in (4). Also a report in Science for January 13 of grants made by the Heckscher Research Foundation contains three items amounting to $2,600 for mathematics. Possibly this latter amount is the one quoted in the same issue of Science (page 52) where grants for research in twelve sciences range from $352,000 for biology down to $2,600 for mathematics. The compiler seems not surprised that "mathematics brings up the rear," since he says that "it would probably appear to most of us to be the subject farthest removed from practical interests." His surprise will doubtless be great when he contemplates a proposal for a million dollar endowment fund for mathematics.

SCIENTIFIC EVENTS

BRITISH RESEARCH ON CEMENT

In order to discover some means of increasing and cheapening the supply of Portland cement, experiments are being made by a panel of experts associated with the British Engineering Standards Association. The object of the research is to ascertain whether cement made from blast-furnace slag can not be made according to a recognized specification which would enable it to be used for work in which Portland cement, manufactured according to the British standard specification, has hitherto been employed.

Mr. H. O. Weller, of the Department of Scientific and Industrial Research, who is a member of the panel, explains in the London *Times* that the British standard specification for Portland cement is recognized all over the world, and has done more than anything else to make Portland cement recognized as a safe material to use. But it is beginning to be recognized that the specification is rather too narrow, and that there is need for a standard specification for iron Portland cement—*i. e.,* cement to which a small portion of blast-furnace slag has been added after clinkering. Cement of this character was first tested in Germany in 1902, and by decree of the Prussian Ministry of Public Works, in 1909, was sanctioned for use in the erection of German public buildings. This cement has come into England in fairly large quantities in recent years. By all the recognized physical and chemical tests this cement passes the British standard specification, but in respect of manufacture it would be barred because slag has been added to it after clinkering. In Scotland a form of this cement has been made for the past 11 years called Coltness Portland cement.

In addition to increasing sources of supply, the Department of Scientific and Industrial Research is making inquiries into the question of the more economical working of processes which have become traditional, with a view to spreading the knowledge thus gained. There is an inquiry at present going on into the economical use of fuel in the burning of bricks. The greatest experts in the country at present find themselves at a loss to state exactly the total quantities of coal needed to burn bricks, and the practice varies most illogically in different brickfields.

Another inquiry is being conducted into the question of the gas-firing of kilns. This method of firing is in use in the potteries for firing clay goods, and it has been used in Scotland for the past 40 years for burning fire-bricks. But the object of the present inquiry is to ascertain whether it can be used for firing ordinary bricks. An expert investigator is being sent over England, Belgium, Germany, and the United States of America to collect the latest data.

THE GORGAS MEMORIAL INSTITUTE

As has been noted in SCIENCE, Dr. Richard P. Strong, head of the Harvard School of Tropical Medicine, has been appointed scientific director of the Gorgas Memorial Institute which will be established at Panama for the study of tropical diseases. Dr. Strong will continue his connection with the Harvard School.

The *Harvard Alumni Bulletin* states that the Gorgas Memorial will constitute a tropical station for the Harvard School of Tropical Medicine and for other medical schools. The work in the laboratories at Panama will be separated into four divisions: 1, bacteriology and pathology; 2, protozoology and helminthology; 3, entomology; 4, biological chemistry and pharmacology.

There will be intimate association and cooperation between the Gorgas Memorial Institute and the Santo Tomas and Ancon Hospitals and the Palo Saco Leper Asylum, and the patients in these institutions will be available for observation and study. Venomous animals, poisonous plants, tropical climatology, and the biological effects of sunlight, will also receive attention in the work of the institute.

Provision will be made for advanced instruction in tropical medicine and hygiene of a limited number of properly-qualified graduates of recognized medical schools. A limited number of advanced students will also be admitted for special investigation upon tropical diseases and their prevention.

Properly-qualified volunteer workers will also be received and the privileges of the institute will be extended and a special effort made to attract experienced investigators from scientific institutions in different parts of the world, to carry on researches which can particularly favorably be conducted in a tropical country. It is especially hoped that members of scientific faculties will avail themselves of this opportunity during their sabbatical years or other periods of university leave.

The larger part of the research work of the institute will be carried out in the laboratories in Panama, but it is also contemplated that from time to time field expeditions will be sent to other portions of the tropics for the solution of special problems in connection with the diseases of men or animals.

THE TEACHING OF EVOLUTION IN THE KENTUCKY SCHOOLS

A BILL has been introduced into the Kentucky legislature forbidding the use of textbooks in the public schools in which the doctrine of evolution is taught. The movement is said to have been forwarded by lectures in the state by Mr. William Jennings Bryan. A number of telegrams have been addressed to Dr. Frank L. McVey, president of the University of Kentucky, among which are the following:

Cannot believe that any American legislature can be induced to prohibit the teaching in public schools of evolution or of any other scientific hypothesis of proven value.—Charles W. Eliot, president emeritus of Harvard University.

Should regard bill such as you suggest certain to make Kentucky the laughing stock of the world. To prohibit the scientific teaching of the facts of evolution would involve adopting intellectual attitude of the twelfth century. It is a proposition which could not be seriously entertained by any really intelligent person.—James R. Angell, president of Yale University.

I take it for granted that the introducer of the bill is in close communion with the rulers of Soviet Russia, since he is faithfully reproducing one of their fundamental policies. Truly we are getting on.—Nicholas Murray Butler, president of Columbia University.

In the name of two hundred and fifty colleges and universities located in forty-two states we pray Kentucky will not commit intellectual suicide by prohibiting the teaching of evolution or the use of books favoring evolution.''—Robert L. Kelly, executive secretary, Association of American Colleges, New York.

Any attempt to impose legislative restrictions on the teachers of science is contrary to all the principles on which the American Republic has been founded.—Charles S. MacFarland, general secretary Federal Council of the Churches of Christ in America, New York.

CARDINAL DOUGHERTY ON VIVISECTION

Cardinal Dougherty, of Philadelphia, under date of December 30, 1921, addressed the following letter to the Society for the Protection of Scientific Research:

Having been asked to give an expression of opinion on the subject of vivisection, I deem it needless to say that, with you and all others opposed to cruelty of whatever kind, I deplore any abuse of vivisection that may cause unnecessary pain to lower animals.

But as actually conducted for the advancement of medical research, vivisection seems to me not only unobjectionable, but even praiseworthy. Scientifically carried out, it is, as you know better than I, almost entirely confined to the inoculation of mice, rats, guinea pigs and rabbits, and is much less frequently practiced on cats, dogs, horses and other higher species of brute animals. Since the invention of anesthetics, and with the use of antiseptic methods, it has become practically painless. Animals used for experimental purposes are well fed and sheltered, and in many respects are better off than those in a state of nature or in subjection to work. They escape the rapacity of fiercer and larger animals, the ill-usage of sport, the drudgery of toil, exposure to the heat and cold of the seasons, and the cruelties of keepers, drivers and exploiters.

According to the law of nature, the lower species of creatures exist for the higher. The clod of earth supports the plant. The vegetable kingdom supplies the wants of the animal. The brute animal and all other inferior things are for the good of man, who was made directly for the glory of God. Man, then, may use all inferior things for his own benefit.

We exterminate vermin and insects, roaches, mice, rats and serpents, for the sake of health, cleanliness and comfort. The children in our schools are taught to combat the plague of flies as carriers of noxious microbes. We kill animals, fowls and fish for our food. Fishermen bait fish with live worms.

If, then, to preserve or restore health, to prolong life, and even to seek pleasure, it is permissible to inflict pain and death upon inferior forms of animal life, why may not the scientific man, for the common good, experiment on lower animals, especially when he takes every precaution against unwarranted infliction of pain by the use of anesthetics and by antiseptic methods?

Animals, themselves, owe to vivisection a great debt. Epizootic diseases, like anthrax, swine-fever, chicken cholera, silk-worm disease, cattle tuberculosis, which, in the past, caused untold suffering to animals, and every year killed them by millions, have been brought under control by the experiments of vivisection.

But man is the chief beneficiary. For it has been mainly owing to these experiments that great discoveries have taken place regarding the nervous system, bone growth, the blood, digestion, infections, serums, antitoxins and vaccinations; and without vivisection little or no progress would have been made in physiology, pathology, bacteriology and therapeutics.

To forbid vivisection would be to hamper science, do a mischief to the human race and foster misplaced sympathy.

SCIENTIFIC NOTES AND NEWS

A summer meeting of the American Association for the Advancement of Science will, by recent vote of the executive committee of the council, be held at Salt Lake City from June 22 to 24, in conjunction with the annual meeting of the Pacific Division of the association. Arrangements for the meeting are in charge of Mr. W. W. Sargeant, secretary of the Pacific Division. All members of the association and of the associated societies are invited to be present, and all associated societies are invited to hold sessions. Sections of the association are also invited to hold sessions, but no attempt will be made to have all sections represented on the program of the meeting. Information regarding this summer meeting will be published in Science from time to time as the preparations mature.

The Norman Bridge Laboratory of Physics of the California Institute of Technology was dedicated on January 28. In the afternoon, Dr. Robert A. Millikan, director of the laboratory, was introduced by Dr. A. A. Noyes, and gave an address on "Recent research work on the extension of the ultra violet spectrum and the insight it affords into the nature of matter." In the evening, the laboratory was presented by the donor and accepted by Dr. Millikan on behalf of the institute. There were brief addresses by Mr. Henry M. Robinson, vice-president of the board of directors; George E. Hale, director of the Mount Wilson Observatory, and Dr. H. A. Lorentz, professor of mathematical physics at the University of Leiden. Then followed a reception in honor of Dr. and Mrs. Millikan and Dr. and Mrs. Bridge.

Sir David Prain is about to retire, under the age rule, from the directorship of the Royal Botanic Gardens, Kew, which he has held since 1905. He will be succeeded by Dr. A. W. Hill, who has been assistant director since 1907. Dr. Hill, before his appointment to Kew, was lecturer in botany in the University of Cambridge, of which he is a graduate.

The gold medal of the Royal Astronomical Society has been awarded to Dr. J. H. Jeans for his contributions to theories of cosmogony.

At a recent meeting of the Paris Academy of Medicine the election of new officers for 1922 resulted as follows: Professor Béhal, the vice-president for 1921, succeeded, in accordance with the provisions of the constitution, to the presidency. Dr. Chauffard, professor of clinical medicine in the University of Paris, was elected vice-president (president for 1923). Dr. Souques was reelected annual secretary.

Dr. Henry Chandler Cowles, professor of plant ecology at the University of Chicago, has been elected president of the Chicago Academy of Sciences.

The American Phytopathological Society, meeting at Toronto December 27 to 31, elected as president Dr. E. C. Stakman, of the University of Minnesota; as vice-president, Dr. N. J. Giddings, of the University of West Virginia; and as secretary-treasurer, Dr. G. R. Lyman, of the U. S. Department of Agriculture, Washington, D. C. Dr. H. B. Humphrey, of the U. S. Department of Agriculture, was elected councillor for one year, and Dr. I. E. Melhus, of the Iowa Agricultural College, for two years.

Charles W. Price, who has retired as editor of the *Electrical Review* after nearly forty years of service, was the guest of honor at a luncheon given by a number of his friends in the electrical industry on January 18, at the Lotos Club in New York.

Dr. Frederick L. Hoffman, of the Prudential Insurance Company, has been elected a member of the Royal Institute of Public Health.

Professor Filibert Roth, head of the Department of Forestry of the University of Michigan, was appointed chairman of the Permanent Timber Supply Committee at the National Agricultural Conference held in Washington, D. C., from January 24 to 27.

According to the *Journal* of the American Medical Association, it is reported that Dr. Hubert Work, president of the American Medical Association and now first assistant postmaster general, may be named postmaster general to succeed Will H. Hays, who is to resign to become the head of the motion picture industry of the country.

Dr. E. W. Dean, long connected with the Bureau of Mines as petroleum technologist, has resigned to accept the position of assistant to Roger Chew, inspection department, Standard Oil Company of New Jersey. He will be succeeded in his position at the Pittsburgh Station by N. A. C. Smith of the Washington, D. C., laboratory. F. W. Lane, organic chemist at Pittsburgh, will succeed Mr. Smith.

Dr. H. W. Dye has resigned as assistant professor of plant pathology, Cornell University, to become chief pathologist of the research department, Dosch Chemical Company, Louisville, Ky., manufacturers of insecticide materials and appliances. Dr. G. E. Sanders also joins the research department of this company, having resigned as chief of insecticide investigations of the Canadian Department of Agriculture.

Dr. H. H. Morris, formerly in the chemical department of E. I. du Pont de Nemours and Company, is now director of the research department of the Bond Manufacturing Corporation, Wilmington, Del.

Louis E. Saunders has been appointed director of the research department of Norton Company, Worcester, Mass.

Sten De Geer, acting professor and chairman of the Geografiska Institutet, University of Stockholm, is to give two courses at the University of Chicago during the coming Summer Quarter. One course will deal with the geography of the Scandinavian countries, while the other involves a survey from the standpoint of political and economic geography of the "New Europe."

Emile F. Gautier, professor of geography in the University of Algiers, has arrived in Cambridge to take up his work as French exchange professor at Harvard University for the second half of the current year. Professor Gautier will give a half course on the geography of Northern Africa and the Near East, which will be open both to graduate students and undergraduates and a research course primarily for graduates.

Dr. Christen Lundsgaard, formerly of the faculty of the University of Copenhagen, has arrived in the United States to become associated with the Rockefeller Institute for the next two years. He will conduct research work in diseases of the heart and on pneumonia.

Charles E. Simon, of the department of medical zoology, School of Hygiene and Public Health, Johns Hopkins University, has been appointed a delegate from this school to the Second International Congress of Comparative Pathology, to be held at Rome on September 20.

Three members of the staff of the Rockefeller Institute, Dr. Paulo Provença, Dr. Frederick Russell and Dr. Richard M. Pearce, sailed February 2, for Sao Paulo, Brazil, where they will consult Dr. Carlos Chagas of the Brazilian Department of Health upon the care and treatment of tropical diseases.

Dr. Charles P. Berkey, professor of geology at Columbia University, has been given leave of absence to accompany an expedition for research work in Mongolia, which is being financed by the American Museum of Natural History and by the magazine, *Asia*.

Dr. Robert S. Platt, of the department of geography at the University of Chicago, is now in Porto Rico in connection with a study of the economic geography of Middle America. The other places to be visited include several of the islands of the West Indies and parts of Mexico, Central America, and the Carribean coast of South America. Dr. Platt is accompanied by Harold S. Kemp, a student in the geography department and for a time secretary to the Geographic Society of Chicago.

A message has been received at Ottawa through Canadian customs officials under date of November 18 last, from a manager of a Hudson Bay post, stating that Donald B. MacMillan was spending the winter at Nauwatta, eighty miles north of Cape Dorset.

The Middleton Goldsmith lecture of the New York Pathological Society was delivered at the New York Academy of Medicine on February 3, by Professor Thomas Hunt Morgan, of Columbia University, the subject being "Some Possible Bearings of Genetics on Pathology."

THE Joseph Leidy memorial lecture in science at the University of Pennsylvania was given by Dr. William Bateson, director of the John Innes Horticultural Institute, Merton Park, London, on January 24. Dr. Bateson's subject was "The segregation of genetic types."

DR. FRANCIS G. BENEDICT, director of the Nutrition Laboratory of the Carnegie Institution of Washington, lectured at Pennsylvania State College under the auspices of the Institute of Animal Nutrition and the Department of Agricultural Chemistry on the subject "Calories for children," on January 26.

DR. CHARLES WARDELL STILES, professor of medical zoology at the Hygienic Laboratory, Washington, D. C., has completed a series of lectures on nomenclature in medical zoology at the School of Hygiene and Public Health of the Johns Hopkins University, under the auspices of the department of medical zoology.

ON February 3 Professor C. J. Keyser made an address before the Philadelphia Section of the Association of Teachers of Mathematics of the Middle States and Maryland on "The mathematical obligations of philosophy and education." On January 14 he spoke before the New York Schoolmasters' Club on "A new conception of the nature of man and its bearings on education."

AT a meeting of the Royal Institution held on January 20, Sir James Dewar delivered a lecture on "Soap films and molecular forces."

PROFESSOR J. A. FLEMING will deliver a lecture on February 21 before the Institution of Electrical Engineers on "Michael Faraday and the foundations of electrical engineering."

DR. C. E. KENNETH MEES, director of research and development, Eastman Kodak Company, gave several lectures in Montreal and Toronto during the last week in February. On February 20 at Montreal he spoke before the Canadian Club on "The road to wealth." The same evening he lectured before the Montreal Section of the Society of Chemical Industry on "Chemistry and the motion picture." At Toronto he gave the following lectures February 21, "Photography through the microscope," before the Camera Club; February 22, "Chemistry and the motion picture," before the Toronto Section of the Society of Chemical Industry; February 23, "The getting of wisdom," before the Empire Club, and "A hundred years hence," before the Canada First League.

ACCORDING to *Nature* the officers of the Ramsay Memorial Fund announce that the dean and chapter of Westminster have consented that a tablet containing a medallion portrait of Sir William Ramsay should be placed in Westminster Abbey in the place immediately below that occupied by the Hooker tablet. The tablet is being executed by Mr. Charles Hartwell, A.R.A. It is anticipated that the unveiling will take place in October next. At the request of the Ramsay Memorial Committee a commemorative medal of the late Sir William Ramsay has been executed by the French sculptor, M. Louis Bottée. The medals will be struck in London when it is known approximately how many copies will be required.

DR. CHARLES BASKERVILLE, director of the chemical laboratories of the College of the City of New York, died of pneumonia at his home on Jaunary 28, at the age of fifty-two.

MR. WILLIAM T. CARRIGAN, one of the senior assistants in the Nautical Almanac Office, U. S. Naval Observatory, died at Washington, D. C., on January 20, 1922. Mr. Carrigan entered the Nautical Almanac Office in March, 1901.

SIR ERNEST HENRY SHACKLETON, the British explorer, died from heart disease on January 5 on board the steamship Quest. Captain L. Hussey will accompany the body to England. Professor Gruvel and the other members of the party will continue the expedition.

FATHER GUISEPPE LAIS, vice-director of the Vatican Observatory, has died at the age of seventy-six years.

THE death is announced in *Nature* of two distinguished English engineers—Dr. Edward Hopkinson, who like his brother, John Hopkinson, was a leader in electrical engineering, and Sir William Matthews, past president of the British Institution of Civil Engineers.

The death is reported of Senator Ciamician, professor of chemistry at Bologna.

Correcting a recent note in Science, the schedule of meetings of the American Astronomical Society is as follows: September, 1922, Yerkes Observatory; December, 1922, Cambridge and Boston; September, 1923, Mt. Wilson Observatory; December, 1923, Vassar College.

Nine British and American scientists, members of the expedition to the Andes Mountains to make a study of the physiological changes which enable people to live permanently at high altitudes, returned on February 1. The expedition was under the leadership of Joseph Barcroft of Cambridge University. Its membership included Dr. Alfred C. Redfield, assistant professor of physiology at the Harvard Medical School; Dr. C. A. L. Binger of the Rockefeller Institute, New York; Dr. George Harrop of the Presbyterian Hospital, New York; Dr. A. V. Bock of the Massachusetts General Hospital; Dr. Henry S. Forbes, of Harvard University; Dr. J. G. Meakins, of Edinburgh University, and Dr. J. H. Doggart of King's College, Cambridge. Professor Barcroft is now giving in Boston a course of Lowell lectures on the work of the expedition.

At the convention of the New York City Federation of Women's Clubs, held in New York City on February 3, a resolution was introduced by Mrs. Belle de Rivera endorsing a bill now before the legislature prohibiting the use of dogs for vivisection. There were about two thousand members in attendance and, according to the daily press, the motion was "overwhelmingly defeated."

The late George R. White, president of the Potter Drug and Chemical Corporation, has bequeathed to the city of Boston a fund of more than $5,000,000, the income of which is to be used for creating works of public utility and beauty. Two of the three objects specified by Mr. White are a zoological garden and an aquarium. Other bequests in Mr. White's will are $100,000 each to the Children's Hospital, the Museum of Fine Arts and the Massachusetts General Hospital. The Massachusetts Hospital also is given a similar sum for the special purpose of treatment of diseases of the skin. Previous to his death Mr. White had given $1,000,000 for a new building and endowment for the Massachusetts College of Pharmacy.

It is announced from Montreal that instead of converting the $100,000 prize he has offered for a cancer cure into a fund for cancer research work, as he had been urged, Lord Atholstan has given a second $100,000 for research.

The fortieth course of popular medical lectures will be given under the auspices of the Stanford Medical School on alternate Friday evenings, as follows: January 13, The Basis of Modern Medicine: Dr. William Ophüls. January 27, The Attitude of the Public Toward the Blind: Miss Katherine Foley. February 10, The Treatement of Deformities Following Infantile Paralysis: Dr. Arthur L. Fisher. February 24, The Control of Botulism: Dr. E. C. Dickson. March 10, The Truth About Vivisection: Mr. Ernest H. Baynes. March 24, Present Day Methods of X-Ray Diagnosis: Dr. W. Edward Chamberlain.

The city of Paris has authorized the expenditure of 2,500,000 francs ($183,750 at present rate of exchange) for the purchase of radium to be used in the public hospitals for the cure of cancer.

UNIVERSITY AND EDUCATIONAL NOTES

Appropriations of $18,210,353 for colleges and universities, $12,029,513 for medical schools, and $646,000 for negro education were made during the last fiscal year by the General Education Board, founded by John D. Rockefeller, according to the report for 1920-21. The total appropriations of the board from its foundation in 1902 to June 30, 1921, have amounted to $89,017,872. Of the gift of $50,000,000 made by Mr. Rockefeller in 1919 for teachers' salaries, appropriations were made up to July 1, 1921, which amounted to $26,732,000, which was distributed among 191 different institutions. The annual report further reveals that Mr. Rockefeller has released the board from any obligation to hold any of his gifts in perpetuity.

THE will of the late A. Barton Hepburn, of New York City, gives $250,000 to the A. Barton Hepburn Hospital at Ogdensburg, N. Y.; $200,000 to Middlebury College in Middlebury, Vt., of which Mr. Hepburn was a graduate; $150,000 to Columbia University, of which he was a trustee, and $100,000 to St. Lawrence University at Canton, N. Y., where he had lived. The will had also given $100,000 each to Wellesley College, of which his daughters were graduates, and to Williams College, of which his son was a graduate, but these gifts were canceled by a codicil because he made gifts to those institutions two years ago, anticipating the intention of his will. Each gift to educational institutions is specifically made for the purpose of founding chairs in economics or history.

MR. WILLIAM COOPER PROCTOR has endowed three visiting fellowships at Princeton University with an annual stipend of $2,000. The fellows are to be appointed, respectively, on nomination of the University of Oxford, the University of Cambridge and the Paris Higher Normal School.

DR. M. C. MERRILL, head of the department of horticulture at the Utah Agricultural College and horticulturist at the Agricultural Experiment Station, has accepted an appointment as dean of the College of Applied Arts and as head of the department of horticulture of the Brigham Young University. This appointment is to take effect July 1.

H. M. JENNISON, assistant professor of botany and bacteriology at the Montana State College, has been granted leave of absence and will spend the remainder of the college year in the graduate laboratories of the Missouri Botanical Garden and Washington University, St. Louis.

ALFRED P. LOTHROP is on leave of absense from the chair of organic chemistry at the Medical School, Queen's University, Kingston, Ontario, where he has taught for the past twelve years, to act as associate professor of chemistry at Oberlin College.

DISCUSSION AND CORRESPONDENCE

PROFESSOR SUDHOFF'S PARACELSUS

THE announcement of the forthcoming publication of the complete works of Paracelsus, under the editorship of Professor Karl Sudhoff, of Leipzig, will be a matter of considerable interest to chemists and physicians as well as to philosophers. This edition will include the unprinted MS. material as well as what is already known in the printed texts. Paracelsus was a most prolific writer, but many of his more important works, familiar to bibliophiles by their characteristic title-pages in red and black, are now so rare as to be practically inaccessible, particularly such pamphlets as those on miners' diseases (1567) and mineral baths (1576).

Paracelsus, one of the pioneers in analytical chemistry, the founder of chemotherapy, and one of the great medical reformers of the sixteenth century, was even a doughtier figure than Vesalius, who began bravely but ended as a courtier, or Paré, whose popularity saved him from persecution. As compared with these men, Paracelsus occupies about the same position in medicine as did Luther or Knox in relation to Erasmus or Maitland of Lethington. He was more impulsive and impetuous and pushed his denunciation of scholastic medicine to the extreme limit of coarseness. His training was, however, better than is commonly supposed. As Sudhoff has shown, he graduated at Ferrara in 1515, having studied under the celebrated Leonicenus. Although Browning's poem idealizes him, he is commonly represented as a charlatan and a mountebank. This false view is, in the main, due to the character of his writings, which are a curious jumble of exaggerated swagger and of passages showing keen insight into the real nature of things, *e. g.*, that gout and calculus are diathetic diseases, or that goitre and myxœdema are hereditary and interrelated. His literary style is turgid, verbose, obscure, but this is a necessary and sufficient reason for a modern edition, with the proper *apparatus criticus* of interpretative notes.

Of the extraordinary fitness of the editor for his task, it is almost unnecessary to speak. A brilliant Goethe scholar and *Goetheforscher* in his youth, Sudhoff is known to physicians as the Paracelsus scholar *par excellence.* His whole life of investigation at the Institute of Medical History at Leipzig, his vast researches in medieval medicine, have been nothing else than preliminary to this work, which (at the age of 68) he regards as his swan-song.

Professor Sudhoff's plan is to issue the work in fifteen volumes, containing all the MS. material, and to be sold by subscription at a flat rate per volume. Librarians and scientific men may obtain further details by writing to Professor Karl Sudhoff, Institut für Geschichte der Medizin (38 Talstrasse), Leipzig, Germany.

F. H. Garrison

THE VALUE OF TILTH IN AGRICULTURE

The remarks of Mr. L. S. Frierson relative to the above question (Science, September 2, 1921, p. 193) have just come to my attention. Bechhold's work, which I quoted (Science, July 22, 1921, p. 74), indicates that evaporation draws salts toward the surface; but rain rather than light cultivation is the main factor returning them toward the roots, although of course cultivation helps.

An essential in cultivation is the breaking of the surface crust or skin, and Mr. Frierson says that, contrary to my hypothesis, this comminution of the upper surrface of the soil "more or less perfectly *stops evaporation, and thus conserves the store of soil water.*"

This claim of Mr. Frierson is quite contrary to all engineering and practical experience. The way to dry wet clothes is not to roll them up, but to spread them out and expose a large surface to the air. The breaking of a crust or skin, with increased exposure of fresh surfaces causes, or tends to cause, *increased* evaporation. Indeed Bechhold says that the cooling effect of talcum and similar dusting powders is consequent upon the fact that they give the skin more free surface for evaporation.

Unless direct experimental evidence to the contrary is produced, I must maintain my view that cultivation, by increasing surface evaporation, tends to bring upward subsurface water and salts, and thus aid plants in dry weather.

Jerome Alexander

New York, January 7, 1922

CASTS OF FOSSIL VERTEBRATES AT STUTTGART

To the Editor of Science: The director of the Stuttgart Museum (Württemburgische Naturalien Kabinett) in Germany has offered for sale a series of casts of fossil vertebrates from originals in that museum. Most of these are of great teaching and exhibition value, and owing to exchange and economic conditions in Germany, the prices are extremely low. The American Museum has purchased the series and received the shipment in excellent condition. The quality of the casts varies, some are excellent, others only fair, but I desire to call attention of those who are interested to the opportunity both to secure some very useful casts at small expense and to aid in continuing the work of one of the leading paleontological museums of Germany. For information write to Dr. Martin Schmidt, director of the Stuttgart museum.

W. D. Matthew

THE RAY SOCIETY

To the Editor of Science: May I be permitted to express the thanks of the Council of the Ray Society to Professor G. H. Parker for his timely letter published in Science of November 25, 1921? I should like also to take this opportunity of apologizing to our American subscribers for the continued delay in the issue of our publications, a delay which is due entirely to the difficulty of executing the elaborate colored plates for Prof. W. C. McIntosh's "British Marine Annelids." The first part of the fourth (and final) volume of this work will form the issue to subscribers for 1920 and will, it is hoped, be ready within the next few months. The second part, completing the work, is already in hand and will form the issue for 1921. Subscriptions for each of these years can still be received up to the date of publication.

W. T. Calman,
Secretary of the Ray Society
1, Mount Park Crescent,
Ealing, London, W. 5,

QUOTATIONS

THE NEW CHEMISTRY

The service, at once scientific and humanitarian, of Dr. Charles Baskerville, who died last week, is illustrative of what the science of chemistry is undertaking for the alleviation of human suffering. Dr. Baskerville's special researches had to do with the causes and prevention of occupational diseases and with the purifying of ether as an anesthetic. These are, however, but suggestive of the innumerable researches in which his brother chemists of every land in this new age of their science are seeking not only to heighten industrial productivity, but to promote and conserve the health and strength of human bodies.

During the war, when it became necessary to use poison gas to fight poison gas, the ablest American research chemists were called to the country's defense. The recent action of the Washington conference gives hope that choking and wasting vapors will not again sweep over fields or stain the skies, and that such another service as these chemists were called upon to give will never again be asked of a benign science that will now have freedom to devote its entire attention to benefiting men, women and children.

That this is more than a vague, visionary hope is intimated by the recent report of a committee of the American Chemical Society, under the chairmanship of Dr. Charles H. Herty. It is a clarion summoning of the chemists to come to the battle against disease. In the war the development of means of defense was not left to haphazard discoveries by isolated chemists. The best-trained workers in systematic research were brought together and were kept in daily—almost hourly—conference, where they were joined by pharmacologists and experimental pathologists, until the problems upon which the fate of nations depended were solved. But while war claimed its sacrifice in millions of lives, "disease each year claims its tens of millions." The new problems give this science a more urgent, poignant call. And the committee, contemplating the ravage of disease, puts this question: "Can we not bring to these problems the same methods so successfully employed in the solution of the means of making war?"

Several centuries ago the chemist and the physician cooperated. Then they separated, the chemist turning toward industrial production. Now it is being realized that, though the bacteriologists and pathologists have accomplished wonders, they have "definitely reached a point where they must turn to the chemists for the solution of many of their most important problems." Not only are the chemists' medicaments needed for the cure or alleviation of certain specific diseases, but their advice is needed as to the acceleration or retardation of chemical reactions that take place in the body. The myriad battles with avoidable or preventable disease there go daily on. The lesson of the war intimates what victories may be expected in these battles from the cooperation, under ideal conditions of time and research, on the part of those whose science touches these very issues of life.

Dr. Baskerville, not only by his own researches, but also and especially by developing and equipping what was perhaps the best series of chemical laboratories in the United States and by organizing a department which has given tuition to hundreds of young men for service in this science, made his lasting contribution, though his studies and researches and teaching here are over. It will be remembered, however, that but a few weeks before his death, after years of intimate study of the atom, he said that "there is something that cannot be explained on a purely materialistic hypothesis." So the quest goes on.—The New York *Times*.

SPECIAL ARTICLES

A CONVENIENT METHOD OF DETERMINING THE BRIGHTNESS OF LUMINESCENCE

Having recently had occasion to measure the brightness of various fluorescent substances I tried out for this purpose an optical pyrometer.

The instrument was of the type based upon the well known "thermo-gauge" devised by the late E. F. Morse for controlling the temperature to which metals are heated in tempering. It consists of a telescope of short focus, low power and relatively large aperture, having a tungsten lamp in the focal plane. The filament of this lamp is superimposed upon the image of the surface the brightness of which is to be measured. With a screen in the eye piece so selected as to give a fair color match with a minimum of absorption it is easy to adjust the current through the lamp until the filament merges in the surface with which it is to be compared. The lamp may be compared for temperature as in ordinary optical pyrometry or directly for brightness, using an illuminated matte surface subject to known fluxes of light.

While this scheme becomes rigorous only in the comparison of non-selective radiation, the departures are not troublesome. Nearly all fluorescence colors, on account of the broad-banded character of their spectra, may be regarded as modified whites. They are in general of diluted rather than of saturated hue. Again, in dealing with very low intensities, as in the study of luminescence, slight color differences become quite inappreciable. All that is demanded of the color screen is to give a ruddy, greenish or bluish tone respectively so as to avoid strong contrasts.

Fortunately, as in all photometric processes involving the distinguishing of a pattern, the sensibility of the determination does not fall off seriously with the diminution of the field of view until it becomes difficult to distinguish outlines.

With this apparatus the breaking down occurs at very low intensities. Any surface against which the unlighted filament can be seen as a black line can be measured as to brightness with surprising consistency. In searching for a white surface devoid of luminescence, for example, it was easy to detect traces of fluorescence in a variety of substances usually deemed inactive. Thus Becquerel,[1] more than sixty years ago, noted that viewed in his phosphoroscope nearly everything non-metallic glowed. The only point here is that by this simple method these traces are found to be measurable.

[1] Becquerel: La Lumière, Vol. 1, p. 256.

Because of its availability at very low intensities this instrument is likewise adapted to the determination of persistent phosphorescence. One has only to find a suitable screen, focus the pyrometer on the phosphorescent body, note the cessation of excitation on a chronograph and record thereafter the times at which the phosphorescence matches the filament which is set successively to a diminishing series of predetermined brightnesses.

The accompanying table gives estimates of the brightness of a number of fluorescent materials determined in this way. The excitation was approximately the same for all, excepting in the case of luciferin. For a sample of this interesting substance, made from marine light-giving organisms, I am indebted to Professor E. N. Harvey. The luciferin was activated by wetting the powdered material and stirring vigorously to hasten oxidation. In all other cases an iron spark was used at a distance of about ten centimeters. The spark was obtained by means of the convenient step up transformer designed by Mr. W. C. Andrews for that purpose.

THE BRIGHTNESS OF FLUORESCENT SUBSTANCES

Substances	Brightness in millilamberts
Dyestuffs in dilute solution:	
Rhodamin 6 G	4.2 to 12.0 m. l.
Rhodamin B	5.2
Fluorscein	4.2 to 5.2
Tetrachoreosin	4.2
Resorufin	3.0
Luciferin (prepared by Professor Harvey)	14.5 to 16.0
Uranyl salts (solid):	
Potassium uranyl sulphate	35.2
Ammonium uranyl sulphate	23.0
Rubidium uranyl chloride	8.11
Potassium uranyl nitrate	7.53
Uranyl nitrate	6.61
Cæsium uranyl nitrate	5.71
Uranyl acetate	5.39
Potassium uranyl fluoride	4.69
Cæsium uranyl acetate	4.56
Lead uranyl acetate	3.75
Miscellaneous solids:	
Synthetic willemites	12.5 to 14.0
Natural willemite (Franklin Furnace)	5.31
Sidot Blendes	3.08 to 10.9

Calcium sulphide (Balmain)	1.26
Canary glass	7.31
Calcite (red) from Langban	0.132
Cadmium phosphate (red)	0.0182

Since to most of us the millilambert conveys no very definite meaning in terms of a familiar visual sensation, I may add that according to the measurements of Coblentz a tungsten filament at 2000° C., which is not far from the temperature of our ordinary incandescent lamps of the vacuum type, has a brightness of *630,000 millilamberts.*

Since our various fluorescent substances vary in color it should be further stated that the brightness in each case is such that the intensity of the maximum region in the fluorescent band equals the brightness of the corresponding region in the spectrum of a neutral matte surface of the specified number of millilamberts.

In general, according to these measurements our known luminescent materials are of the order of a few millionths in brightness compared with an illuminant such as the ordinary electric lamp.

E. L. Nichols

Physical Laboratory
of Cornell University,
December, 1921

THE AMERICAN SOCIETY OF ZOOLOGISTS

The American Society of Zoologists held its nineteenth annual meeting at the University of Toronto in conjunction with Section F of the American Association and in association with other biological societies on December 28, 29 and 30, 1921. President C. A. Kofold and Vice-president A. L. Treadwell presided at the various sessions.

William Bateson, director of the John Innes Horticultural Institution, Merton Park, Surrey, England, was elected honorary fellow of the society.

The following were elected to membership:

Edward F. Adolph, University of Pittsburgh; Charles P. Alexander, University of Illinois; William R. Allen, University of Akron; Horace B. Baker, University of Pennsylvania; Frank N. Blanchard, University of Michigan; Joseph H. Bodine, University of Pennsylvania; Robert H. Bowen, Columbia University; Alfred E. Cameron, University of Saskatchewan; William H. Cole, Lake Forest College; Mary E. Collett, University of Buffalo; Rheinart P. Cowles, Johns Hopkins University; Alden B. Dawson, Loyola University Medical School; Hoyt S. Hopkins, Baylor Medical College; Carl L. Hubbs, University of Michigan; George W. Hunter, Knox College; Donald E. Lancefield, University of Oregon; James W. MacArthur, University of Toronto; Robert S. McEwen, Oberlin College; Peter W. Okelberg, University of Michigan; Charles L. Parmenter, University of Pennsylvania; Mary E. Pinney, Lake Erie College; Franklin P. Reagan, University of California; Robert C. Rhodes, Emory University; Franz Schrader, Bryn Mawr College; Gotthold Steiner, University of Berne; Horace W. Stunkard, New York University; Tage Ellinger, University of Illinois; Lewis H. Weed, Johns Hopkins University; Alvalyn E. Woodward, Amherst College; Benjamin P. Young, Cornell University; Hachiro Yuasa, University of Illinois.

After the election the membership roll of the society contained 357 names of members in good standing.

The report of the treasurer showed a probable balance for January 1, 1922, of $808.20, a loss for the year of $81.71, although there are fewer members in arrears than at any time in the last four years. The attention of the society was called to the fact that the present plan of operating on a basis of fifty cents per member per year must in time deplete the accumulated surplus of the society.

The constitution and by-laws were amended to permit the separation of the office of secretary-treasurer.

The nominating committee, composed of M. F. Guyer, S. J. Holmes and J. H. Gerould, reported the following nominations:

President—H. H. Wilder.

Vice-President—B. M. Allen.

Secretary—W. C. Allee.

Treasurer—D. H. Tennent.

Member of the Executive Committee—C. A. Kofoid.

Member of the National Research Council—H. S. Jennings.

Three associate editors of the *Journal of Morphology*—L. L. Woodruff, G. A. Drew and H. V. Neal.

Membership in Council of the American Association for the Advancement of Science—Charles Zeleny and H. E. Crampton.

No other nominations were presented and these men were duly elected.

The executive committee announced the appointment of Aaron L. Treadwell and A. A. Schaeffer as members of the advisory board for the ensuing four years. The other members of this board are: To serve one year, M. M. Metcalf and Gary N. Calkins; to serve two years, William E. Castle and F. R. Lillie; to serve three years, C. A. Kofoid and D. H. Tennent.

S. I. Kornhauser, who has been representing the society in cooperation with a committee from the American Bacteriological Society, in an attempt to standardize American dyes for biological purposes, requested members to forward any information at their disposal concerning the comparative merits of American and imported dyes. He has on hand a considerable amount of information regarding American dyes which is available for any one interested.

The society approved the resolutions adopted by an intersociety conference called at Toronto by the Division of Biology and Agriculture of the National Research Council as a result of a request from representatives of the Botanical Society of America, the American Society of Naturalists and the American Society of Zoologists.

These resolutions call for the appointing of the presidents and secretaries of the societies concerned as an intersociety council to whom shall be referred matters of common interest and who shall study plans for and report a possible constitution of a proposed federation of American biological societies.

As a result of many conferences among those interested the following action was taken creating a Section on Genetics in the society:

Moved, That authorization be given for the formation of a Genetics Section of the American Society of Zoologists to cooperate with a similar section established in the Botanical Society of America.

It shall be understood that any member of the American Society of Zoologists may become a member of the Genetics Section by indication of his desire to that effect.

Any member of the society submitting a paper on genetics has the right to have it included in the program of the Genetics Section.

The Genetics Section may designate one of its members as a consulting member of the executive committee of the American Society of Zoologists.

The Section was duly organized.

After considerable discussion, the parasitologists assembled at Toronto decided not to organize a section at present, but appointed Charles A. Kofold their representative, with B. M. Ransom alternate, to attend the proposed conference on the organization of a biological federation and to urgently request the conference to arrange that there could be membership in the proposed Section of Parasitology of men not eligible at present for membership in the American Society of Zoologists.

A communication was received from the Ecological Society of America asking for financial aid in classifying the degree of modification from primeval conditions of the animal life in the different national, state and local preserved areas. Twenty-five dollars was voted for this purpose.

GENERAL RESOLUTIONS

The following resolution was adopted and ordered sent to the appropriate officials:

The American Society of Zoologists, understanding that there is a temporary suspension of certain scientific publications of the U. S. government, including the *Journal of Agricultural Research*, the *Experiment Station Record* and the *Monthly Weather Reports*, desires to put on record its very high appreciation of these journals and of their great national and international importance in the field of natural science and would respectfully urge their resumption at as early a date as possible.

The following resolution was adopted:

Resolved, That the secretary express to the president of the University of Toronto and the local committee on arrangements the high appreciation of the American Society of Zoologists for the splendid facilities afforded this meeting and for the cordial hospitality shown the members attending.

The sessions for the prsentation and discussion of papers were better attended than usual in spite of the fact that the society frequently met in sections on account of the length of the program. The symposium on "Orthogenesis," the dinner, and the biological smoker, arranged by the zoologists, were particularly well attended. In point of numbers attending, the smoker was one of the outstanding features of the meeting.

The presence of Professor William Bateson gave a cosmopolitan flavor to the international meeting. The invitation to Professor Bateson was initiated by the American Society of Zoologists, and his presence was due to the cooperation of the Society with the American Association.

A full list of titles and abstracts of the papers presented together with a more complete account of the business transacted will appear in the January number of *The Anatomical Record*.

W. C. ALLEE,
Secretary.

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THE SPECTROSCOPY OF THE EXTREME ULTRA-VIOLET[1]

In the year 1914 I published a monograph under the title of "The Spectroscopy of the Extreme Ultra-Violet"; to-day I wish to trace the progress of the subject to the present time. The part of the spectrum with which we are concerned has for its less refrangible limit wave-length 2,000 A.U.; it now extends to a region separated from X-rays by less than 200 units.

It is more than thirty years ago since Victor Schumann led the way into this undiscovered country, and gave his name to the region he explored. His methods and his results are familiar to all spectroscopists, but it may be well to remind you of the nature of the difficulties which he conquered. The extension of the spectrum in the ultra-violet is opposed by three factors, the opacity of the materials usually employed in the making of prisms and lenses, the opacity of gelatine, and the opacity of the air. By the use of fluorite, by the invention of a special photographic emulsion and by placing his spectrograph in vacuum, Schumann demonstrated that the spectrum could be extended by nearly eight hundred units.

The result, though easily described, was only reached after years of patient toil, for experimentation in this region was, and still is, beset with great difficulties. Every contribution which Schumann made to the subject is marked by the greatest exactness and finish; his field was limited, but within that field not only his technique but also his reasoning remain a model to this day.

The first and most characteristic product of his labors was a series of exquisite spectrograms of hydrogen; but owing to the lack of a dispersion curve for fluorite, it was out of the question to attach wavelengths to the lines

[1] Address of the president of the American Physical Society, Toronto, December, 1921.

which constituted these spectra. It was obvious that if a concave diffraction grating could be substituted for the prisms and lenses wavelength measurements could be made and at the same time the limitations set by the opacity of fluorite could be avoided.

I attacked the problem a good many years ago and most of the results have been long since in print. The spectrum of hydrogen was extended to the neighborhood of 900 units and its wavelengths were measured to within an error 0.2 of a unit, the accuracy being checked by Wolff through an ingenious application of certain series relations devised by Paschen. In a fruitless search for substances more transparent than fluorite the opacity of a large number of solids was next tested. The absorption of the commoner gases was measured and it was demonstrated that oxygen partly resumed its transparency with decreasing wavelength, a result which has been recently confirmed as we shall presently see. A considerable time was spent in the study of the emission of various substances and in the measurement of their spectra; partly because they occurred as impurities in the hydrogen discharge and partly because of the interest which attached to certain series relations connecting the radiations of some of them.

Toward the end of the period covered by these researches W. T. Bovie[2] of the Harvard Medical School became interested in the abiotic effects of Schumann rays, and carried out several investigations in that field. At nearly the same time F. H. Palmer[3] conducted a study of the volume ionisation produced by ultra-violet light; his experiments afford what I believe is the most direct proof of the effect yet obtained by any one. Later P. E. Sabine[4] carried out a preliminary investigation of the photo-electric effect in the region of very short wavelengths; and I. C. Gardner[5] made a quantitative study of the reflective power of metals and demonstrated the superiority of platinum and silicon over speculum in the extreme ultra-violet.

[2] *Botanical Gazette*, 59, No. 2, 1915; 60, No. 2, 1915; 61, No. 1, 1916, etc., etc.

[3] *Phy. Rev.*, 32, p. 1, 1911.

[4] *Phy. Rev.*, N. S. 9, p. 210, 1917.

[5] *Astrophysical J.*, 45, p. 30, 1917.

Having completed a reconnaissance of the region discovered by Schumann it was natural that attention should turn to its extension toward the ultra-violet. By the use of helium gas and by the employment of a strong disruptive discharge I succeeded in pushing the spectral limit to the neighborhood of 500 AU in 1917.[6] In the process of this research various gas spectra including those of argon and nitrogen came under observation; moreover, the existence of the series in hydrogen predicted by Ritz and obeying the law $V = N\left(1 - \frac{1}{m^2}\right)$ was confirmed.

During the period whose activities have so far been described interest in the Schumann region had been confined to a very few, and the work had been carried on in but a limited number of places. We now enter on an epoch extending to the present time, where the study of this field bids fair to be much more general. In view of this awakening interest it may be well to pause long enough to say something of the technique which is involved in the study of the spectral region under discussion.

The spectroscopy of the extreme ultra-violet combines all the difficulties inherent in the nice adjustment of delicate optical apparatus with those which accompany the production and maintenance of high vacua in metallic containers of large volume. The first are only to be overcome by skill and patience; the second have been greatly alleviated during recent years by the improvement in mechanical vacuum pumps and by the use of charcoal and liquid air. In the design of the vacuum spectroscope, whether it be intended for prism or grating, simplicity is the chief requisite. This I was at some pains to point out years ago. A good example is afforded by the highly successful apparatus of Millikan where grating, plate holder and source are all contained in one cylindrical brass tube closed at the ends by simple plates made air tight with rubber gaskets. The improvements which McLennan has introduced have also been directed away from the pernicious ingenuities of the instrument makers.

[6] *Astrophy. J.*, 43, p. 89, 1916.
SCIENCE, 45, p. 187, 1917.

Time does not permit the discussion of details of design but it is useful to note that McLennan has emphasized the advantage of horizontal surfaces for those joints which must be often made and broken; I venture to add that I still find the gasket formed of a string of soft wax useful in such joints even when the highest vacuum is required. Moreover, I have found that a carefully cut screw of say ½ mm. pitch working in a nut about 6 cm. long will serve to communicate motion to electrodes within the apparatus without introducing a leak provided the screw and nut are sealed together with wax after each adjustment.

There is one fault in vacuum spectroscope design so common that it merits particular attention. It is concerned with the question of angular aperture in those cases where a lens cannot be employed. For example, if the slit is placed on the circle whose diameter is the grating's radius of curvature, and to which the plate should conform, it is mechanically difficult to place the source of light sufficiently near the slit to fill the grating. Millikan has overcome the trouble, as we have just seen, by placing the source of light within the body of the spectroscope, but this process presents some inconveniences when vacuum tube spectra are to be examined.

The grating affords the only means at our disposal for analyzing light of the very shortest wave lengths spectroscopically, but its use is accompanied by several disadvantages, not the least of which arises from the fact that an amount of tarnish which would be quite harmless in the ordinary part of the spectrum proves fatal in the region under discussion. To the favored few who have a ruling engine at their command the difficulty is overcome by the simple expedient of ruling a new grating! The majority are not so fortunate, they may therefore be interested in the results of some experiments of my own. Guided by the work of Gardner, I have tried covering a tarnished grating with a thin cathode deposit of either platinum or silicon. The results seem favorable and I have good hopes that the method affords a means of rejuvenating diffraction gratings especially if silicon be employed.

We may now return to a consideration of the results of the last half dozen years. In 1914, Saunders,[7] working at Tübingen, followed the spectra of calcium and zinc in a vapor lamp to the neighborhood of 1000 A.U. He also confirmed my observations on the hydrogen lines of the Ritz series.

About the same period L. and E. Bloch[8] began their investigations; their work, interrupted by the war, has recently been resumed. Their vacuum spectrometer contains a train of fluorite and includes the novel feature of a constant deviation prism. They have measured the spark spectra of sixteen elements, to the neighborhood of 1400 A.U. Their tables contain not only their own results but also those of other investigators in the same field. The determinations of wavelength rest on my values for certain lines in aluminium, hydrogen, mercury and nitrogen. It may be noted parenthetically that wherever possible a direct comparison with the spectrum of hydrogen should be used in measurements between 2000 and 1000 A.U.

McLennan,[9] in collaboration with his students, has measured both the arc and spark spectra of a considerable number of substances. He has employed both prism and grating instruments and with the latter he has pushed his results to the neighborhood of 500 A.U. His researches have emphasized the importance of the suppression of water vapor in the spectroscope; to this end he has added ample drying tubes to his apparatus. It is particularly interesting to note that he has succeeded in obtaining radiations down to the neighborhood of 1020 A.U. through an atmosphere of helium over two meters long at a pressure of 29 cm., thus confirming the transparency of the gas in the Schumann region.

His most recent work revives the discussion as to the existence of the series in helium corresponding to the formula $V=4N\left(\frac{1}{2^2}-\frac{1}{m^2}\right)$. I have presented[10] some evidence for the existence of the two first mem-

[7] *Astrophy. Jour.*, 40, p. 377, 1914.

[8] *Jour. d. Phy. et le Radium*, 2, p. 229, 1921.

[9] Proc. Roy. Soc., 95, p. 258, 95, p. 316, 1919; 98, pp. 95-123, 1920.

[10] Science, 50 p. 481, 1919.

bers, but I must confess that I am not altogether satisfied with its validity. As to the members of higher order adequate proof of their existence seems to be quite lacking. The crux of the whole matter lies in the fact that to produce radiations of sufficiently short wave length a violent disruptive discharge must be employed which introduces impurities torn from the discharge tube and its electrodes. No matter how carefully the gas is treated the lines due to these impurities furnish a constant source of confusion which must never be overlooked. In spite of the fascinating possibilities conjured up by the work of Rutherford on atomic disintegration, I am of the opinion that but three lines can be ascribed to the spectrum of helium in the Schumann region with any certainty. Of these two lie near 1640 and 1215 A.U. and are by no means above suspicion. The origin of the third at 585 discovered by Fricke[11] and the speaker last year is much more to be relied upon. This last radiation possesses the added importance of showing a direct numerical relation with the radiation potential of helium.

I have said that interest in our subject is spreading. As evidence I present some very recent results obtained on the Pacific Coast by J. T. Hopfield. He has devised a method of studying the emission spectra of gases which are opaque in the Schumann region without the use of a window, the transparent gas which fills the body of the spectroscope and the substance under examination being kept separate by gas currents suitably directed. One of his most striking results relates to the spectrum of oxygen; he not only finds a number of lines throughout the Schumann region which he attributes to this element, but he has also discovered that radiations between wavelengths 1336 and 990 may be photographed even through a column of oxygen a meter long and at a pressure of about 0.4 mm. This result confirms and extends my observations on the absorption band of this gas. Finally, he appears to have discovered an improved process for the manufacture of Schumann plates.

By far the most important contribution to the subject has been made by Millikan.[12] Ably seconded by his students, Sawyer and Bowen, he has not only succeeded in extending the spectrum to the neighborhood of 150 A.U. but also by the study of the radiations in this region he has established a connection between light diffracted by a grating and those shorter wavelengths known as X-rays. Rightly conjecturing that the production of vibrations of the highest frequency depends as much on the intensity of the electric field at the source as upon the substance of the radiator, he has employed a minute high potential spark in the best obtainable vacuum. With this arrangement he has investigated the spectra of a number of substances including carbon, zinc, iron, sodium, magnesium and aluminium and has measured many of their lines.

It is a curious fact that many substances produce spectra of striking similarity in the extreme ultra-violet when stimulated by the high potential spark or even when exposed to a disruptive discharge in a vacuum tube. The lines of the spectrum obtained from helium, for example, are nearly all common to the spectra of carbon and of lithium, while aluminium, magnesium and iron, etc., have identical spectra between 1000 and 250 A.U. The presence of a common impurity furnishes the most conservative explanation for this striking phenomenon, though those inclined to speculation may turn a longing eye toward atomic disintegration. Millikan[13] has shown that oxygen is probably the impurity in question.

Fabry[14] has recently emphasized the fact that this region of roughly 150 A.U. between the limit as set by Millikan's experiments and X-rays capable of analysis by a crystal is one of the most interesting in the whole spectrum. He points out that here the absorption of many substances should pass through a maximum and then decrease; here metals begin to manifest their high reflective power and here the phenomena of refraction will appear,

[11] *Phil. Mag.*, 41, May, 1921.

[12] *Astrophy. Jour.*, 52, 47, 1920; 52, 286, 1920; 53, 150, 1921.

[13] Proc. Nat. Acad., 7, p. 289, 1921.

[14] Journal Franklin Institute, p. 227, 1921.

though probably masked by absorption. The exploration of this region by methods not strictly spectroscopic lies beyond the scope of this paper but the subject is so fascinating that I cannot resist a brief digression.

The production and study of very soft X-rays has occupied the attention of many investigators here, in England and on the continent. One of the researches typical of the early development of the subject was that of Sir J. J. Thomson[15] in 1914; one of the more recent is that of Halweck.[16] As the method of this second investigator seems to trace a rather direct path across the frontier of the extreme ultra-violet it merits our attention.

Halweck generated his soft X-rays in a Coolidge tube of special form separated from an ionisation chamber destined to measure the absorption cofficients of the radiations by an extremely thin window of celluloid. He observes that the absorption coefficient of gases increases with wavelength between 40 A.U. and 100 A.U. following an exponential law similar to that observed by Owen for ordinary X-rays. For celluloid the coefficient at first follows the same law, then increases less and less rapidly, passes through a maximum near 320 A.U. and diminishes toward the ultra-violet. This work is of particular interest since it traces a physical property of a solid, its absorption, through the "no man's land" in question. All estimates of wave length are obtained from the potential difference in the tube and the use of the relation $Ve = hv$.

Holweck finds that a film of celluloid a quarter of a micron thick transmits about twenty per cent. near 1000 A.U., while but three per cent. will pass at the maximum of absorption, this result is of some practical importance to the spectroscopist. Miss Laird[17] has also made a preliminary investigation on the transmission of thin membranes.

The study of radiation and ionisation potentials affords another means of bridging the gap between optical spectra and X-rays. Begun by Franck and Hertz, and continued by many investigators here and abroad with results of such fundamental importance, work in this field has led Mohler and Foote[18] to the discovery of characteristic soft X-rays produced by arcs in vapor. They interpret their results to mean that the critical potentials which they have measured correspond to the first L absorption lines of X-ray spectra of the substances in question: for if the square roots of the frequencies, computed from these potentials, be plotted on a Moseley diagram, the points will be very nearly on a continuation of the straight line typical of the L X-ray spectra of the heavier elements. The longest wavelength they have measured in the L series is for sodium, 353 A.U., magnesium yielding 268, and phosphorus 98. A critical potential for potassium is interpreted as an M series limit with a wavelength of 536 A.U.

When we return to purely spectroscopic investigation we find that the most striking results have been recently obtained by Millikan.[19] In an address before the National Academy, in April, he reports the discovery of certain lines of aluminium, magnesium and sodium at 144.3, 232.2, and 372.2 A.U., respectively, which he identifies as the $L\alpha$ lines of the X-ray spectra of these elements. The square roots of the corresponding frequencies lie very nearly on the straight line connecting $L\alpha$ frequencies and atomic number on the Moseley diagram. The wavelength of the $L\alpha$ line for sodium is in qualitative agreement with the value found by Foote and Mohler; for aluminium and magnesium, however, the case is not so clear. As Duane has pointed out the difficulty arises in this way: it is a fundamental property of X-ray spectra that the $L\alpha$ line lies on the long wavelength side of the L absorption; now the L absorption for aluminium and for magnesium can be accurately calculated; they lie at 173 and 257 respectively, but the $L\alpha$ lines for these substances chosen by Millikan are at 144.3 and 232.2. Thus the values are on the wrong side of the position of absorption.

The spectra of aluminium, magnesium and sodium occupy but a very limited region in

15 *Phil. Mag.*, 28, p. 620, 1914.

16 *Comptis Rendu*, 171, p. 849; 172, p. 439.

17 *Physical Rev.*, 15, 543, 1920.

18 *Jour. Wash. Acad.*, 11, p. 273, 1921.
See also Kurth, *Phy. Rev.*, 17, 528, 1921.

19 Proc. Nat. Acad., 7, 289, 1921.

the extreme ultra-violet and there is a considerable blank before their lines reappear in the Schumann territory. It is of interest to inquire if these spectra present that similarity of structure which is a fundamental characteristic of X-ray spectra of the heavier elements.

The nature of modern atomic models might lead one to expect certain rather abrupt changes with decreasing atomic number in the appearance of spectra of elements lighter than Neon. These changes Millikan has observed. He attempts to bring these spectra under the X-ray classification by arbitrarily designating certain lines as the L_α radiation of the corresponding substances. The wisdom of this course seems to me somewhat doubtful, for though there is probably no discontinuity between the mechanism which produces optical spectra and that to which the X-rays owe their origin, yet the structure of spectra of the lighter elements seems to resemble the arrangement of X-rays so little that the same nomenclature cannot be employed in both cases with profit. Even where the radiating mechanism is simple as in hydrogen, there is small advantage in calling the Ritz series a K series or in designating the Balmer series as an L series. However, this objection is only a matter of taste; certainly it in no way detracts from the importance to be attached to Millikan's discovery, for by purely spectroscopic methods he has made a most important advance on the road connecting the region of X-rays with the rest of the spectrum.

Thus we see that the extreme ultra-violet has grown from an obscure corner of spectroscopy to a region of real importance, and that its study has developed from a scientific tour de force into investigations intimately connected with the most fundamental matters.

And now, before I close, let us look back over these thirty years to the man who began it all; *Victor Schumann,* slow, exact, infinitely patient, without any brilliant generalizations in his head but absolutely sound in his conclusions. Perhaps even the atom builder may pause a moment to contemplate him, and may profit by the process.

THEODORE LYMAN

HARVARD UNIVERSITY

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

REPORT OF THE COMMITTEE[1] ON AN INTERNATIONAL AUXILIARY LANGUAGE ACCEPTED BY THE COUNCIL AT TORONTO, DECEMBER 29, 1921

THE present report makes no attempt to discuss what might be the detailed requirements of an international auxiliary language, nor even to consider alternative solutions already suggested. The committee has interpreted its immediate function as in no sense that of a judge to pass on such matters or even to assemble them for critical review at present, but it aims simply to present herein as concise and constructive a view as possible of the present state of public interest in the problem and to recommend what should be the attitude and activities of the association with respect to serious studies in this whole field, leaving it entirely to the results of such studies, if undertaken, to speak for themselves.

The subject of international language is an old one and a great deal of effort has already been expended upon it, but chiefly by individuals or by organizations formed purely for this purpose. It is only in the last few years that there has been any general movement on the part of governmental, scientific or academic bodies to take the subject seriously and follow it systematically.

The present organized movement in this direction may conveniently be considered as dating from the adoption by the International Research Council in July, 1919, at Brussels, of the following resolutions:

(*a*) That the International Research Council appoint a committee to investigate and report to it the present status and possible outlook of the

[1] Authorized by the Council at St. Louis, December, 1919, and appointed April, 1921: S. W. Stratton (chairman), director, United States Bureau of Standards; Carl L. Alsberg, director, Food Research Institute, Stanford University; V. A. C. Henmon, professor of education and director of School of Education, University of Wisconsin; John C. Merriam, president, Carnegie Institution of Washington; C. E. Seashore, professor of psychology and dean of the Graduate College, University of Iowa.

general problem of an international auxiliary language.

(*b*) That the committee be authorized to cooperate in its studies with other organizations engaged in the same work, provided that nothing in these resolutions shall be interpreted as giving the committee any authority to commit the council to adhesion to or approval of any particular project.

The activities of the committee appointed under these resolutions have thus far been devoted chiefly to awakening interest and securing cooperation through the national scientific, academic, educational, technical and commercial organizations of the individual countries, it being felt that a broad and intelligent interest in the subject within these national academies, societies and associations is a necessary prerequisite to any effective international action toward practical results.

Since the creation of the above-named committee a number of other important public bodies have taken definite action looking in the same general direction. Thus, on September 13, 1921, the following resolution was presented in the Assembly of the League of Nations by delegates representing twelve states:[2]

The League of Nations, well aware of the language difficulties that prevent a direct intercourse between the peoples, and of the urgent need of finding some practical means to remove this obstacle and help the good understanding of nations;

Follows with interest the experiments of official teaching of the international language Esperanto in the public schools of some members of the League;

Hopes to see that teaching made more general in the whole world, so that the children of all countries may know at least two languages, their mother tongue, and an easy means of international communication;

Asks the Secretary General to prepare for the next Assembly a report on the results reached in this respect.

The special committee[3] dealing with the inclusion on the agenda, of motions submitted to the Assembly reported to that body on September 15, 1921, with regard to this motion, as follows:

The above-mentioned delegates have proposed the introduction of Esperanto, as an auxiliary international language, into public schools, in order to facilitate direct intercourse between all nations throughout the world.

The committee are of opinion that this question, in which an ever increasing number of great states are interested, should be attentively studied before it can be dealt with by the Assembly. The question was referred to a committee last year and a short report was submitted, recommending that the Secretariat of the League should investigate the experiments already made and ascertain the actual results attained.

The committee proposes *that the question should be placed on the agenda of the next Assembly* and that the Secretariat of the League should in the meantime prepare a complete report, accompanied by the necessary documentation, on the lines indicated in the draft resolution.

In accordance with the wishes of the signitories, the Report of Committee No. 2 (document 253, of December 17, 1920) and the Report of the Under-Secretary-General upon his mission to the Congress at Prague will be transmitted to the members of the League in due course.

This report by the Under-Secretary-General (Dr. I. Nitobe) referred to above, consists of three sections, viz.: (I) An Account of the Thirteenth International Congress of Esperantists at Prague, July-August, 1921; (II) Observations on the Esperanto Movement; (III) The Language Question and the League of Nations. Nearly the complete text of the last section was printed and distributed to delegates during the last Assembly, as document A 72, 1921, XII, 14 Sept., 1919, copy of which is hereto attached as Appedix A.[4] The whole report will undoubtedly be available later.

The first national scientific body to take up

[2] Lord Robert Cecil (South Africa), Jonnesco (Rumania), Emir Zoka-Ed-Dovleh (Persia), La Fontaine (Belgium), Benes (Czecho-Slovakia), Restrepo (Colombia), Tsai Fou Tang (China), Enckell (Finland), Fan Noli (Albania), Adatei (Japan), Escalante (Venezuela), Maharajah Knengarje (India), Askenazi (Poland).

[3] Lord Robert Cecil (South Africa), *chairman;* Restrepo (Colombia); Schanzer (Italy); Tang Tsai Fou (China); de la Torriente (Cuba); Trygger (Sweden); Viviani (France).

[4] Copies of these appendices may be secured through the National Research Council, 1701 Massachusetts Avenue, N. W., Washington, D. C.

the question seriously was the British Association for the Advancement of Science, which, in response to the call of the International Research Council, appointed, through its section on Educational Science at its Bournemouth meeting, September, 1919, a committee "to Enquire into the Practicability of an International Auxiliary Language." At the Edinburgh meeting, September, 1921, this committee presented a comprehensive report of its studies to date, covering chiefly comparisons of Latin, as typifying classical languages; English, as typifying modern languages; and Esperanto and Ido, as typifying the artificial group. The committee briefly summarizes its conclusions as follows:

(1) Latin is too difficult to serve as an international auxiliary language;

(2) The acceptance of any modern national language would confer undue advantages and excite jealousy;

(3) Therefore an invented language is best. Esperanto and Ido are suitable but the committee is not prepared to decide between them.

The committee was continued and is understood to be making a more detailed study of artificial languages. The 1921 report of the committee is hereto appended as Appendix B.[4]

During the past year both the French and the Italian Associations for the Advancement of Science have likewise appointed committees on the international language question, but as yet these committees have made no reports.

Experiments in the teaching of Esperanto abroad, as a regular subject in the public school curriculum, are rapidly multiplying and being taken more seriously. This last year, for example, it was introduced as an optional subject in all the public schools of Milan, Italy, in the eighth year, being actually taken by some 2,000 students, while it has been made a compulsory subject for the present school year in all of the public schools of Geneva, Switzerland, for the seventh year of the course, representing some four hundred students. A brief published account of similar experiments in the north of England is herewith included as Appendix C.[4] Chambers of commerce and labor organizations are also showing a steadily growing interest in the matter, as more fully outlined in Dr. Nitobe's report (Appendix A.)

In the United States, the following academic bodies have already appointed committees on the subject: American Association for the Advancement of Science, American Council on Education, American Classical League, American Philological Association, National Research Council. The American Council of Learned Societies has authorized the appointment of delegates to confer with the last-named committee in an attempt to work out a plan of cooperation between the two councils. This seems of paramount significance because of the position which these two councils occupy as the American representatives, respectively, of the International Research Council and the International Union of Academies, which latter two organizations constitute the recognized international authorities in natural science, on the one hand, and in humanistic studies, on the other.

It is interesting in this connection to note that the initiative in the present question seems to have come from the natural scientists, chiefly out of their interest as prospective users of such a language, although they have indicated throughout that they clearly recognized the technical side of the question to lie squarely in the proper field of the linguist, to whom they turn for help, much as the engineer and manufacturer have in the past turned to the worker in pure science, insisting that he help them in their practical needs with his expert knowledge from the theoretical side, even though their so-called applied science might not attract him as an aim in itself.

It seems to your committee that, to attain useful practical results in this subject, two things are essential:

First, a searching fundamental study of the principles involved and experimental data available;

Second, authoritative international agreement, both as to linguistic details and as to the practical measures to be taken.

In certain general aspects of the first requirement, members of the American Association may be of direct assistance, as, for instance, the physicist, in the recording and analysis of the sounds in speech, and the psychologist, in the measurement of mental phenomena. Also, in each special field of science and technology, the working out of technical vocabularies will call for close cooperation of all concerned. But we must naturally look to the linguist and the philologist for the greater part of the general framework of fact and interpretation. However, it is just in such new frontiers of knowledge that thorough and intimate cooperation by all groups is most apt to be fruitful.

With regard to the second requirement, the American Association may make its influence most potently felt through vigorous moral support of the project in general, and especially of the leadership of the work by the two national councils above mentioned, as the logical path for expression of natural academic thought in the international field.

In order to give expression to the position of the association on this general problem your committee recommends the adoption of the following resolutions:

Whereas, All the sciences are alike interested in unifying the fundamental tools of thought, and have been notably successful in so doing, with respect to our system of numbers, the Arabic numerals, the metric system, the measurement of latitude and longitude, angular divisions, mathematical symbols, chemical formulæ, time and the calendar, notation in music, and other technical usages; and

Whereas, There appears to be a generally expressed need for a suitable international auxiliary language for the prompt and world-wide diffusion of scientific data, and for intercommunicating between nations differing in languages;

Therefore, Be It Resolved, That the American Association for the Advancement of Science:

(*a*) Recognizes the need and timeliness of fundamental research on the scientific principles which must underlie the formation, standardization, and introduction of an international auxiliary language, and recommends to its members and affiliated societies that they give serious consideration to the general aspects of this problem, as well as direct technical study and help in their own special fields wherever possible;

(*b*) Looks with approval upon the attempt now being made by the National Research Council and the American Council of Learned Societies to focus upon this subject the effort of those scholars in this country best fitted for the task, and to transmit the results to the appropriate international bodies;

(*c*) Indorses the heretofore relatively neglected problem of an international auxiliary language as one deserving of support and encouragement;

(*d*) Continues its Committee on International Auxiliary Language, charging it with the furtherance of the objects above enumerated and reporting progress made to the association at its next meeting.

S. W. Stratton,
Chairman

THE PSYCHOLOGICAL CORPORATION[1]

The Psychological Corporation has been incorporated under the laws of the State of New York. The second article of the charter reads:

> The objects and powers of this corporation shall be the advancement of psychology and the promotion of the useful applications of psychology. It shall have power to enter into contracts for the execution of psychological work, to render expert services involving the application of psychology to educational, business, administrative and other problems, and to do all other things, not inconsistent with the law under which this corporation is organized, to advance psychology and to promote its useful applications.

So far as is known, this is the first corporation organized under the provisions of the business corporation laws of any state whose objects are the advancement of science and whose earnings must be devoted to scientific research. There are, of course, membership and charitable corporations not for profit and exempt from taxation, but the Psychological Corporation proposes to earn by its services the money that it will use for psychological organization and research.

Further provisions of the charter provide that no dividend in excess of $6 per share shall be paid during any calendar year and empower the American Psychological Association to take over any or all of the stock on payment of $100 per share. The stock is held in the first instance by psychologists active in the work of the corporation. It may be noted

[1] Statement prepared by the president of the Psychological Corporation.

that the general form of organization would be desirable for any public service corporation.

The directors of the Psychological Corporation are:

James R. Angell, Yale University.

W. V. Bingham, Carnegie Institute of Technology.

J. McKeen Cattell, The Psychological Corporation.

Raymond Dodge, Wesleyan University.

S. I. Franz, Government Hospital for the Insane.

G. Stanley Hall, Clark University.

H. L. Hollingworth, Barnard College, Columbia University.

Charles H. Judd, University of Chicago.

William McDougall, Harvard University.

W. B. Pillsbury, University of Michigan.

Walter Dill Scott, Northwestern University.

C. E. Seashore, University of Iowa.

Lewis M. Terman, Stanford University.

Edward L. Thorndike, Teachers College, Columbia University.

E. B. Titchener, Cornell University.

Howard C. Warren, Princeton University.

Margaret Floy Washburn, Vassar College.

John B. Watson, The J. Walter Thompson Company.

R. S. Woodworth, Columbia University.

R. M. Yerkes, National Research Council.

The Psychological Corporation proposes to maintain adequate standards in applied psychology, to assure opportunities and proper payment to those competent to do the work, and to use the profits for psychological research.

Psychology, owing to its recent progress and war service, is attracting wide public attention. This publicity is being used for all sorts of schemes, some of which may seriously injure psychology, not only in its applications but also in its academic standing. It is desirable that the general public shall have some means of learning what psychology can and what it can not do, and who can and who can not do it. An organized group of psychologists, whose standing is recognized, can exert a useful influence at the present time.

There is much psychological work of economic value that might at present be undertaken to advantage and there are those competent to do the work, but no satisfactory method exists for bringing them together. It is desirable to extend the work and especially to obtain a larger number of able workers and to provide more adequately for those who take up psychology, whether as an independent profession or in universities and other institutions.

The support of research work in any science has always been a difficult problem. In the past such work has been carried forward mostly by those earning their living by teaching. The industrial laboratories are now helping to improve the situation in chemistry, physics and the medical sciences; men are being engaged at relatively large salaries to do research work, often without direct reference to its useful applications. If research in psychology can be supported as a by-product of economic service, its progress will be accelerated in a geometrical ratio.

Perhaps the greatest opportunity is the investigation of problems directly or indirectly of economic value to individuals or groups, of which the work in industrial chemistry of the Mellon Institute of Pittsburgh is an example. Some seventy fellows, mostly younger men, paid an average salary of about $3,000, are engaged in research on problems of use to manufacturing chemists. The Psychological Corporation proposes to use the existing laboratories, where the special work can be done to the best advantage and thus to assist the universities and their psychologists.

The problem of selection for general intelligence and for special aptitudes or training is one in which psychology can be of great service at the present time. If standard tests are developed to be used everywhere, both among employees in groups and with individuals seeking employment or advancement, the corporation can give useful employment to many psychologists and probably earn sufficient income to carry on its work, and by research improve and standardize the tests.

The central offices of the Psychological Corporation are in the Grand Central Terminal, New York City. Branches have been established, or are in course of establishment, in Washington, Boston, Pittsburgh, Chicago, San Francisco and other centers. The real work of the corporation will, however, be done by psychologists in existing laboratories.

At the first meeting of the directors the following officers were elected:

President: J. McKeen Cattell.
First vice-president: Walter Dill Scott.
Second vice-president: Lewis M. Terman.
Chairman of the board: Edward L. Thorndike.
Secretary and Treasurer: Dean R. Brimhall.

SCIENTIFIC EVENTS

LIST OF SCIENTIFIC PERIODICALS[1]

THE Conjoint Board of Scientific Societies (Burlington House, London, W. 1) proposes to provide a world list of periodical publications which contain the results of original scientific research. It is hoped that it will be possible to give in a single octavo volume the titles, in alphabetical order, and the places of publication of all such periodicals in existence on January 1, 1900, and of all issued after that date. The libraries in London, Oxford, Cambridge, Edinburgh, Dublin, and Aberystwyth, which take in such periodicals, would be indicated, and, wherever possible, at least one library in the United Kingdom would be mentioned for each periodical. The scheme aims at supplying a complete list of current scientific periodicals; and, if means are found to carry it out, may form a basis of cooperation between libraries, so that both the number of duplicates and the list of periodicals not received may be reduced. The trustees of the British Museum have consented to allow the compilation of the list to be undertaken by the staff of the Museum, and already a large bulk of material has been collected in the museum by various societies and by the conjoint board. The Museum, however, can not undertake to defray the cost of printing and publication, but it is hoped that a sufficient number of libraries and institutions will agree in advance to purchase one or more copies at the price of 2 guineas each. The preliminary announcement which has been issued does not attempt to define a scientific periodical, but we apprehend that it is intended to exclude technical publications. It is not clear whether periodicals devoted to medicine would be included, and we understand that the point has not yet been decided. All departments of medicine, hygiene, and pathology, however, suffer more or less from the difficulty described, but it is felt to a very special degree by workers in these subjects in their application to the tropics; in particular the literature on helminthology, and indeed on parasitology generally, is very scattered, and papers which turn out to be of importance may be published in out-of-the-way periodicals, in the transactions of local societies, or in periodicals primarily devoted to some other science, as for instance entomology. Some time ago Professor R. T. Leiper, Director of the Department of Helminthology at the London School of Tropical Medicine, suggested that a list, showing the libraries in London and Liverpool at which periodicals publishing papers on tropical medicine could be consulted, would be of great use to workers, who at present may waste much time in making visits to libraries which do not contain the periodical they want or the particular number they wish to consult. The matter was brought to the notice of the Science Committee of the British Medical Association, which recognized the importance of the suggestion and in consequence a small sum of money was voted to cover preliminary expenses. A number of libraries have now been examined under Dr. Leiper's direction and a considerable amount of material collected, which it is hoped may shortly be made available. The manuscript list has been brought up to date and can now, we believe, be consulted at the School of Tropical Medicine.

[1] From the *British Medical Journal.*

THE GORGAS MEMORIAL INSTITUTE

THE American Public Health Association at its fiftieth annual meeting, held in New York City November 14-18, 1921, adopted the following resolution authorizing the president of the association to appoint a committee of five to cooperate with the organizers and directors of the proposed Gorgas Memorial Institute:

WHEREAS, The late William Crawford Gorgas, surgeon general of the United States Army, freed

Havana and the Panama Canal Zone of yellow fever and malaria, thereby saving thousands of lives and making possible the construction of the Panama Canal; and

Whereas, The work of the late General William Crawford Gorgas was an epoch in the field of medical science and a milestone in the work of public health throughout the world, in effect proving conclusively that health, even in the tropics, is a purchasable commodity under scientific guidance and administration; and

Whereas, It is the desire of the American people to join with the peoples and governments of Central and South America in paying tribute to the memory of General Gorgas, and the proposed Gorgas Memorial Institute, which will be erected in the City of Panama, represents the most fitting way to perpetuate the work of General Gorgas and to render the greatest good to humanity, with its possibilities for the saving of tens of thousands of human lives and the making available of hundreds of thousands of square miles of land for inhabitation and cultivation by white people; and

Whereas, The Republic of Panama, in expression of its gratitude to the late General Gorgas, has already donated the site, the building and all necessary equipment for the proposed Gorgas Memorial Institute representing approximately $500,000; there is yet required an endowment fund of from three to six millions of dollars to maintain and to carry on this great work;

Therefore, Be It Resolved, That the American Public Health Association assembled in its semi-centennial convention in the City of New York, November 17, 1921, go on record as heartily endorsing the proposed Gorgas Memorial Institute and that the president of the association be requested to appoint a committee of five to cooperate with the officers and directors of the proposed Gorgas Memorial Institute.

The following members of the committee have been appointed:

W. H. Welch, M.D., chairman, Baltimore, Md.; A. T. McCormack, M.D., Louisville, Ky.; Victor C. Vaughan, M.D., Ann Arbor, Mich.; Professor E. O. Jordan, Chicago, Ill.; M. P. Ravenel, M.D., Columbia, Mo.

THE REORGANIZATION OF MATHEMATICS IN SECONDARY EDUCATION

The complete report of the National Committee on Mathematical Requirements is in the press and will, it is hoped, be ready for distribution in April. It is published under the title "The Reorganization of Mathematics in Secondary Education" and will constitute a volume of about 500 pages. The table of contents given below indicates its general character.

Through the generosity of the General Education Board the National Committee is in a position to distribute large numbers of this report free of charge. It is hoped that the funds available will be sufficient to place a copy of this report in every regularly maintained high school library and also to furnish every individual with a copy free of charge who is sufficiently interested to ask for it. Requests from individuals for this report are now being received. They should be sent to J. W. Young, chairman, Hanover, New Hampshire. Individuals interested in securing a copy of this report are urged to send in their requests as early as possible. If the number of requests received exceeds the number the committee is able to distribute, the earlier requests will receive the preference.

The table of contents of the report is as follows:

Chapter XII. Experimental courses in mathematics. By Raleigh Schorling.

Chapter XIII. Standardized tests in mathematics for secondary schools. By C. B. Upton.

Chapter XIV. The training of teachers of mathematics. By R. C. Archibald.

Chapter XV. Certain questionnaire investigations.

Chapter XVI. Bibliography on the teaching of mathematics. By D. E. Smith and J. A. Foberg.

THE BRITISH COLUMBIA EXPEDITION OF THE UNIVERSITY OF CALIFORNIA

An expedition sent out by the University of California Museum of Vertebrate Zoology returned from northern British Columbia in the latter part of October. The party consisted of Harry S. Swarth, curator of birds; one assistant, William D. Strong, and local packers. Five months were spent in exploration of the valley of the upper Skeena River and in collecting series of the birds and mammals of the region. Over one thousand specimens were secured.

The summer's work was in continuance of a general plan, under way through a period of years, which has necessitated zoological exploration in various parts of British Columbia and Southeastern Alaska. This work was inaugurated and has been continually supported by Miss Annie M. Alexander, her interest leading her to participate personally in several of the expeditions. It has resulted in the acquisition by the museum of large collections of vertebrate materials and a store of detailed information, much of it new, regarding the animal life of the northwest coast region.

In the localities in which the last two seasons' field work was spent (the valley of the Stikine River in 1919, the Skeena River in 1921), the distribution of animal species is of particular interest. The section represented serves as a meeting ground between the faunas of eastern North America, the Pacific Coast humid strip, and the Yukon region to the northward. It thus affords exceptional opportunities for the study of the geographic behavior of the species involved. Hence, in the field work pursued, stress was laid upon the distribution of species, and collections were made showing the contrasts existing between mountain top and valley, and between coast and interior.

BACHE FUND OF THE NATIONAL ACADEMY OF SCIENCES

Dr. Heber D. Curtis has been elected a member of the board of directors of the Bache Fund of the National Academy of Sciences in place of Dr. E. B. Frost, resigned. The board is at present constituted as follows: Professor A. G. Webster, Clark University, Worcester, Massachusetts; Dr. Heber D. Curtis, Allegheny Observatory, Pittsburgh, Pennsylvania; and Professor Ross G. Harrison, Yale University, New Haven, Connecticut.

Applications for grants will be considered semi-annually and should be filed with the board not later than April 1 or October 1 of each year.

The following grants have been recently made:

H. Nort, Gouda, Holland, $200. For counting the stars on the Franklin-Adams Charts.

H. S. Jennings, Johns Hopkins University, $300. For a study of the cytology of the rhizopods with relation to the genetics and development of these organisms.

H. M. Evans, University of California, $500. For the investigation of the œstrous cycle in the rabbit and cat.

Carl Hartman, University of Texas, $500. For the study of the œstrous cycle of the opossum.

William Bowie, U. S. Coast and Geodetic Survey, $250. For the work of the Ukiah Latitude Station.

SCIENTIFIC NOTES AND NEWS

Friends of Professor Chandler presented in 1910 to Columbia University a sum of money which constitutes the Charles Frederick Chandler Foundation. The income from this fund is used to provide a lecture by an eminent chemist and to provide a medal to be presented to the lecturer in further recognition of his achievements in science. Previous lecturers on this foundation have been L. H. Baekeland, W. F. Hillebrand, W. R. Whitney, and F. Gowland Hopkins. The lecturer this year will be Edgar Fahs Smith, president of the American Chemical Society, formerly professor of chemistry and provost of the University of Pennsylvania. Dr. Smith's subject will be "Samuel Latham Mitchill—A Father in American Chemistry." Mitchill was the first professor of chemistry at Columbia College and the first senator from the State of New York. The lecture will be in Havemeyer Hall, Columbia University, on March 2, 1922, at 8:15 P. M.

Professor Theodore Lyman has succeeded the late Professor Charles W. Cross as chairman of the Rumford Committee of the American Academy of Arts and Sciences. Applications for grants from the funds at the disposal of the committee should be made to Professor Theodore Lyman, Jefferson Physical Laboratory, Cambridge, Massachusetts.

Dr. William T. Councilman, since 1892 professor of pathology in the Harvard Medical School, and Dr. Harold C. Ernst, since 1895 professor of bacteriology, will retire from active service at the close of the academic year.

The Ambassador of the United States to France has presented Professor Bergonie with the medal and diploma of the Franklin Institute in recognition of his services to science and more particularly for his apparatus employing electricity in the search for and extraction of fragments of projectiles.

The American Association of Economic Entomologists, at the Toronto meeting, elected Professor James G. Sanders, director of the Pennsylvania Bureau of Plant Industry, Harrisburg, to be president for 1922.

At the New Haven meeting of the American Society of Biological Chemists, the officers elected for 1922 were: *President,* Donald D. Van Slyke; *Vice-president,* Philip A. Shaffer; *Secretary,* Victor C. Myers; *Treasurer,* Walter R. Bloor; *Councilors,* Stanley R. Benedict, Harold C. Bradley, Albert P. Mathews; *Nominating Committee,* C. L. Alsberg, G. H. A. Clowes, P. B. Hawk, P. A. Levene, H. B. Lewis, E. V. McCollum, L. B. Mendel, J. R. Murlin, R. T. Woodyatt. The president and secretary of the Biochemical Society are this year the chairman and executive secretary of the Federation of American Societies for Experimental Biology, which will hold its 1922 meeting in Toronto.

In addition to the election, already noted here, of Professor Henry C. Cowles, of the University of Chicago, as president of the Botanical Society of America, other officers were elected, as follows: *Vice-president,* Margaret C. Ferguson, Wellesley College; *Treasurer,* I. W. Bailey, Bussey Institution; *Secretary,* I. F. Lewis, University of Virginia.

Mme. Marie Curie on February 7 was elected a member of the Paris Academy of Medicine. It is the first time a woman had been elected a member of one of the French academies. The committee had presented six names as candidates to succeed the late Edmund Perrier. The five men nominated withdrew their names when they found out Mme. Curie's name was on the list, and she obtained 64 votes against 15 blanks.

At the annual meeting of the Royal Meteorological Society on January 18 the Symons gold medal, which is awarded biennially for distinguished work in connection with meteorological science, was presented to Colonel H. G. Lyons.

Eric A. Lof, of the power and mining engineering department of the General Electric Company, has been decorated with the Royal Order of Vasa by the King of Sweden, in recognition of services to the Swedish Government.

Professor C. F. Curtis Riley, of the department of zoology of the University of Manitoba, who is carrying on investigations on the ecology and behavior of Gerridæ, has been elected a member of the Zoological Society of Tokyo, Japan.

The Société Française de Physique, at its last meeting in Paris, elected to its membership Professor L. L. Campbell, head of the Physics department of Simmons College, Boston.

The board of directors of the American Electrochemical Society has appointed Dr. Colin G. Fink, 101 Park Avenue, New York City, secretary of the society to fill the unexpired term of the late Professor Joseph W. Richards.

Oliver H. Gish, for the past four years research engineer with the Westinghouse Electrical and Manufacturing Company, resigned on January 1, to become associate physicist in the Department of Terrestrial Magnetism of the Carnegie Institution of Washington.

Louis J. Trostel, who for the past two years has been stationed at the Pittsburgh Station of the Bureau of Mines, engaged on problems relating to industrial gases and dusts, has accepted a position with the Bureau of Chemistry as assistant chemical engineer. He is engaged on chemical problems relating to explosions from starch and other carbonaceous dusts.

Dr. J. H. White has been appointed by the Rockefeller Foundation director of the Mexican commission against yellow fever, to replace Dr. T. C. Lyster, who has resigned.

Dr. Florence L. McKay, recently assistant director of child hygiene, Children's Bureau, U. S. Department of Labor, has been appointed director of the division of child hygiene of the New York State Department of Health.

Dr. Harold S. Davis has resigned from his industrial fellowship at the Mellon Institute of Industrial Research at the University of Pittsburgh to accept a position on the research staff of the Arthur D. Little Company.

A series of five lectures will be given in the University and Bellevue Hospital Medical College under its Herter Foundation on "Interfacial Forces and Phenomena in Physiology" by Dr. W. M. Bayliss, professor of general physiology, University College, London, beginning on Monday, the twenty-seventh of February, 1922, at 4 p. m. and continuing daily at the same hour at the Carnegie Laboratory, 338 East 26th Street. Dr. Bayliss will deliver the seventh Harvey Society lecture at the New York Academy of Medicine on Saturday evening, March 4, 1922. His subject will be "Vasomotor reactions and wound shock."

Dr. Edwin O. Jordan, professor of bacteriology in the University of Chicago, lectured at the School of Hygiene and Public Health of the Johns Hopkins University, on "Interepidemic Influenza," on January 30. His lecture is one of the series of the DeLamar lectures on hygiene.

The schedule for the spring public lectures, to be held at the Brooklyn Botanic Garden at 4 p. m., is as follows:

April 7. The Cultivation of Woodland Flowers: Mr. Norman Taylor, curator of plants, Brooklyn Botanic Garden.

April 14. English Gardens: Miss Hilda Loines, president of the Women's Auxiliary, Brooklyn Botanic Garden.

April 21. American Forests and the Necessity for Regrowth: Professor J. W. Toumey, Yale School of Forestry, New Haven, Conn.

April 28. The Civic Value of Botanic Gardens: Dr. C. Stuart Gager, director, Brooklyn Botanic Garden.

"Research in Chemistry as related to Medicine" was the subject of an address delivered on February 10 by Dr. Russell H. Chittenden of the Sheffield Scientific School, Yale University, before a joint meeting of the New York sections of the American Chemical Society and the American Electrochemical Society, the American sections of the Société de Chimie Industrielle and the Society of Chemical Industry. The address was followed by a discussion by C. H. Herty, H. T. Bogert and F. P. Garvan.

Dr. William McPherson, chairman of the department of chemistry at Ohio State University, spoke before the Chicago section of the American Chemical Society, January 20, on his experiences in visiting Italian universities.

A lecture on "Dyeing: Ancient and Modern" will be given by Professor A. G. Perkin at afternoon meetings of the Royal Institution on February 16 and 23.

Morten P. Porsild, director of the Danish Arctic station, Disco Island, Greenland, recently delivered lectures at the University of Cambridge on the "Flora of Greenland" and the "Excavations in the old Eskimo culture layers."

Professor H. E. Armstrong has consented to deliver the first Messel Memorial Lecture at the annual meeting in Glasgow of the Society of Chemical Industry. The medal to be presented to Professor Armstrong will, if practicable, be made from the platinum dish bequeathed to the society by Dr. Messel.

A STATUE of Emil Fischer was recently unveiled on the Luisenplatz, Berlin, opposite the statue of Robert Koch. A bronze bust of the chemist, who died in 1919, was also presented recently to the Chemical Institute by Dr. H. Fischer.

DR. PEARCE BAILEY, of New York City, known for his contributions to neurology and psychiatry, died from pneumonia on February 11 at the age of fifty-six years.

SIR WILLIAM CHRISTIE, astronomer royal from 1881 to 1910, died on January 22, in the seventy-sixth year of his age.

H. J. COTTERILL, for many years professor of applied mathematics in the Royal Naval College, Greenwich, died on January 8, at the age of eighty-six years.

IT is stated in *Nature* that at the recent meeting of the Hull Museums Committee the curator reported that when in London recently he heard that the specimens in the museum at the Royal Albert Institute, Windsor, were in rooms which were required for other purposes, and that there was an opportunity of obtaining the collections. He consequently visited Windsor, with the result that the whole of the specimens are now in Hull, and among them are many valuable additions to the antiquities and geological and natural history series already there. Particular mention may be made of some pre-historic Bronze Age and Stone Age weapons, a large collection of Roman lamps and pottery, Greek vases, and a miscellaneous series of medieval antiquities. Otherwise the objects are such as were to be found in museums of this character in the early part of the last century. A handbook to the collections, written by Mr. J. Lundy, was published many years ago.

It is announced that the first five commercial research fellowships instituted by the executive council of the British Empire Exhibition for competition among the chambers of commerce in the United Kingdom have now been awarded. The successful competitors are the chambers of commerce of London, Glasgow, Norwich, Warrington and Oldham, which will each nominate a fellow. The value of each fellowship is not less than £500, and will include a first-class return ticket to the dominion or crown colony to which the selected candidate will proceed. The subjects of research will be: the best means of promoting inter-imperial trade in a selected staple industry and the methods whereby the British Empire Exhibition can further the interests of this trade. The fellow will further investigate the potential resources in raw materials in the dominion or colony visited and the best means for exploiting them in the mutual interest of the dominion and England, and also report on the measures to be taken to insure that these undeveloped resources shall be adequately represented at the British Empire Exhibition and brought to the attention of interested financial and industrial groups.

A COURSE of six public lectures on the "Current work of the Biometric and Eugenics Laboratories" will be given in the department of applied statistics and eugenics, University College, London, February 15, 22, March 1, 8, 15 and 22, 1922. The order of the lectures is as follows: "Sidelights on the evolution of man: from the knee-joint," by Professor Karl Pearson; "On the inheritance of intelligence," by Miss Ethel M. Elderton; "Scheme of anthropometric measurements in the biometric laboratory," by Dr. Percy Stocks; "The relation of caries in the teeth of school children to health and home conditions," by Mr. E. C. Rhodes; "On the inheritance of certain types of blindness," by Dr. Julia Bell; "On occupational mortality," by Dr. M. Greenwood.

WE learn from the Fisheries' *Service Bulletin* that at the second meeting of the International Committee on Marine Fishery Investigations held recently at Boston, the members present were William A. Found and Dr. A. G. Huntsman, representing Canada, and Drs. H. F. Moore and H. B. Bigelow, representing the United States. D. James Davies, the member for Newfoundland, and Dr. R. E. Coker, one of the members for the United States, were unable to attend. Mr. Davies sent a cablegram indicating that Newfoundland expected to be in position by next summer to cooperate in collecting the desired statistical information. Pursuant to the resolution adopted at the first meeting looking to uniformity in reporting statistics of the offshore fisheries on the Atlantic coast, the committee adopted a form to be used, beginning with the first of the year 1922, for the recording of data obtained. Another resolution provided for the undertaking at an early date of investigations of the life histories of the cod and the haddock. Subcommittees were appointed for consideration of questions of tagging fish and studying ocean currents by the use of drift bottles. The third Friday in May, 1922, was appointed for the next meeting of the committee, which will be held in Montreal.

IN connection with the establishment of funds for scientific research in Norway, grants have now been made for the following purposes: (1) 8,000 kroner for experiments to be made in connection with the use of acetylene gas as motor fuel; (2) 24,000 kroner for the purpose of investigation of vitamines with special reference to cod-liver oil; (3) 6,000 kroner to examine the possibility of employing calcium carbide as a basis for further manufacture in Norway.

THE *London Times* reports that Dr. Mortensen and Mr. Hjalmar Jensen, Danish biologists distinguished, respectively, in zoology and botany, are leading a small expedition to the Kei Islands, west of New Guinea, where, following the advice of Dutch zoologists, they expect to find a suitable site and to draw up plans for the establishment of a permanent station. The plan was proposed some years ago at a Scandinavian research conference in Copenhagen. The Kei Islands lie on a small area of shallow water above the 100 fathom line, but the ocean floor shelves steeply down to the abyssal depths of the Banda Sea. This natural conformation is favorable to scientific work, for some of the fishes, corals and plants, usually to be obtained only by very deep dredging, are believed to ascend to within easy range. The larger island, Great Kei, is of tertiary formation, with mountains and forests; its bird and insect life will repay intensive study. Little Kei and some of the smaller islands were raised above the sea by volcanic eruption less than a centnry ago, and there is plenty of clean bottom. The islands lie on the Pacific side of Wallace's line, one of the primitive land and ocean frontiers of the globe.

UNIVERSITY AND EDUCATIONAL NOTES

BY the will of Mrs. Dexter Smith, of Springfield, Mass., Wesleyan University receives $150,000.

ONE hundred thousand dollars has been received by the University of California from the estate of E. P. Kraft, to be held in trust for the purpose of creating at the university scholarships to be known as the "Edward Frank Kraft Scholarships." Under the terms of the trust, the scholarships are to be apportioned among the various colleges except agriculture, for which scholarships have previously been provided out of the estate of George H. Kraft.

THE Committee of the University of Cambridge for Geodesy and Geodynamics has reported in favor of the erection and equipment of a two-roomed observation building near the observatory as a first step towards the institution that the committee ultimately aims at to meet the requirements of international geodesy.

CHARLES RUSS RICHARDS, dean of the College of Engineering and director of the Experimental Engineering Department of the University of Illinois, was elected president of Lehigh University on February 7. Mr. Richards succeeds Dr. Henry S. Drinker, now president emeritus.

THE following appointments are noted in *The Journal of Industrial and Engineering Chemistry*: Mr. James H. Ransom has changed his position as research chemist with the Michigan Smelting & Refining Co., Detroit, Mich., to head of the department of chemistry in James Millikin University, Decatur, Ill. Mr. W. H. Rodebush has been appointed associate professor in charge of the division of physical chemistry, University of Illinois, Urbana, Ill.

Mr. Rodebush was formerly national research fellow at the University of California. Dr. Lansing S. Wells, until recently research chemist with The Barrett Company, Frankford, Philadelphia, Pa., has accepted an appointment as assistant professor of organic and physical chemistry, Montana State College, Bozeman, Mont. Mr. Raymond L. Stehle recently resigned as assistant professor of physiological chemistry in the School of Medicine of the University of Pennsylvania to become associated with the faculty of medicine of McGill University, Montreal, as assistant professor of pharmacology.

D. W. Blakeslee has been granted leave of absence for the school year from his position of electrical engineer with the Jones & Laughlin Steel Co., at Pittsburgh, and is teaching in the Electrical Department of Yale University.

Mr. J. Griffith has been appointed head of the department of agricultural chemistry at the University College of North Wales, Bangor.

Dr. Alfred C. Haddon, of Christ's College, University of Cambridge, has been appointed acting curator of the Museum of Archeology and Ethnology.

DISCUSSION AND CORRESPONDENCE

KENTUCKY AND THE THEORY OF EVOLUTION

Your inquiry concerning proposed legislation against the teaching of evolution in the state university and public schools of the state has been received. In reply I will state that two such bills have been introduced in the house, and one was introduced in the senate. The senate bill was reported unfavorably by the senate committee to which it was referred. The same committee also reported unfavorably a milder substitute forbidding the teaching of anything in these public institutions "inimical to religion," but the senate by a vote of 23 to 12 turned down this latter recommendation of the committee and placed the substitute on the calendar.

The house bill which has passed the committee and been placed on the calendar is much more drastic than either of the bills introduced in the senate. It provides for a fine of "not less than fifty nor more than five thousand dollars, or confinement in the county jail not less than ten days nor more than twelve months" for any "teacher, principal, superintendent, president or other person connected directly or indirectly with such schools or institutions, who shall knowingly teach or permit to be taught Darwinism, Atheism, Agnosticism, or the Theory of Evolution in so far as it pertains to the origin of man."

This proposed legislation is the culmination of an active propaganda against evolution which has been carried on in the state for over a year by a number of the ministers of several of the Protestant denominations. The leader of these is Dr. J. W. Porter, pastor of one of the Baptist churches in Lexington, and judging from the expressions in the Baptist press, he has the backing of a large element in his denomination. He it was who received a letter of encouragement from William Jennings Bryan which he promulgated from the pulpit. From this letter we quote the following:

> The movement will sweep the country and we will drive Darwinism from our schools. The enemy is already fighting. The agnostics who are undermining the faith of our students will be glad enough to teach anything the people want taught when the people speak with emphasis.

On Friday, January 20, Bryan was brought to Kentucky, where he made a number of addresses against evolution. The one at Frankfort was before a joint session of both houses of the legislature. In this he advocated legislation against the teaching of Darwinism and kindred "isms." At the close of his address in Lexington a resolution was presented by Rev. W. L. Brock, another Baptist minister of Lexington, and ruled from the platform to have been passed, in which the general assembly was petitioned to prohibit "the teaching in the state schools of evolution, destructive criticism and every form of atheism and infidelity whatsoever."

In their spoken and written attacks on evolution these advocates of suppressive measures quote largely from two publications issued by the Bible Institute Colportage Association, Chicago, Illinois. One of these is a booklet of 144 pages by Alex. Patterson entitled "The Other Side of Evolution" and the other is a pamphlet of 24 pages by W. A. Griffith Thomas entitled "What About Evolution?" In these publications the attempt is made to refute evolution mainly by the citation of authority. With respect to well known advocates of evolution, such as Tyndall, Haeckel, Huxley, Spencer, and even Darwin himself, commendably cautious statements, particularly with reference to the *causes* of evolution, are twisted and construed into "fatal admissions" affecting their belief in the *fact* of evolution.

For expressions of positive opposition to the theory, recourse is had mainly to men of science long since dead, such as Murchison, Sedgwcik, Agassiz, Dawson, Etheridge, Virchow and Dana.

Much reliance is placed upon the views of the late George Frederick Wright, who wrote a preface to the booklet in 1903. The latter, however, is cautious in his endorsement and not willing to say "that all the points in this little volume are well taken."

It is from the book by Patterson that Mr. Bryan gets his leg-from-wart, eye-from-freckle, joke which he is so fond of retailing from the Chautauqua platform.

Within the last few days Dr. Porter has issued a pamphlet of 94 pages, entitled "Evolution a Menace," in which after giving considerable prominence by liberal quotation from standard text-books to the fact that all modern authority is against him in the position he takes on evolution, he then attempts to refute it mainly by an appeal to authority as old, or older, than that cited by Mr. Patterson.

His citation from Whewell's "Inductive Sciences," written about 1854, is a case in point. Here he attempts to discredit all geology by a quotation which refers only to a lack of progress in "physical geology" comparable to the progress made in "physical astronomy" up to the time the work was written.

Dr. Porter's main reliance for material from more modern authority with which to overthrow evolution is upon Howorth's "Mammoth and the Flood," and upon the geological jugglings of a certain "Professor McCready Price."

The bill placed on the calendar of the house reads:

KENTUCKY GENERAL ASSEMBLY
1922
House Bill 191—Introduced January 23
By Representative George W. Ellis, Barren County.

An act to prohibit the teaching in public schools and other public institutions of learning, Darwinism, atheism, agnosticism or evolution as it pertains to the origin of man.

Be it enacted by the General Assembly of the Commonwealth of Kentucky:

Section 1. That it shall be unlawful for a teacher, principal, superintendent, president or anyone else who is connected in any way with the public schools, high schools, training schools, normal schools, colleges, universities or any other institutions of learning in this commonwealth, where public money of this commonwealth is used in whole or in part for the purpose of maintaining, educating or training the children or young men or young women of this commonwealth; for such teacher, principal, superintendent, president or other person connected directly or indirectly with such schools or institutions of learning to teach or knowingly permit the same to be taught; Darwinism, Atheism, Agnosticism, or the Theory of Evolution in so far as it pertains to the origin of man; and anyone so offending shall on conviction be fined not less than fifty nor more than five thousand dollars or confined in the county jail not less than ten days nor more than twelve months or both fined and imprisoned in the discretion of a jury.

Section 2. If any school, college, university, normal school, training school or any other institution of learning which has been chartered by the Commonwealth of Kentucky and which is sustained in whole or in part by the public funds of said commonwealth shall knowingly or wilfully teach or permit to be taught, Darwinism, Atheism, Agnosticism, or the Theory of Evolution insofar as it pertains to the origin of man, shall forfeit its charter and on conviction shall be fined in any sum not to exceed five thousand dollars. In all proceedings of forfeiture or revocation of charter, the holder thereof shall be given thirty days notice in which to prepare for a hearing to be attended by its representative or counsel.

The commonwealth or the accused may take such oral or written proof for or against the accused as it may deem it the best to present these facts.

This act to be in full force and effect from and after its passage and approval as provided by law.

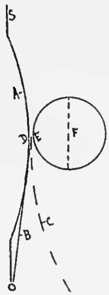
Arthur M. Miller

University of Kentucky,
February 8, 1922

RELATIVITY AND STAR DIAMETERS

To the Editor of Science: That Michelson's wonderful measurements on star diameters have a fundamental bearing on Einstein's theory and are capable of affording a more decisive proof of it than even the eclipse experiments does not seem to be yet appreciated. In my former note of March 25th, 1921, I expressed the hope that some one more competent than myself would discuss the subject; but nothing has so far appeared but a short note by Dr. Burns, and as he appears to be under some misconception of the theory, I will, with the Editor's permission, go into it a little more in detail.

Dr. Burns refers to an acceleration in the direction of propagation. But this field has nothing to do with the measurement of the diameter. What we do, virtually, is to divide the star disc F into halves by the diameter, shown as a dotted line, and take the centers of gravity of the two semi-circles as two sources. Obviously a considerable amount of the light will come from the edge, as at E, and all of it, except that coming from the diametric line, will be pulled sideways towards the diameter.



By Einstein's theory light from a source S to an observer O will be curved in the manner shown, since all world lines are warped in the neighborhood of matter. Dr. Burns's statement that there is no warping of the light from the star disc means that light originating from a prominence E on the star would not be warped, while light traveling past it, originating from an outside source S would; which necessitates an ether between F and O; which is contrary to the theory of relativity.

The really important point, which I had hoped to bring out in the discussion, is that a purely gravitational bending, shewn by the dotted line C, is not a mere warping, but a permanent change of path to a sort of hyperbola. If the light bending were a purely gravitational effect, all stars should shew measureable diameters, if above certain dimensions. But they do not appear to do so. As the only two alternatives seem to be gravitational bending or Einstein's theory, this seems to be a definite proof of the theory.

But we need a quantitative discussion, at, as I have said, the hands of men better qualified than myself. Mere guess work is not enough. It is true that the angular effect of the world line warping changes with distance, being twice the gravitational effect, but the amount of warping by the sun is approximately 1½ seconds, while the total angle subtended by Betelgeuse is only 1|30 of this, and Betelgeuse is somewhere around ten million times the size of the sun. A quantitative calculation is necessary, not only for Betelgeuse but also for those stars which shew no measurable disc, to explain the absence of a measurable gravitational bending, if Einstein's theory is not true.

Reginald A. Fessenden

PRELIMINARY NOTE ON THE ETIOLOGY OF POTATO TIP-BURN

During the past two years investigations have been carried on at the Experiment Station of Pennsylvania State College to determine the etiology and specificity of the potato tip burn caused by the feeding of the potato leaf hopper, *Empoasca mali* Le B.

These experiments were in the form of a series of inoculations with aqueous and alcoholic extracts of *E. mali* Le B, and other potato feeding insects. The inoculated plants were exposed to sunlight of varied intensity by the use of glass and mesh cages to determine the role of sunlight in the development of the disease.

The results obtained from these experiments support the following conclusions:

1. Tip burn of the potato plant may be produced by the extract made from macerated nymph or adult, *E mali* Le B. and is transmissible by direct inoculation. This points to the existence of a "specific," either normal or extraneous, transmitted by the leaf hopper as the cause of the disease.

2. The active principle of this substance is most virulent in the nymphal stage of the leaf hopper.

3. This "specific" is present in diseased leaf tissue after infection by the leaf hopper and may be transmitted to healthy plants by reinoculation.

4. This substance is specific and the disease can not be simulated by inoculation with extracts from or by the feeding of insects other than *E. mali*, or by mechanical injury.

5. Sunlight is an important factor in the progress of the tip burn after its inception, but the absence of sunlight does not prevent the disease.

A more detailed account of the experiments supporting these conclusions will be published in the near future.

JOHN R. EYER
PENNSYLVANIA STATE COLLEGE,
STATE COLLEGE, PENNSYLVANIA,
SEPTEMBER 30, 1921

QUOTATIONS

ECONOMY IN PUBLICATION

THERE is no doubt that all our learned Societies are going through times of financial stress, owing to the war. Some of them are able to meet the difficulties by an increase of subscription, but others fear that this would diminish their membership, and thus compensate any estimated gain. Meanwhile, the increased cost of printing admits of no doubts at all, and Government help in mitigation is apparently not to be had—nor is it likely that private benefactions will come to the rescue. It seems eminently undesirable that scientific publication should be permanently diminished in amount, and minor economies in printing are apt to take up valuable time, which might be spent more profitably. We may hope that the cost of printing will not remain at the present high level, so that the future may bring less stress; but, meantime, we have to consider what is to be done *now*. With some hesitation I beg to put forward a suggestion for consideration in the special case of the Royal Astronomical Society, which is undoubtedly at the present moment in sore straits. The suggestion is that we should have an Economical Year as regards printing. For twelve months beginning either in January next (or, if that notice is too short, with the Annual Meeting in February next) let all the Fellows do their best to minimize the printing. There would be a vital difference between adopting this policy for one year and adopting it permanently, which, as already remarked, is strongly to be deprecated.

If the policy is publicly declared, the Society would probably find relief in many directions during the year; thus it could, without misunderstanding, discourage, or actually decline, papers which could be printed elsewhere, especially those coming from abroad. Usually these are more than welcome, but there would be no harm in asking our distinguished fellows and associates in other lands to publish elsewhere *for one year*. Of our own fellows many would welcome the opportunity to use one year rather for consolidating work already done than for pushing on new work. An exception should be made in the case of the younger astronomers, whose early fire should not be checked.

Again, I submit that, while the Annual Report of the Council is a document too valuable to lose permanently, there might be no serious disadvantage in cutting it down to very small proportions for one year—the thread could be readily picked up again in the following year. Here, again, some exceptions should obviously be made, especially the notices of Fellows deceased, a record which can not be intermitted. But observatory reports and most of the notes might be dropped.

The question arises how the meetings of the Society shall be adequately filled if the supply of papers is cut down? And this, of course, is a question which must be satisfactorily answered if the suggested policy is to be successful. I venture to think that the answer is not difficult: astronomy has been progressing so rapidly of late years that there are many matters, great and small, at which we have only had the time to glance without subjecting them to satisfactory discussion. Important ideas have been laid before the Society and clearly explained, which were so new that the audience was scarcely ready with comments. As one illustration, let me take Mr. Jeans' suggestion that the stellar universe was formerly much more compact, and has since been expanding and scattering. This is an idea which alters profoundly views hitherto adopted and hitherto scarcely questioned. At the time of its suggestion the audience was almost silent, for the simple reason that it was too big a thought to take in at once; but since then time has elapsed and, moreover, Mr. Jeans has published a book. It would be strange if an interesting meeting could not be furnished by the discussion of this new idea.

There are other matters, not on this grand scale, which were passed over quickly, simply because one paper trod on the heels of another, but to which a return could now be made all the more profitably because they have appeared in print.

In further support of this policy I may quote the experience of the Geophysical Society, which has, for a few years past, been holding meetings in the rooms of the Royal Astronomical Society on the lines above indicated. The papers presented have, in general, not been original investigations, but rather accounts of work already published, and the amount of printing has been small.

Doubtless if this policy of an economical year—or, let us call it, without prejudice, a special year—were adopted, other ideas would be forthcoming to furnish the meetings: for instance, we have very rarely had anything of the nature of a conversazione; though the few experiences of this kind have all been most enjoyable. Again, we may remember that there will be a meeting of the Astronomical Union in April next. The April meeting of the R. A. S. might very appropriately be devoted to a preliminary discussion of the topics which will engage the attention of the Union; or the May meeting might be devoted to hearing from the returned delegates their experiences in Rome. We may hope, further, that this meeting of the Union will bring to Europe welcome guests from overseas, who will doubtless be able to interest the Society, as we have already had ample experience on former occasions.

In November or December we may hope for news from our eclipse expedition. Finally, if the cutting down of the Annual Report should leave a blank in the February (1922) meeting, perhaps the Fellows might like to fill it by a full discussion of the present suggestion, which is put forward very crudely in the hope that it may be fully and freely discussed.—From an Oxford Note-Book in *The Observatory*.

SCIENTIFIC BOOKS

Applied Entomology. An introductory text-book of insects in their relations to man. By H. T. FERNALD. First edition. New York: McGraw-Hill Book Company, 1921.

THE author recognizes a two-fold demand of the agricultural colleges in this country for a text-book of entomology which will give: (1) to those students who desire to specialize in entomology a thorough foundational training in the science; and (2) to those students who intend to engage in practical farming and fruit-growing a general knowledge of the kinds, life histories, habits, and control of insects that are of economic importance. He has succeeded in meeting these requirements to a surprising degree in a book of 386 pages. The author first discusses the position of insects in the animal kingdom, their structure, transformations, the losses caused by them, and the nature and kinds of insecticides in modern use in the control of these persistent pests. Necessarily the discussion of these topics is a brief one being included in less than sixty pages. It seems to us unfortunate that the author did not give in this part of the book a general, though brief, discussion of the nature and importance of the biological control of insects and of the vital and extensive relations insects bear to many human and plant diseases. The activities of insects as parasites and as carriers of disease organisms are, however, noted here and there throughout the text in appropriate connection with the species concerned.

The remaining pages of the book are devoted to a discussion of the characteristics of the different orders of insects with an account of the life histories, habits, and control of a well-selected list of common, representative, and mostly economic species of each order. The author uses commendable and conservative judgment in recognizing and discussing but twenty-four orders with a brief mention of an additional one, the *Zoraptera*. An economic entomologist often wishes the author had been a little more specific regarding control measures. For example, paradichlorobenzene is briefly mentioned as having "given fair success recently" in the control of the peach-tree borer. This seems hardly an adequate statement in view of the widely successful use of this substance by the Federal Bureau of Entomology and by the New Jersey Experiment Station.

The book is fully illustrated with numerous original photographs and many familiar illustrations. It is certainly preferable to use good familiar figures in a text-book rather than poor original ones but great pains should be taken to reproduce the old figures with distinctness and fidelity. For example, figures 130, 131, 135, and 242 have lost much of their original clearness and detail. Moreover one is apt to be momentarily a bit shocked to find an illustration in a dignified text-book with the legend "Samples of Anoplura greatly enlarged" without any attempt to give the reader an inkling of the species figured. These, however, are small matters.

The book has few typographical errors and closes with an excellent index of twelve pages. Altogether the author has written a well balanced, well arranged text of applied entomology for the beginning student and many teachers will find it very useful with their classes.

Glenn W. Herrick

Cornell University

SPECIAL ARTICLES

HIGH SPEED HIGH VACUA MERCURY VAPOR PUMPS

The writer has on several occasions[1] described two types of high speed mercury vapor pumps capable of producing exceedingly high vacua in reasonably short intervals of time and yet not demanding of the fore pumps pressures less than .01 to .005 mm. of mercury. These mercury vapor pumps were made of pyrex glass and are still in use.

Since then slight modifications have been introduced which considerably reduce the time required in glass blowing though not altering the speed of either pump or the vacua obtainable. The two types in modified form are shown in Figures 1 and 2, and are each drawn approximately one sixth full size. In Figure

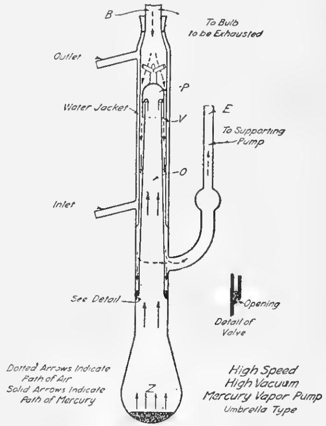


Figure 1

1 we have the umbrella type in which the bulb to be exhausted is attached to B, and the supporting pump to E. The hot mercury vapor reaches the umbrella P through the large diameter thin-walled central delivery tube O. The throat at V is large and annular (no central dead space) and hence the issuing mercury vapor comes into immediate contact with the outer water cooled walls. This construction

[1] *Phys. Rev.*, II, 9, 311; 12, 492.

augurs for speed. The water packet is an integral part of the pump. The condensed mercury vapor is returned directly to the boiler through a pin-hole valve shown in the figure.

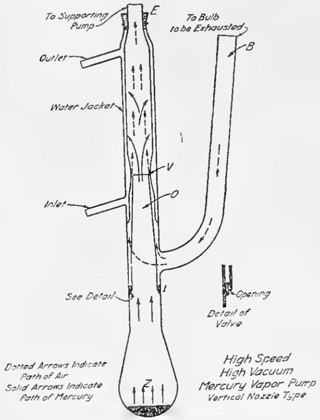


Figure 2

In the second type, Figure 2, the umbrella is omitted, the delivery tube O is short and ends in a central vertical nozzle, and hence the bulb to be exhausted and the fore pump are interchanged. The throat at V through which the hot mercury vapor issues is large but not annular. The water jacket and mercury return are the same as in the umbrella type.

Some idea of the speed of either pump may be obtained from the following data taken recently: With a Cenco-Hyvac oil pump, as a fore pump, a discharge tube of 2.8 liters volume was exhausted from the point at which the mercury vapor pump began to take hold (approximately 1 cm. dark space) to where the tube began to darken (the X-ray stage) in 30 seconds. If a mercury vapor trap is interposed between the pump and B the time in the above may be reduced to 15 seconds or even less!

Comparing the two types it was found that the umbrella type seems, in general, to be the more speedy, possibly for two reasons: first, the water jacket reduces the amount of mercury vapor that finds its way into the bulb B (this of course may be entirely eliminated by the mercury vapor trap mentioned above), and second, the issuing mercury vapor stream is annular. On the other hand the vertical nozzle type is somewhat easier to construct. An advantage of the former, especially for lecture table demonstrations, is that the bulb B to be exhausted is supported centrally over the pump. These pumps are made of Pyrex glass.

Chas. T. Knipp

Laboratory of Physics,
University of Illinois,
December, 1921

THE NEUROMOTOR APPARATUS OF PARAMECIUM

This study which commenced with micro-injection experiments on *Paramecium* has led to the discovery of a complex neuromotor system in the animal. This discovery is important because *Paramecium* is a generalized ciliate and yet has attained a degree of structural complexity and functional diversity in respect to one organ system comparable at least with that of the lower Metazoa. It is thus again exemplified that the unicellular state is plainly not an essential condition for evolutionary specialization and functional efficiency, except as it places limits on the size of the organism and the developmental processes arising therefrom.

The neuromotor apparatus consists of a neuromotor center situated near the anterior end of the cytostome and at the posterior end of the oral groove; a set of cytopharyngeal fibers which run from the neuromotor center to the membranelles of the cytostome and cytopharynx; an oral whorl of peripheral fibers which diverge from the neuromotor center and run to the cilia and trichocysts of the oral side of the body; an aboral whorl of peripheral fibers which diverge from the same center to the cilia and trichocysts of the aboral side. The cilia of the organism arise from grooves in the pellicle which run in nearly parallel lines from the anterior to the posterior end of the body. Those on the oral side are slightly oblique, meeting in a series of V's in a line, the oral suture, which runs obliquely through the cytostome from the anterior to the posterior end of the body. The trichocysts are arranged with reference to the neuromotor system in whorls. They reach the surface of ridges which appear as papillæ because they are cut across at regular intervals by the longitudinal ciliary grooves.

The morphology of this neuromotor apparatus shows that it is well adapted to coordinate the movements of the animal because the organelles of feeding, locomotion, and defense are all connected by a system of conductile fibers to a presumably coordinating center. Furthermore the fibers must be either supporting, contractile, or conductile. Their exceeding fineness indicates the unlikelihood of a supporting function. Their position with respect to the neuromotor center makes it unlikely that they are contractile because those, the main direction of which is longitudinal, would have to operate antagonistically to those whose direction is transverse. The only alternative is that the fibers are conductile.

Three experimental methods, that of staining by micro-injection, the determination of the axial gradient in solutions of narcotics (Child, 1915), and micro-dissection (Taylor, 1920) were used to secure additional evidence pointing towards a neuromotor function of the fibers.

Experiments with the first method were negative. An axial gradient was easily demonstrated, indicating the presence of conductile elements. A high rate of metabolism in the region of the neuromotor center could not be demonstrated, however, because *Paramecium* did not disintegrate as do annelid worms and planarians in the solutions used.

Cutting the cytopharyngeal fibers resulted in the loss of coordinated movement of the cytopharyngeal membranelles. Extensive destruction of tissue in the region of the neuromotor center resulted in the loss of coordinated movement of locomotor organelles. Equal destruction of tissue elsewhere in the body did not destroy coordinated movement.

Thus, while experimental evidence is less conclusive than the morphological it supplements the latter in demonstrating that the fibers of *Paramecium* have a conductile function.

CHARLES W. REES
ZOOLOGICAL LABORATORY
UNIVERSITY OF CALIFORNIA

THE AMERICAN CHEMICAL SOCIETY

(*Continued*)

SECTION OF LEATHER CHEMISTRY

John Arthur Wilson, *chairman*
G. D. McLaughlin, *secretary*

Color measurement of vegetable tan liquors: HENRY RICHARDSON PROCTER.

The color value of a tan liquor as a function of the hydrogen-ion concentration: JOHN ARTHUR WILSON and ERWIN J. KERN. The color value of a tan liquor depends upon its hydrogen-ion concentration when used. A change in pH value produces a change in color of both liquor and leather. Tan liquors change in color like indicators with change in pH value, but over a range of from 3 to 12. This change in color is completely reversible, if the liquors are not long exposed to air. Liquors exposed to air continue to darken in color, the more so the higher the pH value, but this change is not reversed by lowering the pH value. Liquors exposed to air at pH values of about 9 give bulky precipitates when their pH values are brought to 3 and such liquors tend to poison the hydrogen electrode.

Chemical and physical behavior of gelatin solutions: JACQUES LOEB.

The equilibria between tetrachrome collagen and liquors of different chrome content: ARTHUR W. THOMAS and MARGARET W. KELLY.

The adsorption of the constituents of chrome liquor by hide substance during nine months contact and the equilibria between tetrachrome collagen and various concentrations of liquor: ARTHUR W. THOMAS and MARGARET W. KELLY. Previously a tetrachrome collagen was considered the most complex chrome collagen compound obtainable. In this research an octachrome collagen was prepared. Further it was established through study of the change in composition of tetrachrome collagen in contact with liquors of different concentrations over a period of nine months that the reactions taking place in chrome tanning are chemical in nature. This paper is one of a series of contributions from this laboratory establishing the chemical nature of the combination of chromium with hide to form chrome leather.

Influence of sodium chloride, sodium sulfate and sucrose on the combination of chromic ion with hide substance: ARTHUR W. THOMAS and STUART B. FOSTER. Until four years ago it was considered that the only important features involved in the use of chrome liquors in chrome tanning was the percentage of chromium and sulfuric acid and their ratio one to another. The researches by Wilson and Kern, of Milwaukee, and by this laboratory have demonstrated that many simple substances hitherto considered without any influence may have a profound effect on the process of chrome tanning. In this research effects of the substances mentioned in the title have been carefully studied and a chemical theory has been propounded which involves the formation of addition compounds. The recognition of the existence of such compounds will be required for proper control of chrome tanning.

Differentiation between physical mixtures and chemical compounds: Jerome Alexander.

Effect of acidity upon the rate of diffusion of tan liquor into gelatin jelly: John Arthur Wilson and Erwin J. Kern. As ordinarily used in tanning, gambier and quebracho extracts show marked differences in the rate of tanning and of penetration into the hide. It is shown that the rate of penetration is a function of the hydrogen-ion concentration as well as of the nontannin content. A sample of gambier penetrated the jelly only at pH values above 3.0, but a sample of quebracho only at pH values above 4.7. Above 9.0 the quebracho penetrated more rapidly than the gambier. The shape of the interface between a tan liquor and gelatin jelly was also found to be a function of the hydrogen-ion concentration.

Theory and use of electrometric titrations: Harold Fales.

The chemical constituents of skin: F. L. Seymour-Jones. Animal skin consists of proteins, fats and mineral salts, but for the tanner only the former are of much importance. Proteins occur in nature in the colloid state, a state of matter hitherto somewhat obscure in that it appeared impossible to apply normal chemical laws thereto. Professor Procter, of Leeds, and his collaborators, in particular Mr. J. A. Wilson, for many years studied the swelling of gelatin in acids and finally succeeded in showing that it followed a definite course which could be represented by mathematical expression. Dr. Loeb, of the Rockefeller Institute, has carried this further in studying the effects of different acids, alkalies and salts on gelatin and other proteins, and has shown that, taking into consideration the hydrogen-ion concentration (hitherto neglected), proteins really follow ordinary chemical laws. Of the proteins of hide, the most important is collagen, which is undoubtedly closely allied to gelatin. Elastin is most stable, but for light leathers is generally removed in the bating process. It is highly elastic under very small stresses. For keratins the tanner has little use, and their removal is one of his objects. The interfibrillary cementing substance is usually removed in liming; it is probably a mucoid, but its exact nature is still doubtful. A thorough knowledge of the chemical constituents of skin is essential if progress is to be made in the science of tanning. So far progress has been slow in this direction, but each advance materially aids in increasing knowledge and possibilities of further advance.

The warble fly problem: Alfred Seymour-Jones. The warble fly is one of nature's pests, ruining hides by its numerous perforations. The fly lays its eggs on the hairs on the legs of cattle; from here the maggot hatches and bores into the animal's body. In order to prevent or cure this plague, the English, Scottish and Irish agricultural authorities set up a scientific committee to deal with the question. Squeezing the warble bots out of the backs of a herd of isolated cattle during five years proved successful, but this would scarcely be feasible on a large scale. Next a mixture of bird lime material and birch tar oil was painted on the hind quarters of some cattle, but, though this might have prevented the flies from laying their eggs, the cattle's tails stuck to the tacky material and they stampeded. A great variety of mixtures, to be applied to the cattle's backs when the maggots are nearly ready to emerge, have been tried. Some give 80 to 96 per cent. kills, but the work is as yet incomplete. However, applied to *all* cattle in an area for two or three years, there is reason to hope that the fly might be exterminated.

Properties and action of enzymes in relation to leather manufacture: J. T. Wood. Enzymes do not merely accelerate a change already in progress, but actually cause it. An explanation is given of Armstrong's view of the two-fold action of enzymes. The action of hydrolytic enzymes is caused by the increase of hydrogen-ion or hydroxide-ion concentration at the surfaces of their particles. The action of enzymes in the various processes of leather manufacture was discussed. In the "soaks" enzymes are secreted by a variety of species of bacteria, as is also the case in the "limes," but the possibility of the presence of tissue enzymes in these two processes should not be overlooked. The enzymes of the dung bate are then enumerated and a short account of the introduction of commercial enzymes is given. The action of tryptic enzymes on the elastin of the grain and Wilson's experiments are briefly discussed together with the author's views of the interpretation to be put upon the results. In the "drenching process" the presence of an amylolytic enzyme is essential. Starches are transformed into dextrin and glucoses, which are subsequently fermented into organic acids.

A critical study of bating: JOHN ARTHUR WILSON and GUIDO DAUB. A critical study of bating limed skins in the tannery has been made which tends to elevate a heretofore mysterious process to a scientific plane. The primary function of bating is to remove elastin fibers from the skin prior to tanning. This is done by means of pancreatin after liming, unhairing and washing the skins. When a dilute solution of pancreatin was employed, complete digestion of the elastin was effected only when the pH value of the solution lay between 7.5 and 8.5, but when a more concentrated solution was used, the active range was extended to 5.5 to 8.5. An explanation of this is given on the assumption that an addition compound between the enzyme and collagen is formed in increasing amounts as the pH value is reduced from 8. The rate of removal of elastin from calfskin is shown as a function of the concentration of enzyme and of the time of digestion. Ammonium chloride shows an activating effect in concentrations up to 0.5 gram per liter and a marked inhibitory effect in higher concentrations. The failure of commercial bates to remove elastin from calfskin was attributed to the presence of woody fibers. A comparison of bated and unbated leathers was made. The work was illustrated by five photomicrographs and four sets of curves.

The microscope as applied to leather manufacture: FINI ENNA.

The isoelectric point of collagen: ARTHUR W. THOMAS and MARGARET W. KELLY. Recent expemental work in biological chemistry has demonstrated that proteins are amphoteric electrolytes in aqueous solution. The point of transition in their amphoteric properties is known as the isoelectric point, a knowledge of which is essential in interpretation of their chemical and colloid chemical conduct. Hides and skins consist of proteins, the protein collagen predominating. It is obvious that the amphoteric nature of hide protein plays an important rôle in tanning the hide. The object of this research was to determine the isoelectric point of hide protein and thus contribute to the chemical control of leather manufacture. The experiments enumerated in the paper show the isoelectric point to be at a hydrogen-ion concentration of 10^{-5} moles per liter. At acidites higher than this, the hide is electropositive and at lower acidities, or greater alkalinities it is electronegative.

Physiological and histological observations on the flayed skin entering into the art of leather manufacture: ALFRED SEYMOUR-JONES. Before proceeding with the animal skin, the tanner first removes all the hair and outer skin (epidermis) from the outside and all adhering fleshy matter from the inside of the skin. This leaves the true skin to be converted into leather. This true skin consists of four distinct layers. The topmost layer is the grain membrane, which varies considerably in feel and texture with different animals. It forms a connecting link between the epidermis and the true skin. Just below it lies a thin layer, the *cutis minor,* vitally important in the manufacture of good leather. Below again is the fatty layer, largely consisting of groups of fat cells, resembling in appearance bunches of grapes. The last layer is the *cutis major,* which forms the major part of the whole skin. It is composed of white collagen fibers, intertwining in every direction to form a firm and inextensible coat for the body. In the grain membrane and *cutis minor* the white fibers are supported by yellow elastic fibers. When, as in bating, the elastic fibers are removed, these two layers become soft and extensible, and the skin "falls." This is the result desired in the preparation of glove leathers, kid, and the like. But it is only necessary to bate these two upper layers. Since there is no elastin in the two basal layers, bating these latter only causes loss of valuable skin substance without any corresponding benefit.

The chemistry of lime liquors used in the tannery: W. R. ATKIN. The author has extended the theories of Procter and Wilson and of Loeb to the alkaline swelling of hide in lime liquors. The real reason why such sharpening agents as sodium sulfide and sodium carbonate produce greater swelling than lime alone is that the osmotic pressure which causes swelling is greater for sodium collagenate than for calcium collagenate at the same pH value. The smooth grain of skins unhaired in limes containing arsenic sulfide is due to the fact that calcium collagenate only is formed. A rapid method for controlling lime liquors is described. Alkaline swelling is shown to be exactly analogous to acid swelling, which has been more extensively investigated. Certain tanning processes are shown to act in a way parallel to pickling.

The determination of tannin: JOHN ARTHUR WILSON and ERWIN J. KERN. The authors have succeeded in improving the procedure of their new method of tannin analysis. The revised procedure gives the same results as the original, but saves a great deal of time and labor and increases the accuracy for unskilled analysts. To make a determination by the revised procedure, it is necessary merely to shake a fixed amount of hide powder with a solution containing a known amount of the soluble matter of the tanning material until all tannin is removed from solution, washing the tanned powder in a special device which prevents the loss of anything but matter in solution, drying the washed powder and weighing it. The increase in weight of the dry hide powder is a measure of the tannin content. All criticism raised against the new method thus far has been refuted.

Wattle bark tannin: R. O. Phillips.

Measurement of the iron contamination of chestnut extract: T. G. Greaves.

Anthrax prophylaxis in the leather industry: Alfred Seymour-Jones. Anthrax is caused by a micro-organism which exists in two forms. It is imported by materials such as hair, bristles, wool and dried hides and skins, mainly from far eastern countries. The organism in its active form is easy to kill, but the spore is highly resistant. For wool, hair and the like, the British government has erected an experimental plant at Liverpool, using heat and formalin, which promises good results. Such treatment obviously cannot be applied to hides. Experiment has shown that with hides the only practicable method to deal with the spore is by soaking in weak acid solution. Here common disinfectants, such as formalin and the carbolic series, cannot be used, owing to their tanning action. Using mercuric chloride at 1/5000 in one per cent. formic acid, followed by a brine bath to pickle the hides, has proved very successful, and the cost should not exceed six cents a hide. Anthrax can be prevented from entering a country, as New Zealand has shown. Since 1909 there has not been a single case in the country, clearly demonstrating the efficacy of sterilizing material at the exporting port.

A trip through the tannery on the inside of a calfskin: John Arthur Wilson. This lecture is illustrated by microscopic projections thrown on the screen at 2,000 diameters. Cross sections of calfskin at various stages of the tanning process are shown. In fleshing, the adipose tissue is cut away just under the flesh layer of elastin fibers. During liming, the substance of the Malpighian layer of the epidermis is slowly digested, thus effectively separating the corneous layer of the epidermis and the hairs from the dermis. In bating, the elastin fibers are digested by pancreatic enzymes. After bating only the grain membrane, collagen fibers, erector pili muscles and a few blood vessels are left. The tannin combines chemically with the collagen fibers. The fat liquoring process distributed oil uniformly over the surfaces of the fibers. Coloring and the application of finishing materials complete the processes of addition. Chrome tanning gives a very markedly different leather from the vegetable process.

On the hydrophobic colloid content of vegetable tanning extracts with attempts to correlate astringency with the potential difference of the particles against the aqueous phase: Arthur W. Thomas and Stuart B. Foster. The reasons for the different degrees of astringency of various vegetable tanning extracts have been long a matter for speculation. The problem has been attacked from a colloid chemical point of view with the result that astringency has been indicated to be a function of the electrical charge of the tannin particles. The higher the charge the greater is the astringency. The electrical charges for several extracts are submitted and methods of varying these charges and incidentally the astringencies of extracts are suggested. As a result of such discoveries blind use of certain vegetable extracts is no longer necessary, since the properties peculiar to one kind can be obtained with an entirely different extract by simple treatment according to the principles of colloid chemistry.

The time and concentration factors in the combination of tannin with hide substance. I. Gambier. II. Quebracho: Arthur W. Thomas and Margaret W. Kelley. This paper is the first of a series of studies of the action of vegetable tanning extracts in the formation of leather. It brings out clearly the difference in behavior of an astringent tanning agent and of a mild one. Gambier shows slow regular increase in the amount of tans fixed by hide as the concentration of the extract and the time of reaction is increased. Contrasted to this behavior, quebracho shows a rapid and larger amount of tan fixed than gambier does, accompanied with a sharp maximum followed by an abrupt drop in the fixation. The results of this investigation combined with other researches from this laboratory are pointing to a scientific explanation of the astringency of vegetable tanning materials which will afford more intelligent control of them in the tannery.

Charles L. Parsons,
Secretary.

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A MECHANICAL ANALOGY IN THE THEORY OF EQUATIONS[1]

To the mathematician the solution of a problem is the more interesting if it utilizes methods and principles from fields that at first glance seem foreign to the one in which the problem lies. The question of whether a linear differential equation has algebraic solutions is sufficiently important to attract attention of itself, but its answer by reference to the properties of regular polyhedrons has become a mathematical classic. Such analogies are not, however, to be regarded as mere *tours de force* whose purpose is only to astonish, or to appeal to a certain esthetic sense; the instance just mentioned shows that the new point of view may disclose wide vistas hitherto undiscerned. If there is a choice of terms in which the analogy may be stated, the formulation which is most concrete and most striking may also be the most illuminating.

Such considerations as these, doubtless, have led to the description of what are essentially vector methods with complex variables in terms of mechanical systems. I propose here to discuss the progress that has been made by the aid of such an interpretation in studying the distribution in the complex plane of the roots of algebraic equations in one variable.

On the algebraic side the chief purpose of the investigations to be considered has been to obtain what may be called *theorems of separation, i. e.,* theorems which state whether roots of an equation do or do not lie in specified regions of the complex plane. Such theorems may also state how many roots lie in the specified regions, or may give limits, inferior or superior, for the number of roots thus situated. These regions may be defined in terms

[1] Address of the vice-president and chairman of Section A—Mathematics, American Association for the Advancement of Science, Toronto, 1921.

of the roots of other polynomials; we are then concerned with *relative distributions* of the roots of two or more polynomials.

Theorems of separation for real roots of real equations are numerous, and are among the most familiar results in elementary mathematics. I need only mention Descartes' rule, which gives a superior limit for the number of roots on the positive real axis, or Sturm's method for obtaining the exact number in any real interval. Rolle's theorem, in the form which states that between each consecutive pair of real roots of a real polynomial $f(x)$ there lies an odd number of real roots of the derived function $f'(x)$, is perhaps the most important proposition concerning relative distributions of real roots of two real polynomials.

No such progress has been made with similar propositions for complex roots, although the widening of the field of observation from the real axis to the complex plane vastly increases the range of possibilities. To be sure, we have extensions of Sturm's theorem, and other methods, both algebraic and transcendental, which give criteria for the exact number of roots within a region, but in practice these prove so cumbersome as to be of little use. The great desideratum is a body of results whose simplicity and range of applications would make them comparable with Rolle's theorem, or the Budan-Fourier theorem in the real case. As Jensen has remarked, the solution of important problems regarding the zeroes of transcendental functions may be dependent upon progress in this direction.

The significance of Rolle's theorem naturally led to attempts to extend it to the complex plane almost as soon as the now familiar geometric representation of complex numbers had been adopted. A line of attack is clearly indicated by the identity of the logarithmic derivative

$$\frac{f'(x)}{f(x)} = \frac{1}{x-a_1} + \frac{1}{x-a_2} + \cdots + \frac{1}{x-a_n},$$

where $f(x)$ is a polynomial of degree n, whose roots are $a_1, a_2, \ldots, a_n$, and $f'(x)$ is the first derivative of $f(x)$. Gauss was probably the first to give this a mechanical interpretation which depends on the representation of a complex number $x-a$ as a free vector whose length, $|x-a|$, and direction are those of the directed line segment from the point which corresponds to a, or, more briefly, from the point a, to the point x. The conjugate of the reciprocal of $x-a$, which may be denoted by the symbol $K\frac{1}{x-a}$, corresponds to a vector having the same direction as the vector $x-a$ but with a length equal to the reciprocal of $|x-a|$. This is precisely the vector which represents the force at x due to a particle of unit mass at a which repels with a force whose magnitude is equal to its mass divided by the distance. If, then, we take the conjugate of both sides of the identity of the logarithmic derivative, we have the theorem of Gauss: *The roots of* f'(x) *which are not also roots of* f(x) *are the points of equilibrium in the field of force due to particles of unit mass at the roots of* f(x), *each of which exerts a repulsion equal to its mass divided by the distance.*

From this result it is but a step, though one not taken for many years, to the polygon theorem of Lucas, now sufficiently well known to have a place in Osgood's "Lehrbuch der Funktionentheorie," but discovered and rediscovered, proved and reproved in most of the languages of Europe—and all the proofs are substantially the same! This ignorance of the work of others characterizes even some of the most important contributions in this field. Lucas, for example, seems to have considered himself the discoverer of the theorem of Gauss, which really antedates his work by many years.

The polygon theorem, in its usual form, is a theorem of relative distribution which states that the roots of the derived function $f'(x)$ lie within or on the perimeter of the smallest convex polygon (or line segment) which includes within itself or on its boundary all the roots of $f(x)$. This statement implies that there is but one such polygon (or line segment), which reduces to a point if $f(x)$ has all its roots coincident. In case the polygon of Lucas does not reduce to a line or a point, the only roots of $f'(x)$ on its perimeter are multiple roots of $f(x)$. An equivalent form giving a separation theorem for the roots of $f(x)$ states that every straight line through a root of $f'(x)$ either passes through all the roots of

$f(x)$ or else separates them, *i. e.,* has roots on each side of it. This form is immediately suggested by the corresponding mechanical system; it is evident that a point of equilibrium must either be collinear with all the repelling particles, or else the latter must be seen under an angle of more than 180° from the former.

This result is only one of many concerning the relative distribution of roots of $f(x)$ and $f'(x)$ that may be inferred from the conditions of equilibrium of our mechanical system; we have deduced it by taking account only of the directions of the repelling forces. By considering their magnitudes as well J. Nagy (Jahresbericht der Deutschen Mathematiker Vereinigung, Vol. 27 (1918), page 44) has obtained a number of interesting theorems of which the following is one of the most striking: *If* α *is a root of the polynomial* $f(x)$ *of degree* n, *and* β *is a root of* $f'(x)$, *every circle through the points* β *and* $\gamma = \beta + (n-1)(\beta - \alpha)$ *contains at least one root of* $f(x)$. The proofs given do not, however, make explicit use of the mechanical analogy. In a paper read before the International Congress of Mathematicians at Strasbourg J. L. Walsh has utilized Gauss's theorem in discussing the case where the roots of $f(x)$ lie in two circles.

If the repelling particles exert a force inversely proportional to the square of the distance we obtain theorems of relative distribution of roots in which $f'(x)$ is replaced by $f(x)f''(x) - [f'(x)]^2$; from a root of the latter function the roots of $f(x)$ must be seen under an angle of at least 90°, and the polygon of Lucas is replaced by one bounded by arcs of circles. Other extensions of this sort suggest themselves, but nothing, so far as I am aware, has been published along this line.

An immediate corollary of the polygon theorem states that all the roots of all the derived functions lie within the polygon of Lucas. It is well known that the centroid of the roots of $f(x)$ coincides with that of the roots of its derivative of any order. An often discovered theorem places the roots of $f'(x)$ at the foci of a curve determined by the roots of $f(x)$.

In 1912 Jensen, in a very suggestive memoir on the theory of equations (Acta Mathematica, Vol. 36), stated without proof a theorem for equations all of whose coefficients are real which may be regarded as an improvement on the polygon theorem. If $f(x)$ is a real polynomial its complex roots form conjugate pairs. The resultant force of repulsion due to particles at such a pair of points is directed away from the real axis at a point not on this axis and which lies outside the circle whose diameter is the line segment joining the pair; we designate this circle the *Jensen circle* of the pair. At a point within the Jensen circle and not on the real axis the resultant force due to the pair is directed toward the real axis, while on the real axis and on the circumference of the circle it is parallel to the real axis. Thus at a point which is neither on the axis of reals nor within or on the circumference of any of the Jensen circles corresponding to the complex roots, the resultant force of repulsion due to the whole system of particles at the roots of $f(x)$ cannot vanish, for the force due to each particle on the real axis is directed away from that axis, and the same is true of the forces due to pairs of particles at the complex roots. We thus have Jensen's theorem: *The roots of* $f'(x)$ *which are not real must lie within or on the Jensen circles of* $f(x)$. To be more precise, a root of $f'(x)$ cannot lie on a Jensen circle unless it is real, or unless it is a multiple root of $f(x)$, or unless it is also within or on another Jensen circle.

Since the addition of a constant force parallel to the real axis does not change the above argument, Jensen's theorem remains valid when we substitute for $f'(x)$ the function $af(x) + f'(x)$ where a is any real number. Another extension indicated by Jensen concerns the regions within which roots of the successive derived equations lie, these regions being defined in terms of the roots of $f(x)$. Thus the complex roots of $f''(x)$ are in the Jensen circles of $f'(x)$, whose centers are on the axis of reals and whose vertical diameters are within the Jensen circles of $f(x)$. The solution of a simple problem in envelopes shows that all the complex roots of $f''(x)$ lie within or on ellipses each of which has a pair of complex roots of $f(x)$ at the ends of its minor axis and has a major axis whose length is $\sqrt{2}$ times that of its minor axis. For the

rth derived equation the result is the same except that the ratio of lengths of axes is $\sqrt{r}$. Jensen states that this is also true of the function $g(D) . f(x)$, where $g(D)$ is a linear differential operator of order r with constant coefficients whose factors are all real, and that $f(x)$ may be an integral transcendental function of genus zero or one.

In a recent paper (Annals of Mathematics, Vol. 22 (1920) p. 128), J. L. Walsh notes some results for non-real polynomials which follow from considerations that led to Jensen's theorem. He also gives an answer to the question which at once suggests itself as to how many roots of $f'(x)$ lie within a Jensen circle when $f(x)$ is real by a method of interest in itself, doubtless suggested by Bôcher's treatment of a similar problem which we shall note later. By allowing all the roots of $f(x)$ outside a Jensen circle to move out to infinity, noting what roots of $f'(x)$ may enter or leave the circle, and counting those within the circle at the end of the process, Walsh concludes that *if a Jensen circle has on or within it* k *roots of* f(x) *and is not interior to nor has a point in common with any exterior Jensen circle, then it has on or within it not more than* k + 1 *nor less than* k — 1 *roots of* f′(x). In a paper not yet published I have obtained a result a little more precise than this in which, for the sake of simpler statement, I will suppose neither $f(x)$ nor $f'(x)$ has multiple roots. By the term "root of even index" I designate a real root of $f'(x)$ between which and the next real root of $f(x)$ to the right or left there lies an odd number of real roots of $f'(x)$; if $f(x)$ has no real roots this term denotes every other real root of $f'(x)$, starting with the least. All the real roots of even index of $f'(x)$ can be shown to lie in or on Jensen circles, and every such circle that has no point in or on it within or on any other Jensen circle has within it either just one real root of even index of $f'(x)$, or just one pair of complex roots of $f'(x)$. The region covered by a system of Jensen circles each of which overlaps or touches some other of the system has within it the total number of real roots of even index and of pairs of complex roots of the derived equation which the circles would have if they were separated, but there may be circles of the system containing no such points. General criteria to determine whether even an isolated Jensen circle contains a pair of complex roots or a real root of even index of $f'(x)$ are lacking, though Walsh discusses special cases, in some of which we may use a circle smaller than Jensen's.

Relative distributions of the roots of a real polynomial $f(x)$ and of its derivative in various special cases have been discussed by H. B. Mitchell (Transactions of the American Mathematical Society, Vol. 19 (1918), p. 43). The identity of the logarithmic derivative is used, but the mechanical analogy and Jensen's theorem are not cited.

So far we have been concerned only with theorems of relative distribution for the roots of a polynomial and of its derivative. In a most suggestive paper by Bôcher ("A Problem in Statics and its Relation to Certain Algebraic Invariants," Proceedings of the American Academy of Arts and Sciences, Vol. 40 (1904), p. 469) our mechanical system is generalized by assigning to particles at points $e_1, e_2, \ldots e_n$ masses $m_1, m_2, \ldots m_n$ respectively, with the same law of repulsion as before. Negative values for the masses are admitted, the repulsion becoming an attraction in the case of the corresponding particles. The field of force is then given in both magnitude and direction by

$$K\left(\frac{m_1}{x-e_1}+\frac{m_2}{x-e_2}+\ldots\ldots+\frac{m_n}{x-e_n}\right).$$

The cases of greatest interest are those in which the sum of the masses is zero. By projecting such a system stereographically upon a sphere (the same result could be established by inversion on a circle about x), Bôcher proves that a point cannot be a position of equilibrium if it is possible to draw a circle through it upon which not all the particles lie and which completely separates the attractive particles which do not lie on it from the repulsive particles which do not lie on it.

A remarkable property of these systems whose total mass is zero is now developed by introducing homogeneous variables

$$x=\frac{x_1}{x_2},\ e_i=\frac{e'_i}{e''_i}.$$

If the above expression for the field of force is reduced to a common denominator within the parenthesis, the numerator is the product of x_2^2 and *a covariant* ϕ *of weight* 1 *of the* n *linear forms* $e_i''x_1 - e_i'x_2$. The points of equilibrium are roots of the covariant ϕ, and ϕ vanishes at no other points unless two of the particles coincide. If the points e_i are defined as the roots of a system of binary forms f_r, the masses of all the particles corresponding to each f_r being equal, ϕ is an integral rational covariant of the forms f_r, and we are thus led to theorems of relative distribution for the roots of a system of forms and those of a covariant of the system. In particular, if the system consists of but two forms, the covariant ϕ is their Jacobian; in all cases ϕ can be expressed as a polynomial in the ground-forms and Jacobians of pairs of the ground-forms.

The conditions of equilibrium of the corresponding mechanical system can now be interpreted as theorems of separation for the roots of the forms. Thus if f_1 and f_2 are two binary forms whose roots are all in circles C_1 and C_2 respectively, and these circles do not touch or overlap, then all the roots of the Jacobian of f_1 and f_2 are in C_1 and C_2. The actual number of roots in each circle is obtained by allowing the roots of f_1 to coalesce at a point a_1 and shrinking C_1 to this point; during this process C_1 is always to include all the roots of f_1. At the end of this process the Jacobian has $p_1 - 1$ roots at a_1, where p_1 is the degree of f_1. We conclude that the Jacobian originally had this number of roots in C_1, and a correspondingly determined number in C_2. The circles C_1 and C_2 may be replaced by circle-arc polygons.

The polygon theorem of Lucas corresponds to the special case where one of the ground-forms reduces to x_2.

A case of especial interest is that where one of the two ground-forms is linear; we have just noted a particular instance. The Jacobian of $y_2x_1 - y_1x_2$ and $f(x_1, x_2)$ is the first polar of (y_1, y_2) with respect to f. In a series of papers dating from 1874, to be found in his collected works, Laguerre had developed separation theorems for a binary form and its polars, without the use of our mechanical analogy. Bôcher seems to have been unacquainted with these results, which, however, are directly obtainable from his own. If the circle C_1 of the preceding paragraph is replaced by the point (y_1, y_2), we have Laguerre's theorem which states that if this point is outside a circle C_2 that contains all the roots of $f(x_1, x_2)$, then all the roots of the polar $y_1f'_{x_1} + y_2f'_{x_2}$ lie within C_2. Laguerre gives this a more striking form by supposing (x_1, x_2) taken arbitrarily and determining the "derived point" (y_1, y_2) as the point which makes the polar vanish. *Every circle through a point and its derived point either has all the roots of* $f(x_1, x_2)$ *on it, or else there is at least one root within and at least one root without the circle.* In non-homogeneous variables the derived point y of a point x with respect to $f(x)$ *is*

$$y = x - n\frac{f(x)}{f'(x)},$$

where n is the degree of $f(x)$. The first approximation to a root of $f(x)$ being x, the next approximation by Newton's method is $x - \dfrac{f(x)}{f'(x)}$. Thus we have a most interesting light upon Newton's method in the complex plane; it replaces x by a point *within* a circle on which x lies, and which surely contains a root of $f(x)$.

A point coincides with its derived point when and only when the point is a root of $f(x)$. Let α be such a simple root, and let β be its derived point with respect to $F(x)$, where $f(x) = (x - \alpha)F(x)$, and the degree of $f(x)$ is at least two. Since $F(\alpha) = f'(\alpha)$, and $F'(\alpha) = \frac{1}{2}f''(\alpha)$, we have

$$\beta = \alpha - (n-1)\frac{F(\alpha)}{F'(\alpha)} = \alpha - 2(n-1)\frac{f'(\alpha)}{f''(\alpha)}.$$

Each circle through α and β either has all the roots of $f(x)$ upon it or else at least one is within it and at least one is without. There is thus at least one root whose distance from α is not greater than $2(n-1)\left|\dfrac{f'(\alpha)}{f''(\alpha)}\right|$.

Laguerre and others have made interesting applications of these results to polynomials all of whose roots are real, and to polynomial solutions of linear differential equations.

Before leaving this phase of our subject we may note, with Laguerre, that similar theorems hold for each of the successive polars of a binary form with respect to a point. An interesting field hardly touched as yet is that of separation theorems for the successive polars of a form with respect to a sequence of points defined as the roots of another form. By taking the two forms in a special case where they are apolar Grace has proved (Proceedings of the Cambridge Philosophical Society, Vol. 11 (1901), p. 35) a result equivalent to this: *If the distance apart of two roots* α_1, α_2 *of a polynomial* $f(x)$ *of degree* n *is* 2a, *there is at least one root of* $f'(x)$ *on or in the circle whose radius is* $a \cot \frac{\pi}{n}$, *and whose center is* $\frac{1}{2}(a_1 + a_2)$. In this paper lack of references indicates ignorance of Laguerre's work. The same result was proved later by Heawood (*Quarterly Journal of Mathematics,* Vol. 38 (1907), p. 84) by allowing all the other roots of $f(x)$ to vary suitably. Here, again, there is no reference to any other work in this field.

To return to more recent work on the vanishing of the Jacobian of two forms f_1 and f_2, we note two very interesting papers by Walsh in the Transactions of the American Mathematical Society, in which are discussed cases where the roots of the ground-forms are in three circles, instead of two. An added interest is shown to attach to the Jacobian because the numerator of the derivative of a rational function

$$\frac{u(x)}{v(x)} = \frac{f_1(x_1, x_2)}{f_2(x_1, x_2)}$$

is x_2^2 multiplied by the Jacobian of f_1 and f_2. Separation theorems for the Jacobian are then interpretable in terms of this derivative. The results of these papers are, of course, only a first step to the consideration of still more general separation theorems. The field is the more interesting in that its investigation involves a combination of mechanical, algebraical, and geometrical considerations.

I must close with only a mention of certain extensions of the problem we have so far considered. Thus Bôcher, generalizing a method due to Stieltjes, considers the positions of equilibrium of a system of free particles of equal mass in a field of force due not only to a number of fixed repelling particles, but also to their own mutual repulsions according to the same law. If the total mass of fixed and moving particles is 1, the positions of equilibrium of the free particles are determined by the vanishing of covariants, of which some examples are given by Bôcher. These results, as well as some obtained by adding a force function $K[f(x)]$, are useful in the study of polynomial solutions of differential equations. We must regret that Bôcher was never able to fulfill the hope twice expressed in this paper that he might be able to return in detail to these problems which he had merely sketched. Their investigation requires considerable skill, but, if successful, would add a new and important chapter to algebra, with a striking application of invariant theory.

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Northwestern University

WILLIAM BATESON ON DARWINISM

Aside from the fine impression created by the admirable series of papers and addresses in biology, zoology and genetics in Toronto at the Naturalists' meeting, a very regrettable impression was made by a number of passages in the addresses of Professor William Bateson, the distinguished representative of Cambridge University and British biology. On the morning following his principal address the Toronto *Globe* (December 29, 1921) published, in large letters: "Bateson Holds That Former Beliefs Must Be Abandoned. Theory of Darwin Still Remains Unproved and Missing Link Between Monkey and Man Has Not Yet Been Discovered by Science. Claims Science Has Outgrown Theory of Origin of Species." In intermediate type it announced: "Distinguished Biologist from Britain Delivers Outstanding Address on Failure of Science to Support Theory That Man Arrived on Earth Through Process of Natural Selection and Evolution of Species. Have Traced Man Far Back but Still He Remains Man," and, in smaller type: **The missing link is still missing, and the Dar-**

winian theory of the origin of species is not proved. This was the verdict of one of the foremost British scientists, Professor William Bateson, director of the John Innes Horticultural Institute, Surrey, England, in the course of an epoch-making address on "Evolutionary Faith and Modern Doubts" at the general session of the American Association for the Advancement of Science, held in Convocation Hall last evening. While declaring that his faith in evolution was unshaken, he frankly admitted that he was "agnostic as to the actual mode and process of evolution." Believing in evolution in "dim outline," he pronounced the cause of origin of species as utterly mysterious.

The speaker then reiterated views expressed in previous addresses. Again quoting the *Globe:*

Referring to the variations occurring in the different species, Dr. Bateson stated that there was no evidence of any one species acquiring new faculties, but that there were plenty of examples of species losing faculties. Species lose things, but do not add to their possessions. "Biological science has returned to its rightful place," said Dr. Bateson, "namely, the investigation of the structure and properties of the concrete of our visible world. We cannot see how the differentiation into species came about. Variation, of many kinds, often considerable, we daily witness, but no origin of species. Distinguishing what is known from what may be believed, we have absolute certainty that new forms of life, new orders and new species have arisen in the earth, but even this has been questioned. It has been asked, for instance, 'How do you know that there were [no] mammals in palæozoic times? May there not have been mammals somewhere on earth though no vestige of them has come down to us?' We may feel confident there were no mammals then, but are we sure? In very ancient rocks most of the great orders of animals are represented. The absence of the others might by no great stress of the imagination be ascribed to accidental circumstances."

It is not surprising that the next day the *Globe* published a signed letter, under the caption, "The Collapse of Darwinism," of which the following is an abstract:

To an audience rarely paralleled in Canada for scientific eminence and influence, the famous Professor Bateson, with amazing frankness, removed one by one the props that have been considered the very pillars of Darwinism. A scientist of international repute, one of the leading, if not the leading evolutionist, of the day, he exposed the weakness of many of the leading planks in the "Origin of Species," and ruthlessly tore down one by one the once fondly believed links in the great chain of Darwinian evolution.

These citations cannot be dismissed as mere newspaper talk of no import. They are called forth by the fact that many of the statements in Bateson's address as cited below are inaccurate and misleading, especially those relating to the origin of species, natural selection, and infertility between species.

It is not true that we do not know how species originate. The *mode* of the origin of species has long been known—in fact, it was very clearly stated by the German paleontologist Waagen in the year 1869, a statement which has been absolutely confirmed beyond a possibility of doubt in the fifty years of subsequent research. It is also true that we know the modes of origin of the human species; our knowledge of human evolution has reached a point not only where a number of links in the chain are thoroughly known but the characters of the missing links can be very clearly predicated. The *cause* of the origin of species is another matter and has been sought in all branches of biology and biological research without an adequate solution having been found. Charles Darwin's theory of selection forms a partial solution of causation and, so far from being discarded, now rests upon much stronger evidence than it did when Darwin enunciated it.

The broad impression conveyed to my mind by the brilliant series of papers in the division of Genetics at Toronto is that genetics is essentially a branch of morphology. It is a running comparison between the morphology of the germ cell and the morphology of the adult. It is in this field, to which Professor Bateson has lent such distinction, that he fails to find either the mode or the cause of the origin of species.

Referring again to the ethical question of the dissemination of scientific truth, I am reminded of the precaution pressed upon me by Huxley from his own experience. He once told me that before delivering any of his popular addresses he very carefully wrote out every word he intended to say, lest in the heat of enthusiasm at the moment he might say something which would give a wrong impression of the truth. We men of science are far too careless in the application of this Huxleyan advice, especially in our popular addresses, which are eagerly read by the public. We must state the truth so clearly that it cannot be misunderstood and when we give voice to our own opinions we should clearly indicate them as our opinions and not as facts. Bateson's attitude towards Darwinism has been patronizing ever since he began his evolutionary studies. When he refers epigrammatically in a previous address to reading his Darwin as he would read his Lucretius he is indirectly stating an untruth which is calculated to do untold harm. In his Toronto address he *does not clearly distinguish between his own personal opinions based on his own field of observation* and the great range of firmly established fact that is now within reach of every student of evolution who surveys the world of life under natural conditions.

Since writing the above there has come to hand a copy of Professor Bateson's address[1], from which the following excerpts may be made:

Discussions 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. . . . We became geneticists in the conviction that there at least must evolutionary wisdom be found. . . . The unacceptable doctrine of the secular transformation of masses by the accumulation of impalpable changes became not only unlikely but gratuitous. . . . Less and less was heard about evolution in genetical circles, and now the topic is dropped. When students of other sciences ask us what is now currently believed about the origin of species we have no clear answer to give. Faith has given place to agnosticism. . . .

. . . But if we for the present drop evolutionary speculation it is in no spirit of despair. . .

Biological science has returned to its rightful place, investigation of the structure and properties of the concrete and visible world. We can not see how the differentiation into species came about. Variation of many kinds, often considerable, we daily witness, but no origin of species. . .

. . . But that particular and essential bit of the theory of evolution which is concerned with the origin and nature of *species* remains utterly mysterious. We no longer feel as we used to do, that the process of variation, now contemporaneously occurring, is the beginning of a work which needs merely the element of time for its completion; for even time can not complete that which has not yet begun. . . .

. . . Meanwhile, though our faith in evolution stands unshaken, we have no acceptable account of the origin of "species." . . .

. . . The survival of the fittest was a plausible account of evolution in broad outline, but failed in application to specific difference. . . . The claims of natural selection as the chief factor in the determination of species have consequently been discredited. . . .

. . . Even in Drosophila, where hundreds of genetically distinct factors have been identified, very few new dominants, that is to say positive additions, have been seen, and I am assured that none of them are of a class which could be expected to be viable under natural conditions. I understand even that none are certainly viable in the homozygous state. . . .

Analysis has revealed hosts of transferable characters. . . . Yet critically tested, we find that they are not distinct species and we have no reason to suppose that any accumulations of characters of the same order would culminate in the production of distinct species. . . .

Twenty years ago, de Vries made what looked like a promising attempt to supply this so far as *Œnothera* was concerned. . . . but in application to that phenomenon the theory of mutation falls. We see novel forms appearing, but they are no new species of *Œnothera,* nor are the parents which produce them pure or homozygous forms. . . If then our plant may by appropriate treatment be made to give off two distinct forms, why is not that phenomenon a true instance of Darwin's origin of species? In Darwin's time it must have been acclaimed as exactly supplying all and more than he ever hoped to see. We know that that is not the true interpretation. For that which comes out is no new creation. . . .

. . . If we cannot persuade the systematists to come to us, at least we can go to them. They

[1] Bateson, William: Evolutionary Faith and Modern Doubts. SCIENCE, January 20, 1922.

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, the impulse which made us biologists. . . .

The separation between the laboratory men and the systematists already imperils the work, I might almost say the sanity, of both. . . .

I have put before you very frankly the considerations which have made us agnostic as to the actual mode and processes of evolution. When such confessions are made the enemies of science see their chance. . . . Our doubts are not as to the reality or truth of evolution, but as to the origin of *species*, a technical, almost domestic, problem. Any day that mystery may be solved. . . . That synthesis will follow on an analysis, we do not and cannot doubt.

These passages seem to me to do great credit to Professor Bateson in so far as they contain a frank expression of his opinion that up to the present time neither the causes nor the mode of origin of species have been revealed by the older study of Variation, the newer study of Mutation, or the still more modern study of Genetics. If this opinion is generally accepted as a fact or demonstrated truth, the way is open to search the causes of evolution along other lines of inquiry.

HENRY FAIRFIELD OSBORN
COLUMBIA UNIVERSITY,
DEPARTMENT OF ZOOLOGY,
JANUARY 21, 1922

SCIENCE IN THE PHILIPPINES

EVER since returning from the Philippines in 1919, after a four-year stay, I have had in mind the writing of a brief account of conditions as I found them, especially those conditions which are of interest to the research man, who has wondered how the general status of his profession, and working conditions in the tropics compare with conditions in a large city in the northern part of the United States. My own experience in the tropics is limited to Manila and vicinity, but from my reading and from conversation with others I am of the opinion that conditions in the Philippines, Cuba, Panama, India, Java and other places in the tropics are somewhat similar, independent of the longitude. I have purposely delayed setting down my ideas, because I wished to wait until I could have a fair perspective in comparing experiences in the Philippines with experiences in the United States both before and after my stay there.

There are so many advantages and so many disadvantages to be taken into account that it is difficult to say which location is the more satisfactory for scientific work, and of course, the delights and new interests, and the broadening of one's horizon that come about from travel in the Orient are not to be overlooked. I shall mention only a few points to be considered without making any attempt to give them in the order of their importance.

Climatic conditions are unfavorable in so far as their effect on physical and mental efficiency is concerned. The high temperature and high relative humidity have a tendency to cut down productiveness. To accomplish a given result requires much more energy and determination than in a temperate climate. With the thermometer around 95 to 100 degrees Fahrenheit and the relative humidity between 90 and 100 per cent., the average individual is not so keen about performing his daily activities, especially those which require mental effort.

The general slowing up suffered by the average individual coming to the tropics from a temperate climate is so well understood by old Spanish residents of the Philippines that they divide all foreigners into three classes. There are the *Ricien Nacidos*, those who have been in the islands not to exceed two or three years, or literally, the "recently born." The middle class consists of those who have been there for five to ten years, and are beginning to become modified by the environment. The last class is called the *Platinos*, or "bananos." This class is supposed to have eaten so many bananas that they have become sleepy and torpid, have lost much of the industry of a temperate climate and have settled down and become a part of the general scheme of life in the tropics.

The separation from scientific societies and the opportunity to discuss problems and compare notes with others of the same profession must be admitted is a serious disadvantage. The range of acquaintanceship with persons engaged in his own class of work is limited and while there are a few science organizations these are small in comparison with those that can be enjoyed in an American city. The result is that, although one often spends more time in reading books and journal articles than if he were here, he finds on his return that a number of things of importance have transpired in the science world of which he either did not hear, or which failed to make much of an impression on him.

Work is often retarded by failing to get supplies promptly. It so happened that during my stay in the Philippines this condition prevailed all over the world, but it was worse there and is more or less chronic. If supplies are ordered from the United States, they cannot be expected in less than three months. To receive them in such a short time means that the stock was on hand at the supply house when the order was received and that there was no delay in filling the order. The time may be shortened, of course, by sending a cablegram, but unless definite arrangements are made and a special code established, this procedure is not practicable in general. With the cable rate from Manila to New York more than a dollar a word it may be seen that cable messages are justifiable only in rather unusual circumstances. If the order, when it arrives in Chicago or New York, is not filled with care and dispatch, another month or two may elapse. Usually it is not safe to count on delivery of goods in less than six months. It frequently happens that the manufacturer or dealer in America does not realize how long a time is required for an exchange of correspondence and will write requesting some further information, which means a delay of another three months, and so on.

On one occasion I ordered a pyrometer from a well known manufacturer in the United States. The order was sent by mail, but marked rush, and we hoped to receive the instrument within three or four months. At the end of that time, a letter was received, asking whether the wall type or table type of galvanometer was preferred. This was answered at once, stating that the table type was preferable. Several months later another letter came, this time asking whether we desired the scale to be graduated in Fahrenheit or Centigrade. By this time our work had been held up so long and we were so disgusted by the long delay that we at once cabled him to send the Centigrade scale. Practically a year from the date of the original order, the instrument arrived. Possibly a little profanity was justifiable when on unpacking the pyrometer, it was found that he had sent the Fahrenheit scale. Of course, this is an extreme case, but serves to illustrate the serious disadvantage of being separated by 10,000 miles from a supply house where a large stock of chemicals and apparatus may be obtained immediately. In Manila, as a rule, such materials are handled by drug stores and the limited stocks which they carry are available only to tide over until regular orders can be placed. Usually the chemicals in stock are primarily for pharmaceutical purposes, and not many chemically pure reagents are to be had.

Such compounds as ferrous salts seem to become oxidized much more rapidly than here; although I have seen no actual data to that effect. Also a number of compounds which do not take up moisture rapidly in a dry climate, do so there. On one occasion I bought an ounce or two of sodium thiosulphate for some photographic work. After completing the work, I left the remainder of the chemical in its original container which happened to be a paper bag and placed it in a drawer of the library table. On pulling out the drawer a few days later I was surprised to find considerable water which had wet a number of articles in the drawer. On looking for the source I found that the chemical was saturated with water and that it was necessary to keep it in a tight container. Chemicals for use in the tropics should be ordered in small containers so that if a portion is removed and the remainder is allowed to stand for a time, the loss will not be great. Although the cost of chemicals in quarter-pound bottles is slightly higher than in pound bottles, the saving and satisfaction more than repay the extra cost.

The deterioration of instruments and apparatus is especially troublesome. Almost any metal except gold or platinum will corrode rapidly if given half a chance. A number of experiences soon bring this to the attention of a new arrival in the islands. Wire paper fasteners must be made of brass if it is desired to keep pamphlets and magazines in good condition. After a short time, ordinary iron wire fasteners corrode to such an extent that the paper in contact with them is discolored from iron rust. Ordinary iron wire paper clips rust so rapidly that after a year or two they cannot be removed without being bent out of shape. The frames of cameras made of metal covered with leather go to pieces in some cases. The alloy becomes oxidized and pushes off the leather cover. Of course, it is an easy matter to remove the covering of oxide and replace the leather, but in a short time, more moisture has been absorbed and corrosion has taken place a second time.

These are trivial things compared with what happens to delicate physical apparatus of all kinds. It seems almost impossible to protect instruments from atmospheric moisture to such an extent that corrosion does not begin, and if this continues long enough the piece of apparatus is worthless. In many cases the corrosion does not justify replacement, but does demand restandardization. In order to get satisfactory results with pyrometers, galvanometers and the like it is necessary to restandardize them frequently, and this requires considerable time. Too long a time would be required to return the apparatus to the manufacturers for repairs and restandardization. Even glass lenses of microscopes, telescopes, cameras and the like are not immune. If they are not used for a time, they become spotted, and often have to be repolished.

Reliable skilled assistants are difficult to obtain. The demand for them is somewhat limited and every position is filled. However, there does not seem to be a position vacant nor a man out of employment. Most of the positions are filled by Europeans or Americans, though there is an ever increasing body of Filipinos trained in science. The difficulty is that there is very little flexibility to the system. If one man returns to the States or leaves his regular position for any reason, it is almost impossible to replace him without a long delay of correspondence back and forth to the United States and during this time, it often happens that valuable pieces of research are held up and interest is lost in them, because no one can be found to carry on the work.

Thus far I have mentioned only the tribulations of scientists in the tropics and I wish to protest against any charge of exaggeration. The account is not overdrawn and all of the items mentioned have come under my personal observation, and I believe anyone who has had experience in the tropics will verify them. However, there is another side, as I have previously mentioned. In this connection, the first thing which I shall discuss is the great interest and fascination of the various research problems which one encounters in the Philippines. The field is comparatively new and if one has some idea or plan for research, the chances are that on investigation, he will not find that it has been trampled over, but that he has practically a carte blanche. Although extensive research has been carried on at the Bureau of Science and elsewhere for the past decade or two, nevertheless the vast number of problems waiting to be solved have scarcely been touched.

While skilled assistants are few and difficult to obtain, unskilled help is plentiful. Filipinos are adapted physically to careful manipulation and some of them are very satisfactory indeed. The salary for such a position is much lower than here and a number of helpers are often available—which greatly expedites the work. The climatic conditions make the average American irritable and perhaps unusually hard to please, and while he is in the islands he is likely to believe that his unskilled assistants possess little merit and are difficult to direct, but when he looks back at his experiences, he is likely to change his mind materially and wish he could have half a dozen *muchachos* in his laboratory in the States.

Generally the laboratory is in a building of only one or two stories. This is very satisfactory because there is much less danger from fires and accidents. The uniform temperature greatly adds to the flexibility of the laboratory.

If the train of apparatus to be set up is too long for the room available, some of it may be put outside the laboratory. There is no question of cold and heat to be taken into account and during most of the year all that is needed is protection from the sun. There is always the advantage of good light and air and freedom from soot and dirt. Laboratory work is practically out-of-door work. There is no heating system, and no frozen pipes to be dreaded.

J. C. Witt

Chicago, September 10, 1921

CHARLES HENRY DAVIS 2ND

Charles Henry Davis 2nd, Rear Admiral, retired, U. S. Navy, who was twice Superintendent of the Naval Observatory, died at Washington, D. C., December 27, 1921.

He was born in Cambridge, Mass., August 28, 1845, the son of Charles Henry Davis and Harriette Blake Mills.

Admiral Davis graduated from the Naval Academy in 1864. From 1875 till 1885 he was engaged principally in astronomical work, at first in the Naval Observatory at Washington, in the Department of Chronometers, and then in expeditions for the determination of longitudes by means of the submarine cables. Also, the latitudes of many stations were determined by Talcott's Method.

In No. 6, Navy Scientific Papers, published by the Bureau of Navigation, are given the investigations by Davis of Chronometer Rates as affected by Temperature and other Causes. The results of the longitude expeditions are presented in three publications of the Navy Hydrographic Office: with Lieutenant-Commander Francis M. Green and Lieutenant J. A. Norris "Telegraphic Determination of Longitudes, embracing the Meridians of Lisbon, Madeira, Porto Grande, Para, Pernambuco, Bahia, Rio de Janeiro, Montevideo, and Buenos Aires, with the latitudes of the Several Stations"; also with Lieutenant-Commander Green, and Lieutenant Norris, "Telegraphic Determination of Longitudes in Japan, China, and the East Indies, embracing the meridians of Yokohama, Nagasaki, Vladivostok, Shanghai, Amoy, Hong-Kong, Manila, Cape St. James, Singapore, Batavia, and Madras, with the latitude of the several Stations"; with Lieutenants Norris and Laird, "Telegraphic Determination of Longitudes in Mexico and Central America and on the West Coast of South America, embracing the meridians of Vera Cruz, Guatemala, La Libertad, Paita, Lima, Anca, Valparaiso, and the Argentine National Observatory at Cordoba, with the Latitudes of the Several Sea-Coast Stations."

Davis as a Captain was Superintendent of the Naval Observatory from July, 1897, to April, 1898, leaving the Observatory to command the Dixie in the Spanish War. He returned to the Observatory in November, 1898, and remained on duty there as Superintendent until November, 1902. As Superintendent, Captain Davis took an active and successful part in the completion of the equipment of the New Naval Observatory and in formulating plans for the work to be carried on.

In 1904 Davis was made a Rear Admiral, and in 1904 and 1905 he was the U. S. representative on the international commission of inquiry on the North Sea incident which sat in Paris.

After service at sea as Squadron Commander, Admiral Davis was retired August 28, 1907. He continued to be interested in astronomy after his retirement, by reason of his achievements in science and because of his long service at the Naval Observatory.

His father, also a Rear Admiral, had twice been Superintendent of the Observatory and had established the Nautical Almanac Office.

SCIENTIFIC EVENTS

BRITISH SCIENTIFIC INSTRUMENTS[1]

The exhibition of British scientific instruments held under the auspices of the Physical Society and the Optical Society at the Imperial College of Science and Technology, of which a description was given in our columns last week, is a timely reminder of the importance of scientific instruments in the national economy. Modern civilization is based, and must be increasingly dependent, on the extension of

[1] From Nature.

scientific knowledge and its applications to industry; and in these developments scientific instruments are an essential and predominant factor.

Of the part played by scientific instruments in the advancement of scientific knowledge there is no need to speak. The laboratories of the universities and kindred institutions where scientific research is prosecuted would be disabled were they without scientific instruments of the highest trustworthiness and precision. The variety and extent of the industrial purposes served by scientific instruments are so great that there is probably no important industry in the country which is not dependent on scientific instruments of one kind or another for the performance of its productive functions. Moreover, the field of application of scientific instruments is constantly widening; the uses of the microscope in the textile and steel industries, of the polarimeter in the sugar and essential oil industries, of the pyrometer in the metallurgical industry, and of X-rays in the iron and steel industries, are but a few of the many examples that could be cited to illustrate the invasion of scientific instruments into fields of industry in which they were at one time unknown. That the industries gain in sureness and accuracy and in a deeper and wider knowledge of the fundamental scientific principles involved is obvious. And the process continues and must continue. Tomorrow new instruments will be devised and new uses found for old instruments.

Moreover, as was stated in the leading article published in Nature of February 10, 1921, the scientific instrument industry, springing directly from the loins of science, and progressing as scientific knowledge widens, is one of the most highly skilled industries we have. Its expansion means a definite increase in the numbers of academic and technical scientific workers and of the most highly skilled artisans; and the national wealth, in any comprehensive conception of the term, must be enlarged by the increase of the numbers of such educated and skilled classes.

For these and other reasons a flourishing and efficient scientific instrument industry is vital to the nation, whether in peace or war. And, although it is obvious that the users of scientific instruments, whether in the industrial or academic domain, must not be prejudiced or hampered by being unable to obtain the best instruments, from whatever source, it would be a disaster of the first magnitude if British scientific instruments should not be produced equal to the best that the world has to offer.

AN ENGLISH JOURNAL OF SCIENTIFIC INSTRUMENTS[1]

Nature may be continuous and the divisions of time and space no more than artificial articulations devised to suit the human intellect. Nevertheless, physical science is based on measurement, and proceeds only by the use of selected units of time, space, quantity, and so forth. Every new branch of science leads to the creation of a new set of units, and according to the latest theory it would appear that energy itself is most conveniently regarded as divided into "quanta"—measurable and related units. Many of the most illuminating advances in theory and actual discoveries of fact have come about by more refined methods of weighing and measuring. By these, argon, radium, and many new elements have been isolated and identified; by these the structure of the atom and the new alchemy which transmutes one element into another have been revealed. In every laboratory a new research implies the devising of new apparatus or the detection of deficiencies in existing apparatus. The literature in which such advances in technical methods are published is scattered all over the civilized world. It is written in many languages and at present there is no adequate system of indexing or recording it. Doubtless the patent offices contain sufficient descriptions of improvements with actual or possible commercial value; but even this field is so vast that applicants have to employ special agents before they can guess if their claims are novel. But for a large proportion of the methods devised in the prosecution of research patents are neither sought nor desired. Sir Richard Glaze-

[1] From the London Times.

brook, when director of the National Physical Laboratory, recognized the waste of time and the duplication of effort arising from this confusion. He had his opinion confirmed by many men of science, Government Departments, trade associations, and private firms. His successor, Sir Joseph Petavel, and the Advisory Council of Scientific and Industrial Research have taken up the question where he left it, and now hope to found a journal to deal with the methods of measurement and instruments. A preliminary number is being prepared under the direction of the Institute of Physics, the Research Department, and the National Physical Laboratory. It is hoped that the distribution of this, the cost of which is to be borne by the Department of Scientific Research, will secure sufficient support to place the venture on a permanent basis. There can be no doubt that the establishment of the proposed journal would be of value to the progress of all branches of scientific work.

JOURNAL OF THE OPTICAL SOCIETY OF AMERICA AND REVIEW OF SCIENTIFIC INSTRUMENTS

During the past few years there has been an increasing appreciation of the need in America of a journal devoted to scientific instruments of all kinds. This need is due to a number of causes. The ever increasing volume of scientific material which is being offered for publication is so crowding many of our journals that space does not permit an adequate description of apparatus used. Further, many instruments and instrumental methods, developed for a single experiment, can be applied to a variety of measurements. If described only in connection with the work for which they were developed, the description is relatively inaccessible since it is subsidiary to the main scientific discussion of the article.

In many sciences there is no medium for the publication of articles describing apparatus primarily for pedagogical purposes in lecture demonstrations and laboratory. Such short articles or notes should serve a very useful purpose since every real teacher is always on the lookout for means of improving his teaching. Further, newly developed apparatus and methods of one science are very frequently applicable to work in another science. A medium of publication readily accessible to all would save much time and energy.

The first steps toward the development of an instrument journal were taken by the National Research Council and the Association of Scientific Apparatus Makers of the United States of America in jointly taking under advisement the establishment of a new journal for the purpose. After extensive consideration it seemed unwise to start an independent journal. Finally representatives of the Optical Society of America, which was publishing a bi-monthly journal under the title *Journal of the Optical Society of America,* were invited to a conference which ultimately resulted in an arrangement whereby the Optical Society, cooperating with the National Research Council and the Apparatus Makers Association, is to add to its journal a section on scientific instruments. The enlarged journal is to be published under the title *Journal of the Optical Society of America and Review of Scientific Instruments,* and will be issued monthly, beginning with May, 1922. It will be under the direction of an editorial board composed of Dr. P. D. Foote, Bureau of Standards, editor-in-chief; Professor F. K. Richtmyer, Cornell University, assistant editor-in-chief and business manager; and a representative board of associate editors.

In addition to articles on theoretical, experimental and applied optics in the section on optics of the new journal, there will be published in the instrument section original articles on scientific instruments of all kinds (*i. e.,* electrical, mechanical, etc., as well as optical) for research and instruction in chemistry, physics, biology and other sciences. The editors announce that they will be glad to receive manuscripts for publication, and suggestions as to desirable subject matter to include in the journal.

GIFT OF THE PROCEEDS OF RESEARCH FOR RESEARCH

On January 26, 1922, a contract was signed between The Babies' Dispensary and Hospital and the W. O. F. Laboratories Company, Cleveland, Ohio, in connection with the manufacture of S. M. A.—an artificial food adapted to mother's milk and developed by Dr. H. J. Gerstenberger, medical director of The Babies' Dispensary and Hospital and professor of Pediatrics of Western Reserve University Medical School, who has transferred all of his rights to The Babies' Dispensary and Hospital.

S. M. A. is said to represent an improvement over the older attempts at making an artificial food for infants more like human milk in that it contains a fat that in its saponification, iodine, and Reichert-Meissl numbers is like the fat of woman's milk, and in that it further possesses decided anti-spasmophilic and anti-rachitic powers. The latter are at least partly due to the use of codliver oil in the making of the S. M. A. fat.

S. M. A. was fed to dispensary and hospital infants under careful supervision from 1915 to 1920. During January, 1920, it was made available to the medical profession of Cleveland with excellent results, as can be realized from the increase in sales per month, being 1,000 quarts at the beginning and 20,000 quarts during December, 1921. During November, 1920, S. M. A. was put up in powder form, and a year later was made available to the medical profession throughout the country.

As a result of this contract the Babies' Dispensary will receive a minimum of $10,000 per year. To meet the request of Dr. H. J. Gerstenberger, the contract contains a clause limiting the use of the funds to research purposes.

Inasmuch as The Babies Dispensary and Hospital will be the future department of pediatrics of Western Reserve University Medical School, it is hoped that this accomplishment will aid in the prompt development of the pediatric unit of the new medical group of Western Reserve University.

PROFESSOR J. W. TOUMEY AND THE YALE SCHOOL OF FORESTRY

Appreciation of the part played by Dean J. W. Toumey, of the Yale School of Forestry, in securing Mr. Henry S. Graves as his successor, and satisfaction in the former's decision to continue in the service of the university as Morris K. Jesup professor of silviculture, is expressed in a vote passed by the Yale Corporation. It was due to Professor Toumey's initiative and wish that efforts were made to induce Mr. Graves to return to the university as head of the School of Forestry. The vote of the corporation follows:

> Voted, in accepting, at the request of Professor James W. Toumey, his resignation as dean of the School of Forestry, to record the satisfaction of the president and fellows that he is to remain in Yale's service as Morris K. Jesup professor of silviculture, and to spread upon the minutes of the corporation an expression of its gratitude to him for his successful administration as acting director and then as dean. During this, and due to his untiring interest and enthusiasm, this youngest of Yale's schools has gained largely in endowment, extended its educational scope, and added both to its equipment in New Haven and to its facilities for instruction in the field through the acquisition of the school forests in Connecticut and in New Hampshire. The corporation recognizes with pride and gratitude that no other school of Yale University has enjoyed a more remarkable and better planned development than has the School of Forestry under Dean Toumey's administration, the close of which is fittingly marked by the successful consummation of two projects nearest his heart. One of these is the acquisition by the School of Forestry of a building adequate for its needs; the other is the return to Yale University as head of the school of Henry S. Graves, B.A. 1892. The fact that the movement to bring the latter back as dean originated with Professor Toumey is but one example from many which might be cited of his desire to see the school take advantage of every opportunity before it and of his constant, loyal and unselfish devotion to its welfare.

SCIENTIFIC NOTES AND NEWS

The annual meeting of the National Academy of Sciences will be held at the United States National Museum, Washington, on April 24, 25 and 26.

Dr. George E. Hale has resigned as president of the Pacific Division of the American Association for the Advancement of Science to attend the meeting of the International Research Council in Brussels. Dr. Barton Warren

Evermann, director of the Museum of the California Academy of Sciences, has been elected president to succeed Dr. Hale, and will give the address at the meeting to be held in Salt Lake City from June 22 to 24. It will be remembered that the American Association for the Advancement of Science will hold a summer meeting at Salt Lake City in conjunction with the Pacific Division.

We learn from *Nature* that a portrait of Sir Patrick Manson was unveiled by Sir James Michell at the London School of Tropical Medicine on January 20. The portrait was subscribed for by a large number of past and present students and other friends at home and abroad.

The board of managers of the Hospital of the University of Pennsylvania will extend the age limit for professors to enable Dr. John B. Deaver to continue as head of the surgical department of the University Medical School. Dr. Deaver will be 67 years old on July 25, and the board of managers was unanimous in the desire to retain him.

Dr. Smith Ely Jelliffe has been elected president of the New York Psychiatric Society.

Bradley Stoughton, formerly secretary of the American Institute of Mining and Metallurgical Engineers, was elected president of the Yale Engineering Association at the annual meeting on February 2, 1922.

Dr. Harold Pender, director of the department of electrical engineering at the University of Pennsylvania, was recently appointed chairman of the standards committee of the American Institute of Electrical Engineers.

Mr. John G. Sullivan was elected president of the Engineering Institute of Canada for 1922 at the annual meeting held in Montreal from January 24 to 25.

We learn from *Nature* that shortly after the retirement of Professor P. F. Frankland from the Mason chair of physics in the University of Birmingham a fund was opened with the object of providing some permanent memorial of his work in the university. The money subscribed was devoted in the first place to a portrait of Professor Frankland (painted by Mr. Bernard Munns), which now hangs in the great hall of the University at Edgbaston. The balance of the fund has been applied to the institution of a Frankland medal, which, together with a prize of books, is to be presented annually to the best student in practical chemistry.

The council of the Geological Society has this year made the following awards: Wollaston Medal, Alfred Harker; Murchison Medal, John William Evans; Lyell Medal, Charles Davison; Wollaston Fund, Leonard Johnston Wills; Murchison Fund, Herbert Bolton; Lyell Fund, Arthur Macconochie and David Tait.

The Prince Albert of Monaco and Professor G. O. Sars, of Christiania, were elected foreign members of the Zoological Society of London at its monthly meeting on December 21.

In the recent reorganization of the Russian Soviet cabinet, three new portfolios were created, one of them for public health, in which Dr. Semashko has been placed in charge.

Dr. Lester A. Pratt, who has been in charge of the research laboratory of the Merrimac Chemical Company, Boston, for the past six years, has been made director of research in the same institution.

Edward A. Dieterle, assistant chief chemist of the Koppers Company, Pittsburgh, Pa., has been made chief chemist of the Chicago By-Product Coke Company, Chicago.

Dr. Carl S. Oakman, of the Digestive Ferments Company, Detroit, has accepted the general managership of the Wilson Laboratories, Chicago.

Professor Jacob R. Schramm, of the department of botany of Cornell University, has been granted a leave of absence for work in Washington on *Botanical Abstracts.*

Professor Stephen S. Visher has resumed his teaching of geography at Indiana University after spending nearly six months in a field study of the tropical cyclones of the Pacific. The investigation was financed by the Bishop Museum of Honolulu and by Yale and

Indiana Universities. Dr. Visher studied in the Hawaiian, Fijian and Philippine Islands and in Australia, coastal China and Japan.

Dr. Howard S. Reed, professor of plant physiology in the University of California, is spending the winter in the West Indies and Central America, in travel and in observation of the citrus industry.

J. S. Negru, managing editor of *Chemical and Metallurgical Engineering*, sailed for Europe on February 11, for a six months trip through Germany, France, Belgium and other European countries. The purpose of the trip is to study industrial and economic conditions and observe the latest advances in engineering and technology.

Leave of absence has been granted a party of naturalists from the State University of Iowa to spend the summer of 1922 in the Fiji Islands and New Zealand. The party will consist of Professor C. C. Nutting, zoologist, who will act as leader; Professor R. B. Wylie, botanist; Professor A. O. Thomas, geologist; Assistant Professor Dayton Stoner, entomologist and ornithologist; Mrs. Dayton Stoner, assistant entomologist, and Mr. Waldo S. Glock, assistant geologist.

Dr. J. Gordon Thompson, lecturer on protozoology at the London School of Tropical Medicine, has, at the invitation of the British South African Country, gone to Rhodesia to investigate protozoological diseases. Dr. Thomson sailed on January 5 and expects to be absent six months. He will give special attention to the etiology of blackwater fever.

Professor H. S. Langfeld, of Harvard University, delivered an address on "Instinct and War" at an open meeting of the William James Club of Wesleyan University on December 4. Professor E. G. Boring, of Clark University, addressed the club on February 10, on "The Changing Status of Introspection."

Dr. Hawley O. Taylor gave a course of twelve lectures on auditorium acoustics at Franklin Union, Boston, beginning on January 3. The lectures were addressed particularly to architects and builders and treated the subject in a way to enable architects to satisfactorily adjust the acoustics of the rooms which they design.

On February 9, Professor J. Howard Mathews, chairman of the department of chemistry of the University of Wisconsin, addressed the Purdue Section of the American Chemical Society on the subject "Some of the Research Methods and Research Problems of Photochemistry."

Dr. J. C. Bloodgood, of Baltimore, Associate Professor of Clinical Surgery at the Johns Hopkins Medical School, gave a Mayo Foundation Lecture, January 14; he discussed "The present day trend of surgery and pathology and the outlook for the future."

Dr. Roger I. Lee, professor of hygiene, Harvard University, lectured before the School of Hygiene and Public Health, Johns Hopkins University, on "The physical examination of large groups of individuals," at its regular weekly lecture, February 6.

Dr. J. A. Detlefsen, of the University of Illinois, delivered a lecture before the Royal Canadian Institute at Toronto on January 21, on "Recent experiments bearing upon the inheritance of acquired characters."

Professor H. A. Brouwer, of Delft, Holland, who is exchange professor in the University of Michigan for the spring semester, will deliver a course of lectures on the "Geology of the Dutch East Indies." He will also deliver a series of more popular lectures upon "The people and geology of the East Indies."

The annual meeting of the Eugenics Research Association will be held at Cold Spring Harbor, Long Island, Saturday, June 10, 1922. The title of Dr. Lewellys F. Barker's presidential address is "Heredity and the Endocrine Glands."

Professor Leffler, of Stockholm, is endeavoring to organize an International Congress of Mathematicians, to be held at Stockholm in the coming summer.

The Royal Society of Archeology of Brussels has formed a section of the history of medicine, the first meeting of which was held on December 9. Dr. Mélis was appointed president, and Dr. Muls of Brussels, secretary.

Dr. Ella B. Everitt, professor of gynecology at the Woman's Medical College, Philadelphia, was killed on January 24 when her automobile collided with a motor truck.

The Yale *Alumni News* writes: "The late Professor Joseph Paxson Iddings, of the United States Geological Survey, a graduate of the Sheffield Scientific School in the Class of 1877, and who had a distinguished career as a teacher and research worker in the field of petrology, was always greatly interested in the work of petrology at Yale, and especially in the work of his friend, the late Professor Pirsson. Dr. Iddings gave, some years ago, the Silliman Lectures at Yale University, and he was for many years connected with the University of Chicago as professor of petrology. Through a gift from his sister, Mrs. Estelle Iddings, Cleveland, the entire portion of Dr. Iddings' estate, amounting to over $25,000, has been presented to the Board of Trustees of the Sheffield Scientific School, the income of this fund to be used for the promotion of research work in petrology. During the life of one person a portion of the income of this fund will not be available, but there will be established for the next university year a scholarship of $500 open to a properly qualified student in the graduate school of the university competent to carry on research work in petrology. This scholarship is to be known as the Joseph Paxson Iddings Scholarship in Petrology. The award of this scholarship is, by the terms of the gift, in the hands of a committee composed of the director of the Sheffield Scientific School and the professor of geology, who is a member of the Governing Board of the Sheffield Scientific School."

Attention is called in *Nature* to the fact that on January 2 occurred the centenary of the birth of Rudolf Julius Emmanuel Clausius, the distinguished mathematical physicist and the predecessor of Hertz in the chair of natural philosophy at Bonn. The son of a pastor and schoolmaster, Clausius was born at Koslin, in Pomerania, and after attending the gymnasium at Stettin, spent four years at Berlin, where he studied under Dirichlet, Steiner, Dove, and Magnus. Before going to Bonn he held appointments at the Royal Artillery School, Berlin, Zürich Polytechnic, and Würzburg University. Recognized as one of the founders of the science of thermo-dynamics, it was in his memoir to the Berlin Academy of Sciences in 1850 that he re-stated Carnot's principle in its correct form. To him is also due the conception of entropy. His chief work, "Die Mechanische Wärmetheorie," appeared in 1867. The kinetic theory of gases and the theory of electrolysis also owed much to his labors. He was called to Bonn in 1869, served as Rector of the University during 1884-85, and died there on August 24, 1888.

The House of Representatives has passed the Lampert bill to increase the salaries of the chief or principal examiners of the Patent Office from $2,700 to $3,900 per year and those of the assistant examiners by amounts ranging from $150 to $900 per year. The bill provides an increase of force to the extent of one law examiner, 26 assistant examiners, and 22 clerks.

UNIVERSITY AND EDUCATIONAL NOTES

The will of Amos F. Eno, disposing of $13,000,000 or more, is declared invalid by a surrogates' court jury on the ground that Mr. Eno was of unsound mind when he executed it. It is the second time the will has been declared invalid in surrogate's court, the appellate division having ordered a retrial. The will was executed in June, 1915, two months before Mr. Eno's death. His estate has increased since then, so that the distribution under the document now would have been approximately: Columbia University, between $5,000,000 and $6,000,000; other institutions, $3,000,000, and relatives, $4,600,000. Besides the residuary bequest to Columbia University Mr. Eno bequeathed to New York University, the American Museum of Natural History, the Metropolitan Museum of Art and other institutions, $250,000 each. The largest cash beneficiary was the General Society of Mechanics and Tradesmen, to which the testator left $1,800,000.

The will of Cora M. Perkins gives her residuary estate to Columbia University, in addition to a direct bequest of $30,000 for chemical research.

A Reuter dispatch from Brussels states that Louvain University has received a legacy of $100,000 toward erecting a special building for cancer research.

Dr. M. C. Merrill, professor of horticulture at the Utah Agricultural College, has been appointed professor of horticulture and dean of the new College of Applied Arts at the Brigham Young University, Provo, Utah.

T. L. Patterson, Ph.D., formerly of the physiological department of the State University of Iowa College of Medicine, has been appointed professor and director of the department of physiology at the Detroit College of Medicine and Surgery.

Dr. Alice Sullivan has sufficiently recovered from her accident of last summer in the Colorado floods to assume her position as instructor in psychology at the University of Illinois.

DISCUSSION AND CORRESPONDENCE

KILOBAR, KILOCAL, KILOGRAD

In a letter just received from The Meteorological Office, Professor Whipple very kindly informs me of the result of a question put to the Secretary of the Chemical Society regarding the attitude of British chemists regarding the *bar.*

While the opinion expressed is to be regarded as unofficial, Professor Philip says:

"Your letter in reference to the definition of the 'bar' was considered by our Publication Committee. The general opinion is that very few English chemists use the 'bar' as a unit of pressure on either basis. There was a feeling, however, that in view of the use of the 'bar' in Langmuir's papers and other communications emanating from the same quarter (see *e. g.* Dushman in the *General Electric Review,* 1920-1) English chemists would be more likely to use the 'bar' in that sense than in the sense employed by meteorologists."

It will be recalled that meteorologists in 1913, quite unaware of the fact that the *bar* had been accurately defined by Professor T. W. Richards in 1903, and thinking they were coining a new word, adopted the *bar* as the unit of pressure but gave it the value of a *megabar.* My friendly correspondent, a meteorologist of prominence, adds: "This looks as if the confusion is likely to spread. We shall have a permanent ambiguity like those in the words *billion* and *calorie.*"

To this, I have answered: There need be no confusion if meteorologists will simply write *kilobar,* where they now use *millibar.*

The practical unit of pressure is 1000 *bars,* the *bar* being the pressure expressed in terms of force which will give an acceleration of 1 centimeter per second per second to one gram of matter.

It is the natural basic unit, strictly C. G. S. and was in legitimate use by chemists and physicists 10 years previous to its appropriation by meteorologists.

With regard to the calorie, it will no longer be necessary to specify the calorie as the gram calorie or therm. The word *calorie* by itself will mean the amount of heat that will raise the temperature of a gram of pure water from 1000 to 1003.66 Kelvin-kilograds. The larger unit, much used by engineers, being the amount of heat required to raise the temperature of one kilogram of water, can be called the *kilocal.*

The scale of temperature which has been used without difficulty at Blue Hill Observatory for the last five years, makes the thermal coefficient of the expansion of a gas (air) at constant pressure .001 instead of .00366.

This is very easily accomplished by making zero on the scale, the absolute zero (—273.12° Ac) and making the freezing point of pure water at megabar pressure, 1000. There are numerous advantages in the use of the scale. When used in connection with kilobar pressure, values of temperature and pressure are decimalized; and equations in thermodynamics require about half the old style multiplication and division.

It may be noted that, unlike the Fahrenheit and Centigrade which depend upon the boiling point of water, a variable quantity, depending upon pressure, and hence not the same from one day to another, or even from one place to another, the Kelvin-kilograd uses only the freezing point. The effect of change of pressure on the freezing point is so small compared with the boiling point that the correction is practically negligible.

Alexander McAdie

Blue Hill Observatory,
January 30, 1922

THE GEOLOGY OF WESTERN VERMONT

In a paper entitled "Studies in the Geology of Western Vermont," published in the Twelfth Biennial Report of the Vermont State Geologist, pp. 114 to 279, the writer has described field relations among the lower and middle Ordovician strata along the eastern shore of Lake Champlain in the townships of Benson, Orwell and Shoreham which seem best explained as great dislocations in the forms of reverse faults and one or more low-angle thrusts by which certain massive dolomite and limestone strata of lower Ordovician age have been broken and moved westward for indeterminate distances over shales and interbedded black slates and limestones belonging to the same geological system, but undoubtedly younger in age.

Similar phenomena were described also for the lake region near Burlington, where, however, thrust phenomena had long been better known. In the northern areas, so far as studies had then been carried by the writer, the presence of lower Ordovician limestones on middle Ordovician slates seemed largely confined to the islands of the lake, while on the mainland of Vermont certain siliceous dolomites and quartzites belonging to the Cambrian system and to the lower Cambrian terrane were found reposing on black slates with interbedded limestone bands not very different from those found beneath the lower Ordovician limestones on the islands and on the mainland farther south in Orwell and Benson.

In addition to the description of the more or less clearly defined deformations just referred to the writer offered field evidence in support of the view that similar dislocations may probably define the fundamental deformational features of the rocks within parts of the Taconic Range, and along the "Vermont Valley" and the western margin of the Green Mountain plateau contiguous thereto, although within the latter-mentioned areas the thrust relations have been much disguised by normal faulting.

In the summer of 1921 the writer continued his studies in western Vermont among the islands of Lake Champlain and along the mainland in Phillipsburg, Quebec, and in the Vermont towns of Highgate, Swanton, Sheldon, St. Albans, Georgia, Fairfield, Fairfax, Milton and Colchester. Although there are present in these areas certain differences in respect to deformation and erosion, with which in some degree apparently are to be correlated the former extent and present boundaries of the lake in its northern portions, and also certain geographical variations, chiefly in the rocks composing the lower Cambrian beds in northern Vermont, the major thrust relations are clearly defined. Many interesting structural details were noted.

It is purposed, at the first opportunity, to continue these later studies thus begun and to publish a second paper on the geology of western Vermont, dealing chiefly with deformational features among the islands of Lake Champlain and along the Vermont shore region of the lake as far south as Shoreham.[1]

C. E. Gordon

Amherst, Mass.,
November 1, 1921.

ACUTE SENSE OF SOUND LOCATION IN BIRDS

In a recent issue of Science,[1] Dr. A. G. Pohlman, of the St. Louis University School of Medicine, briefly discusses some matters pertaining to the ability of birds to locate the

[1] Published with the consent of the Vermont State Geologist.

source of sounds, under the heading, "Have Birds an Acute Sense of Sound Location?" He closes by saying that he would appreciate any direct observational data touching upon this subject. The following is an affirmative answer to his question:

On the morning of September 9, 1921, when in camp near Kneeland post office, Humboldt County, California, while I was seated among some rather tall bushes, watching for sparrows, a Sharp-shinned Hawk (*Accipiter velox*) flew on to a lower limb, some thirty or forty feet above the ground, of a dead fir tree about seventy yards away, alighting with its back toward me. While the bird was visible to me through the small openings among the branches of the bushes I must have been absolutely hidden from its view.

Just to see what the result would be I squeaked in imitation of a wounded bird when, to my great astonishment, the hawk wheeled as if on a pivot with remarkable rapidity and darted in a bee line over the tops of the bushes straight in my direction. When it reached the spot directly over my head, and not six feet above me, it evidently was aware that it had reached the center of the sound field for, not seeing anything there to account for the sound, it shot abruptly up into the air and lit on a limb of another dead fir so close to me that I shot it with my 32 caliber auxiliary barrel with a small charge of No. 12 shot.

The most curious part of this incident is that the hawk did not stop to listen and analyze or locate the sound, as might a jay for instance, but with the first squeak it turned quick as a flash, and darted with arrowlike speed for the spot from which the sound emanated; that is to say on the exact line (more correctly, vertical plane) between its perch and the spot, as the height of the bushes prevented it from aiming its flight quite low enough. It seemed to me that if my head had been high enough to be above the bushes it would have struck me.

This was the most remarkable exhibition of instantaneous precision in locating sound, not only as concerns direction but also as to rapidity of impulse, that it has been my good fortune to witness.

JOSEPH MAILLIARD

CALIFORNIA ACADEMY OF SCIENCES,
SAN FRANCISCO, CALIFORNIA

[1] SCIENCE, New Series, Vol. LIII, No. 1375, May 6, 1921, p. 439.

SCIENTIFIC BOOKS

Déodat Dolomieu, membre de l'Institut National (1750-1801); sa correspondance, sa vie aventureuse, sa captivité, ses œuvres. ALFRED LACROIX. Ouvrage publié par l'Académie des Sciences avec le concours de l'Institut (Fondations Debrousse et Gas) Paris, Librarie Académique, Perrin et C^ie^, 1921, 2 vols, lxxx, 255, and 322 pp., port., 8vo. With line portrait frontispiece.

THE latest work of Professor Alfred Lacroix is a very important contribution to the history of the scientific men of France in the eighteenth century, perhaps all the more so that the name of Dolomieu is not well known in foreign lands.

The book has grown out of the researches made by Professor Lacroix in preparing the biographical sketch of Dolomieu which he read before the Académie des Sciences on December 2, 1918, and which has already been reviewed in SCIENCE. He found a number of Dolomieu's letters in the library of the Muséum d'Histoire Naturelle, and traced out many others in foreign libraries and in private hands. The author remarks that the chief value of those letters he has selected for publication is that they include a series, covering a period of some twenty years, written by Dolomieu to a small number of particular friends, so that they enable the reader to follow his life day by day in its more intimate details. The earliest in date of these letters were addressed by Dolomieu to his patron, Duke Alexander de la Rochefoucauld, member of the Académie des Sciences and colonel of the regiment "De la Sarre," who was destined to be assassinated in 1792, almost in Dolomieu's arms.

An interesting group of 47 letters are those written to the Sicilian naturalist Giseni; these treat at length of the important investigations of Dolomieu in the domain of volcanic formations. Other groups of letters are those sent to the Chevalier Philippe de Fay, the truest of Dolomieu's friends, to Picot de la Peyrouse, botanist and geologist of Toulouse, to the great geologist Saussure, to the Genevan physician Pictet, to Pierre Picot, professor of theology in Geneva, and to Frederic Munter, professor of theology in Copenhagen.

The following extract from a letter to this last named correspondent, is a characteristic example. Dolomieu, after passing safely through the throes of the French Revolution, was appointed, in 1796, lecturer in geology and the distribution of minerals at the newly-organized Ecole des Mines. A year later, Jan. 15, 1797, he writes to his friend Munter:[1]

"The sciences, which were for me formerly a relaxation, have become a profession which furnishes me the means of livelihood, and none the less I cultivate them with pleasure. I am chiefly occupied with mineralogy and geology, and I give lessons in these branches at the Ecole des Mines during the winter. During the summer I travel to inspect the mining operations. I have assumed charge of the mineralogical articles of the Dictionnaire Encyclopédique, and I write articles which are published in various journals. Thus I employ my time in a manner agreeable to myself and I advance without much disquietude toward that fatal term against which all human hopes make shipwreck. We have become so accustomed to the idea of death, that we now see our last hour approaching with complete indifference."

The biographical sketch already noted is reprinted by Professor Lacroix at the beginning of the first volume of the present work (pp. i—lxxx). To this succeeds the unique record written by Dolomieu in 1799, in his prison at Messina, where he was incarcerated because of his supposed guilt, as a Knight of Malta, in aiding Bonaparte to seize the island. It was inscribed on the margins of the leaves of a book he had succeeded in obtaining, and which is now a precious possession of the Muséum d'Histoire Naturelle (pp. 1-44). The quality of this record may be exemplified by the following brief extract:

"My passion for the phenomena of Nature was so strong that every year, when spring renewed the life of the vegetable kingdom and gave new force to all organized beings, the environs of Paris seemed too restricted for me, its atmosphere heavy and offensive . . . . Therefore each year I hastened to the mountains, and sought on their summits those profound emotions which the contemplation of very great objects always procures us . . . Now, confined within a space of twelve feet long, and ten feet in height and width, I can only contemplate my own wretchedness and reflect upon the vicissitudes of fortune and my strange destiny."

Fortunately the Italian victories of Bonaparte opened his prison doors, his liberty being prescribed in one of the articles of the peace treaty of Florence, March 20, 1801. However, his enfeebled health did not long permit him to enjoy his recovered freedom. He died at Chateauneuf, November 6, 1801, but fifty-one years old.

Of Dolomieu's scientific attainments, Professor Lacroix notes that it was principally in the study of volcanic phenomena that he left his trace, and asserts that by his researches concerning Auvergne, he takes his place in the first rank of those who have recognized and demonstrated the relations existing between volcanism and the internal heat of the earth.

GEORGE F. KUNZ

[1] Vol. II, p. 138.

SPECIAL ARTICLES

DISSOCIATION OF HYDROGEN IN A TUNGSTEN FURNACE AND LOW VOLTAGE ARCS IN THE MONATOMIC GAS

IN the course of an investigation of arcing characteristics of diatomic gases being carried on in this laboratory, it was found that the arc between a hot tungsten filament and a plate anode in hydrogen struck and broke at a minimum of 16.4 volts. This potential is about that ascribed by Bohr's theory to the potential necessary to accelerate an electron so that it will dissociate the molecule and ionize one of the atoms upon impact. In view of the fact that Bohr's theory puts the ionizing potential of the hydrogen atom at 13.52 volts and the radiating potential at 10.14 volts, it seemed that it should be possible to maintain an arc at 13.52 volts or even as low as 10.14 volts. The failure to maintain an arc at these potentials was ascribed to the insufficient amount of monatomic hydrogen in the tube.

During the course of this investigation, Professor K. T. Compton suggested that it might be possible to dissociate hydrogen by means of a cylindrical tungsten furnace which could also be used as one of the electrodes for the arc. The writer undertook the investigation of the possibility of this and computed the per cent. of monatomic hydrogen which would be in equilibrium with the diatomic gas on the basis of Nernst's equation of the "reaction-isobar."[1]. Taking the heat of dissociation to be 84,000 calories per gram, $\beta = 0.000225$, and the chemical constants for the diatomic and the monatomic hydrogen to be[2] −3.4 and −1.6 respectively, the per cent. of monatomic hydrogen in equilibrium with diatomic hydrogen is indicated in the following table:

Pressure	1000° K	1500° K	2000° K	2500° K	3000° K
0.5 mm.	.005	2.36	61.5	Complete	
1.0 mm.	.004	1.69	40.0	98.8	
5.0 mm.	.002	0.74	26.7	90.4	Dissociation

As it is possible to obtain a temperature of more than 2000°K in a tungsten furnace, it seemed that a sufficient amount of monatomic hydrogen could be obtained to maintain the arc at the lower potentials.

The furnace consisted of a cylinder of thin sheet tungsten, furnished by the General Electric Company, mounted on water-cooled leads and heated by means of an electric current. A tungsten filament ran axially through the furnace and was also heated by a current. The fall of potential in the furnace and that in the filament were in the same direction and of nearly the same amount. A potential was applied between the furnace and the filament, and was tried in both directions. The potential of the arc was corrected to the amount between the middle of the two electrodes. Gas pressures of 0.6, 0.8 mm, 1 mm, and 2 mm were used.

When the furnace was not heated the arc could not be maintained below the 16.4 volt point. When the temperature of the furnace was raised, a point was reached at which the arc would strike at about 16.6 volts and break at about 14 volts, indicating that the increased dissociation in the arc raised the percentage of monatomic gas sufficiently so that the arc could be maintained to approximately the ionizing potential of the atom. At still higher furnace temperatures the arc could be made to strike and break at about 13.5 volts and the results when plotted showed also unmistakable evidences of ionization at about 10.3 volts. Curves were obtained showing three sharp breaks in the neighborhood of 10.3, 13.2, and 16.2 volts. With the furnace at a very high temperature the arc would strike at about 14 volts and break at 11 volts. It seems certain that the arc struck at the ionizing potential of the atom and was maintained as low as the resonance potential of the atom. There was a considerable amount of tungsten "sputtered" on the walls of the tube, and from this it was concluded that the temperature of the furnace must have been 2000° to 2500° K. The results seem to indicate that the percentages of dissociated hydrogen calculated above are approximately correct.

These results constitute, it is believed, the first direct experimental proof of the correctness of the values of the radiating and ionizing potentials predicted by Bohr's theory for the hydrogen atom, and of the interpretation of the ionizing potential of the molecule as due to its dissociation plus the ionization of one of the atoms.

A complete report of these experiments will be published later. The apparatus will also be used to study the arcs in other gases and for investigating the excitation of the spectra of substances at high temperatures.

O. S. DUFFENBACK
PALMER PHYSICAL LABORATORY,
PRINCETON, NEW JERSEY,
JANUARY 26, 1922

[1] Nernst: Theoretical Chemistry.

[2] Reiche: Ann. d Physik, 58, p. 657, 1919, and Shames: Phys. Zeits., 21, p. 41, 1920.

A SIMPLE METHOD OF DEALING WITH ELECTRIFIED MICROSECTIONS

Electrification of the sections is a frequent cause of trouble in microtomy. The sections when cut fly back into the paraffin block when the block rises for the next cut, or, if a short ribbon has already been cut, this flies to the knife, twists and curls, or "bunches up" on the knife in such a way that it is an exceedingly wearisome task to seriate the sections, and requires almost infinite care and patience. The causes of electrification may be various. It is owing either to atmospheric conditions or to faulty methods of infiltrating or blocking. The use of a metal drum on which the sections may be wound as cut, reduces somewhat, as is well known, the difficulty experienced because of the electrification of the sections. The suggestion of Guyer (p. 47 of his revised ed. of *Animal Micrology* 1917) to postpone cutting till a more favorable time is not very satisfactory to one who is compelled, because of press of time, to cut continuously. The following simple device I have used with electrified sections and have found very satisfactory. The labor of mounting such sections, by its use, has been very much reduced, and I believe it will be quite generally serviceable.

Fig. 1

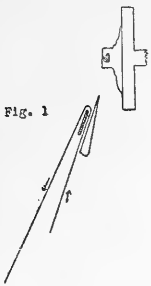
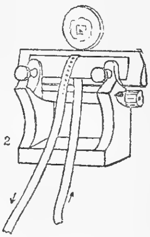


Fig. 2



Figures 1 and 2 show the whole device, which is adapted to any of the common types of rotary microtomes for the cutting of serial sections. It consists of a thin blade of celluloid (one of the 6-inch rulers furnished by the biological supply-houses does very well). This is screwed flat against the section-knife by means of the usual knife-holding screws of the carriage. (Fig. 2). A long narrow strip of thin, tough paper is passed up between the celluloid blade and the microtome knife, until about 3 cm. of it protrudes above. After the paraffin block has been properly trimmed and adjusted to the knife, the sections are cut, and as each one is cut, it is attracted and held by the paper-strip which is pulled along with the fingers so as to produce a series. (Fig. 2). When the strip is nearly filled with sections, it is taken and fastened to the table or board with thumb-tacks, to keep it from curling, and another strip substituted.

By means of this extremely simple device, the writer has found it possible to cut with excellent seriation material which otherwise, owing to electrification, would have been impossible.

S. W. Geiser

Zoological Laboratory,
The Johns Hopkins University

THE AMERICAN CHEMICAL SOCIETY

(*Continued*)

Division of Industrial and Engineering Chemistry

H. D. Batchelor, *Chairman*
H. E. Howe, *Secretary*

Symposium on Filtration

D. R. Sperry, *Chairman*

Filter cloth and its relation to filtration: Alvin Allen Campbell. Filter cloth is a very important consideration. Principal kinds are made of cotton, wool, jute, hemp, nickel and monel metal. Cotton duck the most used, but being replaced by materials of longer life though not necessarily better filterers. Solids really are the filter medium, the cloth is merely the retaining wall. The combination of strength, fineness and rapidity is what is wanted. Life of cloths depends on chemical action tending to destroy its use. Considers monel metal the best cloth material in most cases. Gives interesting list of various acids and salts and whether or not monel metal is recommended. Warns against electrolytic action on monel cloths, citing potassium permanganate as a case in point. Gives opinion as to round, square or rectangular openings. Wire cloth a failure in filtering certain colors. Filter aids work well with wire cloth. Does not recommend that wire cloth be rolled.

Filter aids: C. P. DERLETH. The term filter aid is defined and a list of materials used for this purpose given. Materials to which the term Kieselguhr is applied are discussed. Author divides filtration problems into three classes on the basis of whether the solids in the mixture are rigid, non-rigid or a combination of the two. A discussion is given as to the manner in which a filter-aid may be used and the advantages accruing therefrom, in each of the three cases. Desirable characteristics in filter-aids is given. Filter-aids are said to improve clarity of filtrate, reduce power consumption, reduce loss of liquid in cake, reduce labor in cleaning cloths, increase life of cloths, and increase rate of flow.

The feeding of filters: J. F. SPRINGER. Defines "feeding" as consisting of the transmission under pressure of the unfiltered liquor from a point where it is received from storage to the inlet aperture of the filter. Necessary equipment is pipe-line, pump and power. Suggests that in order to keep pump and valves clean from solids, precipitation of the solids when possible ought to be done either in filter or between pump and filter. Suggests possibility of solids being dissolved before reaching pump and then again precipitated between pump and filter. Describes feeding devices made of various materials and the corrosive action of certain substances thereon. Discusses suction, gravity and pressure feeding and appropriate apparatus. Steam, power-reciprocating, centrifugal pumps and montejus are dealt with.

Fundamental laws of filtration with suggestions regarding research work: D. R. SPERRY. The writer develops a formula which is a statement of the fundamental laws governing filtration. This is done to form a foundation upon which filtration may be put upon a scientific basis. Definitions of filtration, porous mass, filter-base and filter are given. Three indispensable conditions of filtration are difference in pressure between the two sides of the porous mass, a filter base and a filter. A study is made of the phenomena of filtration and it is found that the rate of flow of filtrate at any instant equals the rate of flow through the cake at that instant were there only liquid above the cake. With this as a basis a study is made separately of the laws of flow through cake and the laws of building up of cakes. The two expressions are combined into one which is the fundamental law of filtration as follows: $Q = \sqrt{WPT + N^2} - N$ (for constant pressure conditions); $Q = \frac{WP}{2M} - \frac{WRM}{2}$ (for constant discharge conditions); where Q = total discharge, P = pressure, T = time, R = resistance of cake, Rm = resistance of porous mass, c/o = per cent. of solids, M = constant discharge rate, K = rate of disposition, $W = \frac{2K}{R\%}$, $N = \frac{KRm}{R\%}$. Units for measuring K, the rate of deposition, and R, the resistance of cake, is given. A list of research suggestions follows.

Washing filter presses: EUSTACE A. ALLIOTT. Washing is used to recover a valuable liquor from the solid particles which retain it or to free such particles from impurities dissolved in the adhering liquor. Generally wash water ought to be as little diluted as possible; hence the smallest quantity should be used. Adsorption, capillary diffusion, formation of chemical compounds, and colloid formation on removal of electrolytes are disturbing factors in washing. Each of these factors is discussed. Simple washing involves too much space and care. For best washing results plate and frame type filters should be used with thorough washing. Air vents should be provided at top of wash chambers, wash must leave at top of press and enter at bottom. Considers various mechanical appliances for washing, hydrometer bowls, wash pumps, and montejus. Under ideal conditions wash equal to one displacement volume should effect complete washing. A number of washing results is given from actual practice, showing displacements volumes of 1.6 to 5.5. Describes stage washing. Gives a number of interesting wash curves, and cuts of mechanical appliances for washing.

Pulp or filtermasse filters: E. E. FINCH. Divides filters into two classes—those whose primary purpose is for clarification and those for retaining solids. The pulp filter belongs to the first class and uses cellulose as a filtering medium. Gives a short history of the pulp filter. Origin was probably in Germany. Gives a list of various substances used as a filter-masse with appropriate remarks. Concludes pure cotton masse the best. Describes method of preparing and using filter-masse. Pulp filters can be constructed for handling liquids which must not touch the ordinary metals. Discusses advantages of a clear product for manufacturer. Filtration in pulp filters is a violent agitation which may cause precipitation requiring re-filtration. Gives methods of treating liquids by pasteurizing, chilling or settling. Mentions filtration of glue and gelatine.

Atkins-Shriver automatic filter press: H. D. ATKINS. This apparatus is a modified form of a round, center-feed filter press. A shaft passes through the center openings, on which is mounted plows, one in each chamber. The press is mounted on trunnions and is filled in the vertical position. When filled the shaft is rotated and the plow by moving in a spiral manner peels off the cake from the chambers. The cake pieces fall out of the press through the central openings. The plows do not remove all the cake but leave a thin layer on the cloths. If it is desired to remove this layer it may be sluiced off. For assembling and clothing the press is swung into the horizontal position. Washing may be done in the press. Claim is made that this press saves wear and tear on cloths, saves labor, washes thoroughly, and is well adapted to arrangements to carry away cake. This type of press costs more than the ordinary filter press per unit of filtering area.

Vallez rotary filter: H. A. VALLEZ. This apparatus consists of a cast-iron cylinder so made that by removing bolts it can be split lengthwise disclosing a hollow shaft on which is mounted the filter leaves. Filtrate from leaves is drawn away through center of shaft. When cylinder halves are bolted together the material to be filtered is pumped into the interior under pressure, causing filtrate to issue from shaft. Filter surfaces may be sluiced off. Extra shafts with leaves may be kept to facilitate repairs. Leaves are spaced 2½, 3 or 6 inches apart. A screw conveyor at bottom of cylinder removes the solids, which drop off the leaves when pressure is relieved or a back air pressure applied. Claim is made that the rotation of leaves while filtering causes even depth of solids, indicating uniform washing. Used in sugar factories.

Centrifugal filters: H. C. BECKMAN. There are two classes of centrifugal filters, those in which the drum is perforated and those in which the drum is imperforated. The first class is used largely in sugar factories. Experiments have been made in which filter paper or cloth is used over perforations. Has no advantage over ordinary pressure filter and several disadvantages. Centrifugals of the second class use filter paper and act in a measure as a self cleaning filter due to the fact that the solids are discharged from the discs by centrifugal force. Due to this fact small areas have large capacity. A disadvantage is the smallness of size. A ten-inch drum eight inches high with twenty seven-inch filter plates operating at 6,000 R.P.M. is the largest size found commercially practical. Costly liquids like physiological serums, expensive varnishes, etc., are handled by centrifugal filters. Maintenance and upkeep are nominal. Largest size requires about two H.P. and about four square feet floor space.

Modern leaf type filters: ROBERT C. CAMPBELL. Description is made of Kelly and Sweetland leaf filters. Operating instructions for complete cycle are given. Washing is effected by stopping formation of cake while there is yet space between adjacent leaves. Eighty-five to 125 per cent. of the weight of discharged cakes is required for complete washing. A disc filter of the continuous suction type in which discs are mounted on a rotating shaft which allows them to dip into the mixture to be filtered is described. Pressure disc filters are suitable for handling sludges. Containing from less than one per cent. of suspended solids to the highest per cent. of solids which can be conveniently pumped and drained from filter. By use of Kisselguhr colloidal or gummy solids may be handled. Suction disc filters are recommended for sludges containing over 10 per cent. of comparatively free filtering solids wherein a cake of greater than one fourth inch thickness may be built in from one to eight minutes. Average capacity of suction filters is from 300 to 700 pounds of dry solids per square foot filter area per 24-hour day. Data is given regarding size of air and sludge pumps for pressure or suction disc filters, also water required for sluicing. When suspended particles are soft and compressible the plate and frame filter will produce a drier cake than leaf filters. Claims leaf filters have lower cloth consumption than plate and frame filters.

Oliver continuous filters: H. A. MORRISON. (1) Types manufactured—being a brief description of the individual kinds made. (2) General principles involved—covering the use of the continuous vacuum filter. (3) Characteristics to be considered in filter applications. (4) Uses—with generalized statement of the more important fields of operation and special description of the unusual problems we have solved. (5) Installation and operating costs—showing complete installation and operating costs in detail. (6) Advantages—realized by use of continuous vacuum filters as compared with plate and frame presses and other intermittent types. (7) Limitations and disadvantages.

Suction filtration: G. D. DICKEY. After a brief outline of the development of suction filtration, there are taken up the four main points of interest to filtration operators, viz.: Cake formation, washing, drying, and discharge. Under "Cake Formation," there is discussed the various factors which modify cake building in suction apparatus. Examples are cited as to capacities and rates of flow of specific materials under varying conditions, which will illustrate the influence that these conditions exert over the deposit of the filter cake. Following the discussion of the filter cake comes that of washing of the cake, which of course is dependent upon the formation of the cake itself, but which can be greatly aided or hindered by the filter operator. The discussion of cake drying and discharge is also based primarily upon the cake formation, but allows of many modifications before obtaining the desired results. Next there is given a brief description of the construction and operation of the open tank type of filter, the continuous rotary filter, and the continuous rotary hopper dewaterer, together with the advantages and disadvantages of each type. A number of lantern slides have been provided, so that the discussion of the construction and operation can be illustrated. In conclusion, there is given specific data as to the handling of a number of materials by the three types of apparatus above mentioned.

Industrial filter media: ARTHUR WRIGHT. Defines industrial filtration as the separation of a comparatively large amount of solids from small volumes of liquid, hence small rates of flow are permissible and filter cloths used as contrasted with the municipal filtration where gravel beds are used and conditions are the opposite. Selection of filter fabric depends upon whether for non-corrosive or corrosive liquors. For the latter, wool, metal, asbestos, stone, etc., is used, while for the former, cotton is used. Describes various weaves of cotton and its use. Fabric filtration should be of surface type, and not bed filtration where solids enter interior of the medium as in loose thick duck. Suggest superficial layer of thin muslin to prevent bed action, permitting cake to fall off easily. In certain kinds of filters the cloth porosity must be of definite kind to permit use of back pressure. Cake adheres more strongly to unnapped cloth. Discusses drainage provided under cloths. Precoating cloths should be used where initial filtrate must be clear. Shrinkage and stretch of cloth is considered. Mentions incrustation due to lowering pressure and suggests action to be taken.

The use of filter-cel for industrial filtration processes: G. M. HICKEY. Filter-Cel, a porous cellular product, is used as a filter aid, by mixing a small percentage with the liquor prior to filtration, overcoming slimes and giving brilliant filtrates. In cereal beverage filtration, addition of one fourth pound of Filter-Cel per barrel insures complete removal of yeast cells, gives brilliant product and permits use of modern pressure filters. In crude and refined vegetable oils it aids in the removal of foots, soaps and slimes, giving clearer filtrates that requires less bleach for refining. When mixed with the bleaching agent, it increases the capacity of filter and gives dryer cakes. Apple products and fruit juices are mechanically clarified by filtration with small quantities of Filter-Cel. Soap lyes and fats are clarified using one per cent of Filter-Cel, improving filtration and the quality of by-products. Catalytic agents from hydrogenation processes are completely removed by filtering with Filter-Cel.

Plate and frame filter presses: G. B. RICE. The filter press includes a large filter area in a small floor space, high pressure can be used, the apparatus is simple, unskilled labor only is required for operation, and repairs are quickly made. Considers the plate and frame type the best form of filter press. Describes washing and various combinations used in filter presses. Filter presses can be made of various materials, as iron, for ordinary materials, wood for weak acid liquors, lead for strong sulphuric acid. For wooden plates resinous woods are best, as yellow pine; such wood will stand 25 per cent. cold HCl. Hot solutions tend to destroy the resin, so for that purpose maple or oak is best. Describes operation and storage of wood presses. Discusses filter plate surfaces, closing gears, and filter cloths. For most aqueous solutions, cotton cloths are good, but for strong acid solutions asbestos, wool or camel's hair cloth is suitable. Wire cloths made of monel metal, copper, nickel and bronze can be used.

The filter press: D. R. SPERRY. The filter press is defined as a press employed for holding together the component parts of a filter. The component parts of the filter consist of plates or plates and frames. The filter press is described by aid of illustrations. Recessed and flush plate and frame operation is defined. Filter plates and frames may be made of various materials to suit the substance handled. This is also true of filter-bases. A discussion of plate surfaces tends to show that correct design should be for long wear of cloth and proper drainage. Also that the contact area of the cloth does not reduce the net filtering area as might be supposed. The filter press comprises most filter area per unit of floor space, can employ high pressures, has low repair costs, produces the driest cake, is economical in clothing, can be operated by cheap labor and is the most universal and widely used filter apparatus to-day. Eleven plant installation views are given.

A symposium on the chemistry of gases and fuel was also held with C. H. Stone chairman and R. S. McBride secretary. The following four major subjects were discussed:

(*a*) *Coke-oven problems,* discussion to be opened by W. H. Blauvelt, F. W. Sperr and others.

(*b*) *Low temperature carbonization of coal,* discussion to be opened by H. C. Porter.

(*c*) *Gas works control,* discussion to be opened by E. C. Uhlig, J. R. Campbell and O. A. Morhous.

(*d*) *Gas analysis and its applications,* discussion to be opened by G. W. Jones, E. R. Weaver and A. H. White.

Two new methods for determining light oil in coke oven gas: Arthur L. Davis. The most accurate and thoroughly reliable method that has been developed to the present time utilizes activated carbon as the absorbing medium. Absorption of the light oil is rapid and the carbon is very convenient to handle. The absorbed light oil is removed by distillation of the enriched carbon with cresol and the subsequent treatment of the distillate with caustic. The true light oil recovered, uncontaminated with wash oil, may be examined and its quality determined. A very satisfactory means of absorbing light oil is to pass the gas through a plate and bell tower, laboratory size, using cresol as the absorbing medium. A tower of this type is imperative since incomplete absorption will be obtained using other than this general type of equipment when any liquid absorbent is used. The cresol is stripped of the light oil and the distillate agitated with caustic. The light oil obtained is true light oil with no high boiling ends due to the lower boiling portions of wash oil being present.

Standardizing gas combustion by premixing portions of air with gas: N. H. Geller.

A chemically controlled automobile: George G. Brown, Jr. The average motor car wastes twice as much energy as is converted into useful work. The thermal efficiency averages not over 15 per cent. This loss, entirely preventable, is a waste of a valuable and limited natural resource, petroleum. In all industrial combustion problems increased efficiency can be obtained by returning as much heat as possible from the exhaust gases to the combustion zone by preheating the air. Another factor, known as turbulence, which results from the velocity of the mixture entering the cylinder, has an equally noticeable effect upon the rate of combustion. Repeated tests have shown that 30, 35, 40 miles per gallon and even more may be obtained driving at constant speed along a level highway and burning a lean hot mixture. It has been found that the two variables, temperature of air and manifold suction, are sufficient in themselves to supply all the automatic control desired. Working along these lines a carbureter has been designed from a scientific and mathematical standpoint that can be made to deliver a mixture of any proportions desired under any conditions. It has been found possible to obtain 35 to 40 miles per gallon on a standard Ford touring car with equally quick acceleration and even more flexibility than could be obtained with standard equipment giving 20 miles per gallon under the same conditions.

Theoretical maximum temperature: George G. Brown, Jr. (1) A comparison of the values for specific heats of the products of combustion as obtained by the various investigators. (2) Calculation of maximum temperatures using a table of mean specific heats, or thermal capacities: *a.* Estimating temperatures and solving by trial and error; *b.* The graphical method of Damour. (3) Calculation of maximum temperature using the equations for thermal capacities: *a.* Algebraic solution; *b.* Slide rule solution; *c.* Graphical solution.

The formation of oxides of nitrogen in the slow combustion and explosion methods in gas analysis: G. W. Jones and W. L. Parker. Procedure and results of investigation are given showing the amounts of oxides of nitrogen formed when gases are analyzed by the slow combustion and explosion method. The following conclusions were obtained: The production of oxides of nitrogen by the slow combustion method when the time of burning is not more than three minutes and the wire heated not greater than a bright yellow is within the experimental error in routine gas analysis. Under the above conditions not more than .003 c.c. of oxides of nitrogen were produced by the explosion method when air was used as the oxygen supply. When mixtures of air and oxygen were used as the oxygen supply in the explosion method appreciable quantities of oxides of nitrogen were produced which are too large to be disregarded in gas analysis. The method used for determining the quantity of oxides of nitrogen produced was a modification of the di-phenol sulphonic acid method as used in water analysis.

The present status of methods used for fuel gas analysis: G. W. JONES. The constituents present and difficulties encountered in the accurate analysis of fuel gases are given. The methods used at the present time, considerations which must be taken into account in choosing a particular method, the comparative accuracy of the different methods and debatable points which require further consideration are discussed.

Electric heat for thermal processes: E. F. COLLINS.

Humidity equilibria of various common materials: ROBERT E. WILSON. A knowledge of the equilibrium amount of moisture held by various materials as a function of the relative humidity of the air is very important for a variety of purposes. The author presents determinations by a method previously described in the *Journal,* of the humidity equilibria of the following materials: cotton, linen, paper, jute, hemp, viscose silk, cellulose nitrate silk, cellulose acetate silk, rubber, leather, feathers, catgut, tobacco, crackers, bread, macaroni, etc.; and includes data gathered from various sources on other materials, such as wool, silk, paper half-stuffs, timber, flour, etc.

The frictional resistance to the flow of viscous liquids through elbows: ROBERT E. WILSON, WILLIAM H. MCADAMS and M. SELTZER. The frictional resistance to the flow of liquids through elbows has been the subject of a considerable number of scattered experiments, but the results are seldom expressed on any uniform basis and in many cases the methods of measurement were faulty. Furthermore, there is practically no data on the frictional resistance to flow through elbows for very heavy oils flowing in straight line motion. The authors present a series of data covering the whole range, from highly viscous oils to water, and show that, while the customary rule of assuming an elbow to be equivalent to thirty or forty pipe diameters' length of straight pipe holds very well over the whole region of turbulent flow, the resulting correction is far too high in the region of viscous flow, dropping to as low as two or three diameters for very viscous liquids in small pipes.

A fermentation process for the production of acetone, alcohol and volatile acids from corn cobs: W. H. PETERSON and E. B. FRED. Corn cobs are a possible raw material for the production of acetone, ethyl alcohol, formic acid and acetic acid. These products are obtained by fermenting a sirup which is made from corn cobs by hydrolysis with dilute sulfuric acid and contains chiefly xylose. This crude xylose sirup is fermented by *Bacillus acetoethylicum* under the proper conditions of nitrogen, and phosphate supply and hydrogen ion reaction. A continuous fermentation is maintained by filling the container with cinders to which the bacteria may attach themselves. The fermented solution is removed and a new sugar solution added without disturbing the bacteria. Under these conditions the fermentation is rapid and vigorous. The yield of products is 2.7 lbs. of acetone, 6.8 lbs. of alcohol and 3.4 lbs. of acid per 100 lbs. of corn cobs.

A new method of preparing sulphuric acid: P. C. HAESELER. Instead of oxidizing SO_2 with the oxide of nitrogen, selenium dioxide is used according to the equation: $2SO_2 + H_2O + H_2SeO_3 = 2H_2SO_4 + Se$. The selenium is filtered and reoxidized. A 50 per cent sulphuric acid free of selenium can thus be obtained without pressure. Anode slimes and other impure selenium sources can be used for the source of selenium, as roasting the same will yield an oxide sufficiently pure for the above reaction.

Corrosion under oil films and the protective action of certain colloidal solutions: WILBERT J. HUFF. An investigation by the writer in the research laboratories of the Bureau of Mines on the subject of corrosion beneath oil films caused by water soluble salts from perspiration residues, sea sprays, and certain manufacturing operations. Preliminary treatment with water, followed by a suitable emulsion, and finally by oil is recommended for inaccessible surfaces. Experiments are given to show the valuable anti-corrosive property of certain soap emulsions, and some of the conditions under which this protective property fails. The mechanism of the corrosion and protection is discussed briefly.

On the dehydration of tar and other organic emulsions: WILBERT J. HUFF. A note discussing some of the methods for the dehydration of tar and similar emulsions, pointing out a few advantages and disadvantages of each, together with a description of a method suggested by the author and now used in the laboratories of The Koppers Company. The tar is simultaneously heated from above and cooled by a jacket of liquid water about and below. The jacket water is allowed to fall by evaporation, gradually bringing more and more tar into the heated zone. The manipulation is so simple the author finds it difficult to believe that the method has not been used before, but if so is unaware of such use. The method permits the simultaneous approximate determination of light oil and water, requires no new apparatus and practically no attention, and handles efficiently very stiff tars and tars of high water content.

The arc rupture of liquid dielectrics: C. J. RODMAN. Various organic liquid dielectrics were subjected to high frequency arcing. Finely divided, highly non-conducting amorphous carbon, saturated and unsaturated hydrocarbons lower in the series, and a number of gases were obtained. These gases consisted chiefly of hydrogen and unsaturates with small amounts of carbon monoxide, carbon dioxide, methane and nitrogen. With an increase in molecular weight a slight decrease in gas evolution per kilowatt seconds of arc rupture was noted. With an increase of halogenation a corresponding decrease in gas evolution per kilowatt seconds arc rupture is noted. Paraffine oils give approximately 60 c.c. gas per kilowatt seconds. The liquid dielectrics are apparently broken down by a temperature pressure effect of very short duration, rather than by sympathetic vibration and rearrangement of the compounds by high frequency alone. Direct application of this data is found in the use of compounded liquid dielectrics for transformers, circuit breakers and fuses.

The effects of waterproofing materials upon the tensile strength of cotton yarn: H. P. HOLMAN and T. D. JARRELL. Two sizes of cotton yarn used in the manufacture of high grade cotton ducks, after treatment with numerous waterproofing materials including commercial preparations, individual substances and formulas developed in the laboratory, were exposed to the weather for one year to show the effects on tensile strength. The tensile strength of the treated yarn after one year's exposure was in most cases greater than the strength of the untreated yarn after one year's exposure.

Special order on world's standardization: E. C. BINGHAM, *chairman.* The attitude of the manufacturer of reagent chemicals toward world standardization. The attitude of the dealers in chemicals. The attitude of the university users of chemicals. The attitude of the technical users of chemicals. The attitude of Great Britain and Canada toward world standardization. The attitude of the federal government. Discussion led by CHARLES L. REESE, W. A. NOYES, B. L. MURRAY, R. F. RUTTAN, H. D. HUBBARD and others.

The nature of acid mine water from coal mines and the determination of acidity: W. A. SELVIG and W. C. RATCLIFF. Water from coal mines is usually decidedly acid in character containing free sulphuric acid and ferrous, ferric and aluminum sulphates in addition to sulphates of calcium, magnesium, sodium and potassium together with silica and usually some chlorides. On standing, dilution, aeration or warming insoluble iron compounds tend to precipitate. The direct titration of free sulphuric acid of mine water with standard alkali solutions in the presence of methyl orange gives results much too high. Methods of accurate determination of contents of mine water are given.

Tests of the iodine pentoxide indicator for carbon monoxide: S. H. KATZ and J. J. BLOOMFIELD. The iodine pentoxide or "hoolamite" indicator for carbon monoxide is a small, rugged, portable instrument for quickly and easily indicating the presence of carbon monoxide and estimating its concentration. Commericial instruments were tested for sensitivity and accuracy. Results showed that the instrument gives positively indications with .07 per cent. or more carbon monoxide in air. With .15 per cent. carbon monoxide in air, determinations ranged from .10 to .23 per cent. with an average of .16. With higher concentrations, the variations were proportionally about the same. Fresh activated charcoal removes the following gases that tend to give interference: acetylene, ammonia, benzene, ether, ethylene, gasoline, hydrogen chloride, hydrogen sulphide, natural gas containing members higher than methane, and water. The following gases do not interfere: carbon dioxide, carbon tetrachloride, chlorine, methane, nitrogen peroxide, phosgene, and sulfur dioxide. Determinations are made in less than one minute and no skill is required. The instrument should prove valuable in testing air in mine rescue and recovery operations around blast furnaces, gas producers, water gas plants, flue gases and other places where carbon monoxide occurs.

The Berrigan filter (By title): MR. STARK.

CHARLES L. PARSONS,
Secretary

SCIENCE

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ATOMIC NUCLEI[1]

I. INTRODUCTION

THE conception that atoms consisted of central positively charged nuclei of small dimensions surrounded by one or more systems of electrons whose aggregate charge of negative electricity exactly neutralized the nuclear positive charge, arose in an attempt by Rutherford[2] to explain the large angle scattering of α rays obtained when these traversed thin foils or sheets of various metals.

To account for the results obtained it was found necessary to assume that the positively charged nucleus contained nearly all the mass of an atom and that the dimensions of the nucleus were very small compared with the ordinarily accepted magnitude of the diameter of the atom.

On this view the electric field close to the nucleus was very intense and therefore sufficient to deflect α particles which in traversing sheets of metal happened to pass close to nuclei.

Assuming the electric field of nuclei to be central and to follow the inverse square law, Rutherford showed that an α particle projected so as to pass close to the nucleus of an atom would describe a hyperbolic orbit about the nucleus and that the magnitude of the deflection impressed upon it was determined by the closeness of its approach to the nucleus.

(*a*) The electric charge on nuclei.

On this theory Rutherford showed by deductions made from observations on the single encounter large angle scattering of α rays that the resultant charge on the nucleus was about $\frac{1}{2}$ A e where A is the atomic weight of the

[1] Address of the vice-president and chairman of Section B—Physics, the American Association for the Advancement of Science, Toronto, December 29, 1921.

[2] Rutherford, *Phil. Mag.*, Vol. 21, p. 669, 1911; *Phil. Mag.*, Vol. 27, p. 448, 1914.

scattering element and e is the fundamental unit of electric charge. Elaborate experiments by Geiger and Marsden[3] on the scattering of α rays confirmed this view. The validity of the theory was also established in a convincing manner by C. G. Darwin[4] who made a thorough mathematical investigation of the deflexions which could ensue from an intimate encounter between an alpha particle in motion and a nucleus. In this investigation he showed that the results of the scattering experiments of Geiger and Marsden could not be reconciled with any law of central force except that of the inverse square.

In another entirely different field of investigation, namely, that of the scattering of X rays by light elements, Barkla[5] had shown in 1911 that the number of electrons in an atom which took part in the scattering of the X rays was equal to about one half of the atomic weight of the element.

Both lines of investigation therefore led to the view that the charge on the nucleus of an atom was given by ½ A e and that the number of electrons in an atom surrounding the nucleus was ½ A. It was the experiments on the scattering of α rays, however, which led to the view that the positively charged portions of atoms were nuclear in character with dimensions small compared with those of the atoms themselves, and that by far the greater part of the mass of the atoms was concentrated in the nucleus.

(*b*) Nuclear charge and atomic number.

In 1913 Van den Broeck[6] put forward the suggestion that the scattering of α particles was not inconsistent with the view that the charge on the nucleus of an atom was equal to Ne where N is the atomic number of the atom of the element concerned, *i. e.*, the number of the element when the elements are arranged in order of increasing atomic weight. A reference to a table of atomic weights will show that N is approximately equal to ½ A. The importance of this suggestion was soon made evident by the remarkable work of Moseley[7] on X ray spectra which followed in 1913 and in 1914. In this work Moseley showed that the frequencies of the vibrations of corresponding lines in the X ray spectra of the elements depended on the squares of numbers which varied by unity with the successive elements.

This relation, it was seen, could be readily explained by assuming that the nuclear charge of an atom varied by unity in passing from an atom of one element to that of another, and by assuming that the nuclear charge was given numerically by N, the atomic number.

The importance of Moseley's work was enhanced when it was seen that it gave us a new method of regarding the periodic classification of the elements based on the assumption that the atomic number or its equivalent, the nuclear charge, was of more fundamental importance than the atomic weight. As a result of Moseley's work it became possible not only to fix definitely the number of possible elements and the position of undetermined elements, but also to show that the properties of an atom were defined by a number which varied by unity in successive elements.

In Moseley's work the frequency of vibration of corresponding lines in the X ray spectra of the elements was not found to be exactly proportional to N^2 where N is the atomic number but to $(N - a)^2$ where a was a constant which had different values depending on whether the K or L series of characteristic rays was measured.

The investigations of Bohr[8] on the origin of radiations emitted by atoms are entirely in keeping with the assumptions that the nuclear charge is given by Ne, for he has shown that the frequency formula for X ray spectral lines must include a term $(N - a)^2$ with "a" having values approximately equal to those found by Moseley. In Bohr's investigation he showed that X rays originated in disturbances given to certain classes of extra nuclear electrons and that the quantity "a" represented a modifi-

[3] Geiger and Marsden, Roy. Soc. Proc. A., Vol. 82, p. 495, 1909.

[4] Darwin, *Phil. Mag.*, Vol. 27, p. 499, 1914.

[5] Barkla, *Phil. Mag.*, Vol. 21, p. 648, 1911.

[6] Van den Broeck, *Phys. Zeit.*, Vol. 14, p. 703, 1914.

[7] Moseley, *Phil. Mag.*, Vol. 26, p. 1024, 1913; *Phil. Mag.*, Vol. 27, p. 703, 1914.

[8] Bohr, *Phil. Mag.*, Vol. 26, p. 476, Sept., 1913.

cation of the electric field of the nucleus by the electric fields of the extra nuclear electrons within the atom.

II. ON THE STRUCTURE OF ATOMS

Through the advances made by a study of the scattering of α rays and of X rays the attack on the problem of the structure of atoms and the origin of radiations naturally proceeded upon two well-defined lines, namely:

1. The investigation of the constitution and properties of the nucleus, and

2. The investigation of the configuration and modes of vibration of extra nuclear electrons in atoms.

In pursuing this attack it has been assumed, with very good warrant, that the positive electric charges on nuclei are given by Ne where N is the atomic number of the element concerned, and that the number of extra nuclear electrons in an atom is N. For example, the number of extra nuclear electrons in various atoms is taken to be as follows: Hydrogen 1, helium 2, lithium 3, carbon 6, fluorine 9, neon 10, sodium 11, chlorine 17, argon 18, potassium 19, etc.

III. POSITIVE RAY ANALYSIS

This method of analysis was devised by Sir J. J. Thomson[9] and consisted in projecting successively through an electric and a magnetic field positively charged atoms or molecules, *i. e.*, those from which one or more extra nuclear electrons had been detached. By this means he was able to show that positive atom ions can be obtained with one, two, three, and, in the case of mercury, with eight positive elemental charges.

Among other results he has been able to show that such compounds as CH, CH_2 and CH_3 can exist with a recognisable though transitory existence. He has also shown that a substance having the molecular formula H_3 and bearing a single positive elemental charge can be obtained from various sources, a result which has been confirmed by Dempster, who showed that this molecular aggregate can be obtained with a transitory existence when an electric charge is passed through hydrogen. Perhaps the most notable discovery made by Thomson, however, was that neon existed in two forms with identical chemical properties, but with different integral atomic weights, namely, 20 and 22.

This discovery was of prime importance for it pointed to the probability of the general applicability of the principle which had been already found by Soddy and others to hold with the radioactive elements, namely, that the atoms of elements consist of *isotopes, i. e.*, that we have atoms of an element with identical chemical properties, but with different atomic masses. This discovery also offered an explanation of the non-integral values found by chemical analysis for the atomic weights of many of the elements. If it turned out, assuming the atomic weight of oxygen to be 16, that the atomic weights of the isotopes of an element were integers, then the non-integral value found by chemical analysis for the atomic weight of an element would result from the element existing as a mixture of its isotopes.

IV. ISOTOPES

Aston,[10] Dempster,[11] and later G. P. Thomson[12] have recently greatly improved Sir J. J. Thomson's methods of positive ray analysis with the result that they have been able to separate many of the elements of non-integral atomic weight such as chlorine, magnesium, argon and mercury into *isotopes*, each of which has an integral value for its mass. Chlorine, for example, has an atomic weight of 35.5 and can be separated by the positive ray method into an isotope of weight 35, and into one of weight 37. The validity of this result has been confirmed by Harkins,[13] who succeeded

[9] J. J. Thomson: Rays of positive electricity.

[10] Aston, *Phil. Mag.*, Vol. 38, p. 707, 1919; Vol. 39, p. 611, 1920; Vol. 40, p. 628, 1920; *Nature*, March 17, 1921; May 12, 1921.

[11] Dempster, *Phys. Rev.*, Vol XI, No. 4, p. 316, 1918; SCIENCE, Dec. 10, 1920; Apr. 15, 1921; Nov. 25, 1921.

[12] G. P. Thomson, *Phil. Mag.*, Aug., 1920, p. 240; *Phil. Mag.*, Nov. 1921, p. 858; *Nature*, Feb. 24, 1921.

[13] Harkins, SCIENCE, March 19, 1920.

in separating, by diffusion, a mass of chlorine into two portions with different densities. Mercury, too, has been found by positive ray analysis to consist of a number of isotopes, probably six, with integral atomic weights 197-200, 202, 204. As a confirmation of this result Bronsted and Hevesy[14] have shown that it is possible by fractional distillation to separate mercury into two parts with different densities.

The list of the elements in so far as they have been investigated for isotopes is given in Table I. In Table II following there is also assembled the isotopes of the various radioactive elements.

TABLE I
ISOTOPES

Element	At. No.	At. Wt.	Minimum No. of Isotopes	Masses of isotopes in order of their intensity
H	1	1.008	1	1.008
He	2	3.99	1	4.0
Li	3	6.94	2	7, 6
Be	4	9.1	1	9
B	5	10.9	2	11, 10
C	6	12.0	1	12
N	7	14.01	1	14
O	8	16	1	16
F	9	19	1	19
Ne	10	20.2	2	20, 22, 21?
Na	11	23	1	23
Mg	12	24.32	3	24, 25, 26
Si	14	28.3	2	28, 29, 30?
P	15	31.04	1	31
S	16	32.06	1	32
Cl	17	35.46	2	35, 37, 39?
A	18	39.88	2	40, 36
K	19	39.1	2	39, 41
Ca	20	40.09	1	40 (39, 40, 41)
Zn	30	65.4	4	64, 66, 68, 70
As	33	74.96	1	75
Br	35	79.92	2	79, 81
Kr	36	82.92	6	84, 86, 82, 83, 80, 78
Rb	37	85.45	2	85, 87
Sr	38	87.63	2	87, 85, 88?
I	53	126.92	1	127
Xe	54	130.32	5 (7?)	129, 132, 131, 134, 136, 128? 130?
Cs	55	132.81	1	133
Hg	80	200.6	6	197-200 202, 204

[14] Bronsted and Hevesy, *Nature*, September 30, 1920.

V. DISCUSSION OF ISOTOPES

A glance at the results in Table I suggests a few observations.

(*a*) Isobares and radioactivity.

It is interesting to note that while iodine with an atomic weight 126.92 has but one isotope, 127, bromine with an atomic weight 79.92 has two, 79 and 81. Had it turned out that bromine consisted of but one isotope with weight 80 we should have had an example of an isobare, that is, an atom of one element with an atomic weight the same as that of an atom of a second element. It will be seen that one of the isotopes of krypton has an atomic weight 80.

It is also of interest to point out, as Harkins has done, that with magnesium having 3 isotopes and chlorine 2 it is possible to have nine isotopic forms of $MgCl_2$. As mercury has six isotopes there would follow the possibility of having 63 isotopic forms of Hg_2Cl_2. Similar considerations would apply in regard to other elements.

G. P. Thomson has recently found that strontium consists of two isotopes of weight 85 and 87. He failed however to find one of weight 88 or any higher number the necessity for which the atomic weight of strontium, 87.63, would seem to demand. As rubidium was shown to have isotopes of weight 87 and 85 we have in strontium and rubidium an example of isobaric isotopes, *i. e.*, the atoms of these two elements are identical in mass. As the nuclear charge of rubidium is 37e while that of strontium is 38e, it follows that the nuclei of rubidium atoms differ from those of strontium atoms only by the inclusion of one electron. This may possibly afford an explanation of the radioactivity which rubidium and its salts are known to exhibit. It has been shown that rubidium emits a soft radiation of beta particles, and since it is now generally agreed that radioactivity is a property of nuclei, it would follow that by the emission of beta rays, rubidium atomic nuclei are being transmuted into those of strontium. One should expect to find, then, strontium associated with the sources of rubidium.

TABLE II
ISOTOPES OF RADIOACTIVE SUBSTANCES

SUBSTANCE	AT. NO.	WEIGHT OF ISOTOPE					GROUP
Uranium	92	238 U_1	234 U_2				VI
Protoactinium	91	234 UX_2	230 Pa				V
Thorium	90	234 Th.	232 UX_1	230 I & UY	228 Ra.Th.	226 Ra.Act.	IV
Actinium	89	228 $Ms.Th_2$	226 Ac.				III
Radium	88	228 $Ms.Th_1$	226 Ra	224 ThX	222 Act.X		II
Emanation	86	222 Ra.Em.	220 Th.Em.	218 Act.Em.			VIII
Polonium	84	218 Ra.A.	216 Th.A.	214 Ra.C. Ac.A.	212 Th.C′	210 Ac.C′ Ra.F.	VI
Bismuth	83	214 Ra.C.	212 Th.C.	210 Ac.D. Ra.E.			V
Lead	82	214 Ra.B.	212 Th.B.	210 Ra.D. Act. B.	208 Th.D.	206 Ra.G. Ac.D.	IV
Thallium	81	210 Ra.C″	208 Th.C.″	206 AcC″			III

As potassium is also known to emit a radiation of beta particles we should expect the nuclei of atoms of potassium to be transmuted thereby into nuclei of calcium of the same weight, *i. e.,* we should expect to find that calcium consisted of two isotopes isobaric with those of potassium and therefore of weight 39 and 41. As regards this point the only evidence we have available is that furnished by the experiments of G. P. Thomson, who states that he found an isotope for calcium at 40 but with the magnetic field at his disposal it was impossible to separate lines even two units apart if such had existed for calcium. Thomson states, however, that it is certain that one or more isotopes of the weights, 39, 40, and 41 were present in his experiments. In some preliminary experiments made by Dempster an isotope of calcium was found at or near 40. He states, however, that the possibility of one of weight 39 is not excluded by his results. It will be interesting to see whether future experiments show that calcium has two isotopes of weight 39 and 41. Some additional evidence on this point might be gained by investigating the association of calcium with primary sources of potassium and its salts.

In this connection it is of interest to point out that lithium, sodium and cæsium have not been found to be radioactive. Moreover neither lithium and beryllium nor sodium and magnesium have any isotopes in common. Cæsium has been found to have but one isotope of weight 133 and although the isotopes of barium have not yet been investigated it would appear to be highly probable that, since the atomic weight of this element is 137.37, it will be found not to have any isotope isobaric with that of cæsium.

(*b*) Isotopes of cadmium.

Since the atomic weight of cadmium is 112.4 it will be seen that it will likely be found to have a number of isotopes, especially since zinc has been shown to have four and mercury six.

(*c*) Atomic weight and atomic number.

It will be noted that, with the possible exception of K^{39} and the doubtful Cl^{39} Table I does not show any other examples of *isobares.* There is a remarkable intermingling of the atomic weights and it is particularly noticeable in the case of ten consecutive integers representing the isotopes of bromine, krypton, and rubidium —Kr 78, Br 79, Kr 80, Br 81, Kr 82, Kr 84, Rb 85, Kr 86, Rb 87. This result makes it clear that the exact order of the chemically determined atomic weights is of little significance and that the anomalies such as argon and potassium and possibly too of tellurium and iodine as well as nickel and cobalt are merely due to the unequal relative proportions of their constituent isotopes.

From a consideration of the total abundance of various elements Harkins[15] pointed out that for the great majority of possible configurations it would probably be found that even atomic weight was associated with even atomic number and odd with odd. The results given in Table I, it will be seen, support this view. Of the halogens (odd atomic numbers) all six isotopes are odd. Of the alkali metals (odd atomic numbers) seven istopes are odd and only one even. On the other hand, of the isotopes of the inactive gases (even atomic numbers) fifteen are even and but three odd. This means that in the nuclei of most types of atom the number of electrons is an even number.

(*d*) The spectra of isotopes.

In an attempt made by Harkins, Aronberg and Gale[16] to see whether any method of distinguishing between the isotopes of an element could be obtained from a study of their spectra it was found that the wavelength of the line $\lambda = 4058$ A.U. as obtained from radiolead was 0.0044 A.U. greater than that from ordinary lead. A similar result was also obtained by Merton.[17] It has been pointed out however that this difference is about one hundred times greater than that predicted on the basis of Bohr's Theory of Radiation. Loomis[18] also has drawn attention to the unexpected satellites which Imes[19] found beside each line of the HCl absorption band at 1.76μ, and which measurements of his curves show to have an average wavelength of 16.4 A.U., longer than the lines which they accompany. These satellites Loomis has shown can be accounted for by assuming them to be due to the heavier of the isotopes of chlorine of weights 35 and 37. On this basis, his calculations show that the difference between the wavelength of the main line and its satellite should be 13 A.U., which it will be seen is in good agreement with observations of Imes.

(*e*) Structure of atomic nuclei.

By far the most important conclusion which can be drawn from the results recorded in Table I is that, with the exception of hydrogen, the weights of the isotopes of all the elements measured and, therefore almost certainly of all elements, are whole numbers, within the accuracy of the experiments—namely, about one part in a thousand. This result carries with it the possibility of greatly simplifying our ideas of mass. The original hypothesis of Prout, put forward in 1815, that all atoms were themselves built of atoms of protyle, a hypothetical element which he tried to identify with hydrogen, has been established on a new basis with the modification that the primordial atoms are of two kinds—atoms of positive and negative electricity. The unit of negative electricity, *the electron,* we have long been familiar with, but the unit of positive electricity, *which also appears to be the real unit of mass,* has remained unidentified experimentally until now as the positive nucleus of the atom of hydrogen. To this unit of mass and of positive electricity the name of "proton" has been given.

This profound modification of our views of the nature of mass has been very clearly set forth by Aston. The Rutherford atom whether in Bohr's or Langmuir's development of it consists essentially of a positively charged central nucleus around which are set planetary electrons at distances which are great compared with the dimensions of the nucleus itself. As has been stated the chemical properties of an element depend solely upon the atomic number which is the charge on its nucleus expressed in terms of the unit charge "e." A neutral atom of an element of atomic number N has a nucleus consisting of K + N protons and K electrons and around this nucleus are set N electrons. The weight of an electron on the scale we are using is 0.0005 so that it may be neglected. The weight of the atom will therefore be K + N so that if no restrictions are

[15] Harkins, *Nature,* April 4, 1921.

[16] Harkins, Aronberg and Gale, *Jl. of the Am. Chem. Soc.,* July, 1920, Vol. 42, p. 1328.

[17] Merton, Proc. Roy. Soc., 96A, p. 388, 1920.

[18] Loomis, *Nature,* Oct. 7, 1920.

[19] Imes, *Astrophys. Jl.,* Nov., 1919.

placed on the value of K any number of isotopes is possible.

The first restriction is that excepting in the case of hydrogen K can never be less than N for the atomic weight of an element is always found to be equal to or greater than twice its atomic number.

The upper values of K also seem to be limited, for so far no two isotopes of the same element have been found differing by more than 10 per cent. of its mean atomic weight, the greatest difference is eight units in the case of krypton. The actual occurrence of isotopes does not seem to follow any law at present obvious, though their number is probably limited by some condition of stability.

Protons and electrons may therefore be regarded as the bricks out of which atoms have been constructed. An atom of atomic weight m is turned into one of atomic weight $m + 1$ by the addition of a proton plus an electron. If both enter the nucleus the new element will be an isotope of the old one, for the nuclear charge has not been altered. On the other hand, if the proton alone enters the nucleus and the electron remains outside, an element of next higher atomic number will be formed.

If both of these new configurations are possible they will represent elements of the same atomic weight but with different chemical properties. Such elements we have pointed out above are called isobares, and are already known to exist among the radioactive elements. (See Table II).

The element hydrogen, it will be noted, is unique in that its nucleus weight, 1.008, exhibits a departure from the rule of integers followed by the isotopes of all the other elements investigated. It will be noted, however, that it is the only atom in which the nucleus is not composed of protons and electrons closely packed together. It can be shown that with close packing of protons and electrons there must follow a reduction in effective mass, and that when four protons and two electrons are closely packed together as they must be in alpha particles, the nuclei of helium atoms, the resultant effective mass must be somewhat less than four times that of the hydrogen nucleus.

VI. THE DIMENSIONS OF ATOMIC NUCLEI, THEIR ELECTRIC CHARGES AND FIELDS OF FORCE

While phenomena connected with the scattering of α rays have led to such profound modifications in our views of atomic structure, it is of interest to note that through the agency of these same α rays we are likely to make still further advances in the problem of determining the ultimate structure of matter. Through the attacks now being rigorously pressed by Rutherford and his associates, the structure of the nuclei of atoms is slowly but steadily being revealed. Through the bombardment of atomic nuclei by α rays it has been found that the electric charges on atomic nuclei can be measured with a high degree of precision, estimates of the diameters of nuclei can be made, the field of electric force about a nucleus can be examined, and the structure of the nucleus itself can be broken down.

(*a*) Nuclear charges.

In his early experiments, Rutherford had shown from the experiments of Geiger and Marsden on the scattering of α rays that the charge on the nuclei of atoms of gold was within 20 per cent. equal to 100 e. More recently Chadwick[20] has shown by the use of direct and more refined methods that the charges on the nuclei of three types of atoms, namely, those of platinum, silver and copper, have the value of 77.4e, 46.3e and 39.3e respectively. As the atomic numbers of these elements are 78, 47 and 39, it will be seen that these results strongly confirm the view put forward by Rutherford as a result of the experiments of Moseley and others, which indicate that the nuclear charge is equal to Ne, N being the atomic number of the element.

(*b*) Nuclear dimensions and nuclear electric fields of force.

As mentioned above, Rutherford has shown by experiments on the scattering of α rays that the dimensions of atomic nuclei must be exceedingly small. For example, when high speed α particles collided with atoms of gold they were found to be turned back in their path at a distance of 3×10^{-13} cm. between

[20] Chadwick, *Phil. Mag.*, Dec., 1920, p. 734.

the centers of the α particles and those of the nuclei of the atoms of gold bombarded. This would go to show that in the case of the nucleus of an atom of gold, its radius is probably not greater than 3×10^{-13} cm. Further evidence in this direction has recently been adduced by Chadwick who found that the distance of approach of high speed α particles to the nuclei of platinum atoms was about 7×10^{-12} cm. and of low speed α particles about 14×10^{-12} cm.

In order to account for the velocity given to hydrogen atoms by collision with α particles, Rutherford calculated that the centers of the nuclei of helium and hydrogen must approach within a distance of 1.7×10^{-13} cms. of each other, assuming the law of repulsion to be that of the inverse square.

But the recoil phenomena of hydrogen atoms bombarded by α particles cannot be completely accounted for by assuming an inverse square law to hold for all distances between the centers of the α particle and the hydrogen nucleus. Rutherford suggested that roughly they could be explained by taking the α particle to be the equivalent of a plate of radius 3×10^{-12} cm. and assuming that as long as the α particle did not approach within this distance of the hydrogen nucleus, the ordinary inverse square law of repulsion held. If, however, the α particle did approach within this distance of the hydrogen nucleus a collision ensued which swept the latter straight forwards.

An attempt was made by Darwin[21] to work out the collision relations for all possible models of the α particle for which the electric fields would give integrable orbits. As a basis for this work he assumed the α particle to consist of 4 protons and 2 electrons, and found that a square nucleus in which the protons were arranged at the four corners of the square and the two electrons together at the center of the square, would give a field of force very similar to that of a bipole with collision relations roughly similar to those deduced from Rutherford's experiments.

[21] Darwin, *Phil. Mag.*, Vol. 41, p. 486, March, 1921.

This model has been put to the test by Chadwick and Bieler[22] and by McAuley[23] in a new series of investigations on collisions between particles and hydrogen nuclei and has been found to be not entirely satisfactory. In these experiments the earlier observations made by Rutherford were confirmed, namely, that α particles and hydrogen nuclei in collision do not behave as point charges. Not only is the angular distribution of the projected hydrogen nuclei different, but the numbers projected at small angles are for α particles of high velocity many times greater than those for point nuclei. For example, the observed number of hydrogen nuclei projected within 30° of the direction of incident α rays of range 8.2 cm. is more than 100 times as great as the theoretical number. The number projected within the same angle by α rays of range 4.3 cm. is 15 times the theoretical number. Also the observed variation of the numbers of projected hydrogen nuclei with velocity of the α particle is in the opposite direction from that given by the point theory. For example, α rays of range 8.2 cm. project within an angle of 30° nearly 3 times as many hydrogen nuclei as α rays of range 4.3 cm. On the basis of the point charge theory the α rays of 4.3 cm. range should give nearly 3 times as many as the 8.2 cm. α rays. It would appear, according to Chadwick and Bieler, that as a first approximation the α particle behaves in collision with a hydrogen nucleus as a body with properties intermediate between an elastic sphere and an elastic plate, and more like an elastic oblate spheroid of semi axes about 8×10^{-13} cm. and 4×10^{-13} cm., respectively, moving in the direction of its minor axis. On this view a hydrogen nucleus projected towards an α particle would move under the ordinary electrostatic forces governed by the inverse square law until it reached a spheroidal surface of the above dimensions. Here it would encounter an extremely powerful field of force and recoil as from a hard elastic body. The deductions made by Chadwick and Bieler are

[22] Chadwick and Bieler, *Phil. Mag.*, Vol. 42, p. 923, Dec., 1921.

[23] McAulay, *Phil. Mag.*, Vol. 42, p. 892, Dec., 1921.

interesting in that they emphasize the view that in dealing with collisions between α particles and hydrogen nuclei one must recognize that the inverse square law of repulsion ceases to hold in the immediate neighborhood of the electric charges carried by these nuclei. What the law of variation of the electric force is very close to an electric charge such as we have in an α particle can not as yet be deduced from the experimental evidence available. It is clear, however, that the electric forces in this region are of great intensity.

It is of interest to note that Chadwick and Bieler have pointed out that their experiments provide the only direct evidence we have as to the size of electrons. Assuming an α particle to consist of 4 protons and 2 nuclei it can be seen that the dimensions of the model of the α particle which their experiments have led them to put forward require that the radius of an electron cannot be greater than about 4×10^{-13} cm. Hitherto the only information we have had available as to the dimensions of the electron has been that obtained by calculations based on the assumption that its mass is wholly electromagnetic. Such calculations have given the value 2×10^{-13} cm. for its diameter. While it is clear that an inverse square law of force does not hold in the region extremely close to a nucleus, the experiments of Geiger and Marsden on the angular scattering of alpha particles by gold atoms between 5° and 150° show that it does hold very closely for distance, between 3.1×10^{-12} cm. and 36×10^{-12} cm. from the center of nuclei such as those of gold atoms. In this connection it will be recalled that the agreement between the experimental measurements of the X-ray K series spectra and the theoretical values of Debye[24] and Kroo[25] shows that the inverse square law still holds at the K ring of electrons. In the case of platinum the radius of the K-ring is about 10^{-10} cm. Thus measured from any point in the region between 3×10^{-12} cm. and 10^{-10} cm. from the nucleus of a heavy atom like gold or platinum, the nuclear charge is equal to the atomic number

[24] Debye, *Phys. Zeit.*, XVIII, p. 276, 1917.

[25] Kroo, *Phys. Zeit.*, XIX, p. 307, 1918.

and the law of force is the inverse square. We may therefore conclude that no electrons are present in the region between the nucleus and the K ring.

This result is of special importance in connection with observations recently made by Barkla[26] and White and confirmed to a certain extent by Crowther,[27] which point to the possibility of stimulating atoms to emit radiations of wavelengths shorter than those of any of the known K-series. If these experiments should be corroborated by the results of later work it would appear that we must conclude that these J-rays and possibly, too, the more penetrating gamma rays originate within atomic nuclei and are not produced by disturbances of any of the systems of electrons situated within the atoms but outside their nuclei. In this connection it should be pointed out that Richtmyer[28] has failed to find any valid evidence of the existence of X-rays of the J type.

VII. The Structure of the Nucleus

(*a*) H. particles.

The study of isotopes which we have briefly outlined above has led to very definite views regarding the structure of atomic nuclei. It is clear that all nuclei must be made up of protons and electrons held together by intense fields of force. Direct experimental evidence in support of this view has recently been brought forward by Rutherford[29] and those associated with him.[30] It is found that when swift alpha particles are made to pass through air or nitrogen a few particles having all the properties of protons are projected forward with velocities which give them a maximum range in air of 40 cm. No such long range particles are observed in oxygen or carbon dioxide. When swift alpha particles are made

[26] Barkla and White, *Phil. Mag.* (6), XXXIV, p. 270, 1917.

[27] Crowther, *Phil. Mag.*, (6), Vol. 42, p. 719, Nov., 1921.

[28] Richtmyer, *Phys. Rev.*, p. 433, March, 1921.

[29] Rutherford, Bakerian Lecture, Proc. Roy. Soc. (London), A., Vol. 97, p. 375, 1920.

[30] Rutherford and Chadwick, *Phil. Mag.*, S. 6, Vol. 42, p. 809, Nov., 1921.

to pass through hydrogen the maximum range obtainable for the recoil of hydrogen nuclei is never greater than the equivalent of 29 cm. in air. This makes it clear that the recoil of H particles or protons obtained with nitrogen can not arise from the presence of hydrogen as an impurity in the gas. The H particles must therefore originate in the nuclei of the nitrogen atoms which must therefore suffer disintegration under the intense bombardment of the alpha rays. Results similar to those obtained with nitrogen have been obtained with other elements that have been examined but it is of interest to note that it is only those elements whose atomic mass is given by $4n + 2$ or $4n + 3$ where n is a whole number that give rise to H particles. Elements of mass 4n like carbon, oxygen and sulphur show no effect. In Table III the results obtained so far are summarized.

TABLE III

Recoil H Particles and Their Ranges

Element	Mass	$4n + 2$ or $4n + 3$	Maximum range in cm. of air of H particles or protons expelled under alpha ray bombardment
Boron	11	$2 \times 4 + 3$	Ca 45
Nitrogen	14	$3 \times 4 + 3$	40
Fluorine	19	$4 \times 4 + 3$	40
Sodium	23	$5 \times 4 + 3$	42
Aluminium	27	$6 \times 4 + 3$	90
Phosphorus	31	$7 \times 4 + 3$	65

(*b*) Ranges of H particles.

With aluminium it will be seen the range of the expelled protons is more than twice as great as for those liberated from nitrogen.

The number of H particles expelled from the nuclei of the atoms of different elements is found to vary greatly with the speed of the impinging alpha rays. When alpha particles from thorium C which have a range of 8.2 cm. in air are used the H particles are relatively numerous. With α particles having a 7 cm. range in air, *i. e.*, those emitted by Ra.C, the number of H particles ejected is considerably smaller. With alpha rays of range 5 cm. in air the number is exceedingly small. With aluminium no H particles appear to be released by alpha particles of range less than 5 cm.

(*c*) H particle satellites: backward recoil.

In experiments with aluminium foils bombarded by alpha rays it was found that the direction of escape of the H particles was to a large extent independent of the direction of the impinging alpha particles. Nearly as many were expelled in the backward as in the forward direction. The maximum range for H particles ejected in the backward direction was, however, found to be less than that of H particles projected forwards. In the case of the former the maximum range was 67 cm. while with the latter it was 90 cm. air equivalent.

In order to explain the ejection of H particles in all directions Rutherford and Chadwick have put forward a simple explanation. They suppose that in such an atom as that of nitrogen the main nucleus has a mass 12 and that it has two H particles moving in an orbit round and close to it. The manner in which the collisions are supposed to occur is shown in Fig. I.

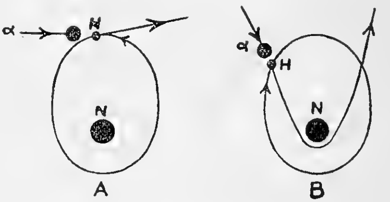


Fig. 1

If the collision occurs as in A the H particle is driven in the forward direction of the alpha particle and away from the nucleus; if, as in B, the H particle is driven towards the nucleus; it describes an orbit close to the latter and escapes in a backward direction. The difference in the velocity of the H particles in the forward and backward directions is probably due to the fact that the main nucleus has been set in motion, in the direction of the alpha particle, before the close collision with the H particle occurs. On this view the relative velocity of the H particle and the residual nucleus is the same whether the H particle escapes in the backward or forward direction, but the actual velocity in the backward direction is less.

(*d*) Attraction between positive charges.

This explanation, it will be noted, implicitly assumes that positively charged bodies attract one another at the very small distances involved in the close collisions between alpha particles and atomic nuclei. Rutherford and Chadwick have pointed out that in order that the colliding alpha particle may communicate much of its momentum to an H particle satellite the latter must be held by strong forces to the nucleus. If, however, the H satellite is very close to the nucleus the alpha particle may have to communicate a considerable fraction of its momentum to the central nucleus, and the velocity of escape of the H satellite is correspondingly reduced. This for example may be the explanation why the alpha particles from aluminium are ejected at higher speeds than those from phosphorus of higher nuclear charge. In phosphorus the H satellites may move so close to the nucleus that the alpha particle is able to give a smaller share of its momentum to the H satellite than in the case of the more distant satellite of aluminium.

(*e*) Close satellites.

So far no H particles have been obtained with elements heavier than phosphorus. The failure to obtain them with such elements may be due to the fact that the H atoms either move very close to the central nucleus or are incorporated in it.

(*f*) Disruption potential.

The theory of nuclear disintegration put forward would seem to demand a definite disruption potential for nuclei having one or more H satellites revolving about them. The experiments with aluminium support this view as no H particles are released from aluminium nuclei by α particles of range in air less than 5 cm. The disruption potential for the nuclei of aluminium atoms, *i. e.,* the potential difference required to communicate the same energy to an electron as is possessed by the α particle is of the order of six million volts. The corresponding potential to liberate an electron from the K or inner ring of electrons of the atoms of aluminium is only about 2,200 volts.

By a simple calculation it can be shown that the results obtained by Rutherford indicate that by operating at six million volts one could with the daily expenditure of 600,000 H.P. disintegrate the nuclei of three cubic feet of nitrogen and obtain thereby not only the recovery of the 600,000 H.P. but also approximately 80,000 H.P. in addition.

(*g*) Atomic weight of nitrogen.

If the view put forward is correct that the H particles are satellites of the central or main nucleus the mass of the H satellite,—since it is not in the "closely packed" condition,—should not be very different from that of a free H nucleus. Assuming that the nitrogen nucleus is derived from that of carbon by the addition of two H satellites and one electron, one might expect the atomic weight of nitrogen to be 14.016, assuming $C = 12.00$, and $H = 1.008$ in terms of $O = 16$. By a slight refinement of Aston's positive ray analysis it should be possible to examine this point.

(*h*) Atomic energy.

A matter of primary importance which has emerged from the experiments on the disintegration of atomic nuclei is that the energy of the H particle as it is ejected from aluminium atoms by the impact of α particles is 1.40 times the energy of the impinging α particles. Even when ejected in a backward direction the released H particle has kinetic energy about 13 per cent. greater than that of the α particle, causing its ejection. This additional energy must come from the atom in consequence of its disintegration. We have therefore in these experiments of Rutherford strong indications of a method of attack which, if followed up, may open a way to the release of the stores of atomic energy existing in ordinary materials about us.

(1) H_3 particles.

In addition to the long range H particles liberated from nitrogen, the passage of α particles through oxygen as well as through nitrogen gives rise to much more numerous swift atoms which have a range in air of about 9 cms compared with that of 7.0 cm. for the colliding α particles. From preliminary observations on these particles they appear to have a mass of 3 and to carry a positive charge 2e. They would thus seem to be the nuclei of an isotope of helium. A number of experiments have been made by Rutherford with α particles traversing gases other than oxygen and nitrogen with the object of definitely establishing the origin of these particles. The imperfection of metal foils, used in the experiments, from the point of view of α rays is very great and as yet no very final conclusions can be drawn from the observations. So far, there is always the possibility that these particles may come from the source of α rays. The H_3 particles obtained from nitrogen are from five to ten times as numerous as the H particles so that if these particles really originate in the nuclei of nitrogen atoms, it is clear that the nitrogen nuclei can be disintegrated in two ways and that the two forms of disintegration must be independent and not simultaneous. Since the H_3 and α particles both carry the positive charge 2e, and the range of the former is 27 per cent. greater than that of the latter, it can easily be shown that the H_3 particles have a velocity 20 per cent. greater than that of the α particles. The kinetic energy of the H_3 particles must therefore be about 8 per cent. greater than that of the 7 cm. range α particles. If, therefore, the H_3 particles are ejected from nitrogen nuclei by the α particles there must be a gain of 8 per cent. in energy of motion even though we disregard the subsequent motion of the disintegrated nucleus and of the colliding α particle. It will be interesting to follow developments in connection with these H_3 particles. If their existence be confirmed by future experiments and it can be shown definitely that they originate in the nuclei of atoms of such elements as oxygen and nitrogen, then we shall have in their production a second example of the release of atomic energy through the agency of α rays.

(*j*) Alpha particles.

Attention should be drawn to the branched X-ray cloud tracks recently obtained by Takeo Shimizu[31] by the use of C. T. R. Wilson's beautiful method of making visible the tracks of ionising rays in gases. According to Rutherford if about one hundred thousand α rays from Radium C pass through air, on an average there will be one close nuclear collision which results in the ejection of a swiftly moving H particle. In Shimizu's experiments he found that about one in every three hundred α rays traversing air produce a branched track. These branched tracks cannot therefore have been produced by the ejection of an H particle. One striking feature of the Shimizu branched tracks is that their shapes and sizes are very similar and the lengths of the two limbs of the branches are approximately the same. The angle between the two branches seems to vary but little and judging from the photographs, an example of which taken from Shimizu's paper is shown in Fig. 2, it appears to be about equal to a right angle. With these branched tracks the branching always takes place near the end of the path of the α particle.

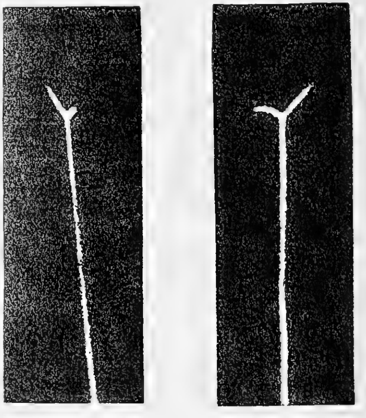


Fig. 2

Photograph of a branched α-ray track viewed from two positions at right angles to each other. Actual magnification 5.5.

In this regard they differ from the short-spurred tracks obtained by C. T. R. Wilson[32] where the abrupt bending of the α ray track took place at different distances from the source of the α particles. In Wilson's experiments the angle between the direction of the short spur and that of the deflected α particle

[31] Shimizu, Proc. Roy. Soc., Series A, Vol. 99, pp. 425 and 432, Aug., 1921.

[32] C. T. R. Wilson, Proc. Roy. Soc., A, Vol. 87, 1912.

was about 107°. This fact, together with the observed relative length of the spur and the track of the deflected *α* particle seems to show that the spur was due to an oxygen atom recoiling under close impact with the alpha particle. The Shimizu branched tracks, however, appear to be similar to what one would expect to get, on the basis of Darwin's calculations, in a closed collision between an *α* particle and the nucleus of a helium atom.

This idea naturally suggests that we have in the Shimizu branched tracks examples of the disruption of nuclei with the liberation of He_4^{++} or alpha particles. If this conjecture should turn out to be correct it would indicate that *α* particles can exist as definite units within the nuclei of atoms of one or more of the gases which make up air. It would be of interest to see if the Shimizu tracks can be obtained in pure nitrogen and also in pure oxygen and other simple gases. Since *α* particles are known to exist at definite units within the nuclei of the atoms of the radioactive elements, it would not be surprising to find their occurrence in the nucleus of an element such as oxygen. It would be of special interest, however, to find out the lightest atom other than that of helium in the nucleus of which the *α* particle exists as a unit.

(*k*) Models of atomic nuclei.

It is difficult with the present state of our knowledge to go into details regarding the possible structure of the nuclei of even the lighter and presumably less complex atoms. It would seem, however, that there is strong evidence for the view that among the possible units or structural bricks out of which nuclei are constructed are protons (H_1^+) and *α* particles (He_4^{++}). There is also some evidence that the particle (He_3^{++}), *i. e.*, the nucleus of a triprotonic isotope of helium can exist as a distinct elementary unit in the nuclei of some types of atom. With such or somewhat similar combining units, attempts have been made by Harkins[33] to work out a constitutional formula applicable to the nuclei of all the elements. The validity of such generalizations can be firmly established only through elaborate and varied experiments, but in the meantime they can at least serve as guides in arranging schemes of attack for prospective experimental work.

A rather suggestive set of models of the atomic nuclei of helium, carbon, nitrogen, and oxygen, based on the ideas of Rutherford is shown in Figs. 3, 4, 5, and 6. In these, the particles H_1^+, He_3^{++} and He_4^{++} are utilized as constituent units. Similar models can be easily made for the nuclei of the atoms of other elements. From these models one would expect to find He_3^{++} particles released by the disruption of carbon atoms, He_3^{++} and H_1^+ particles when nitrogen atoms are broken up and He_4^{++} as well as He_3^{++} particles when oxygen nuclei are disintegrated. It will be seen that the models provide the requisite masses and resultant electric charges for the nuclei they represent. In so far as the nuclei of helium, nitrogen and oxygen atoms are concerned the constitution presented would seem

[33] Harkins, *Phys. Rev.*, Vol. 15, p. 73, 1920.

Fig. 3
Helium Nucleus

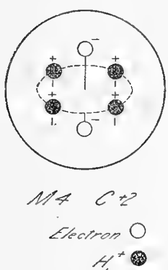


Fig. 4
Carbon Nucleus

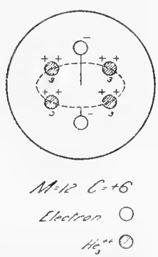


Fig. 5
Nitrogen Nucleus

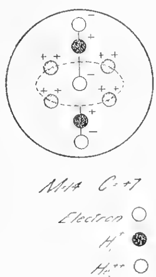
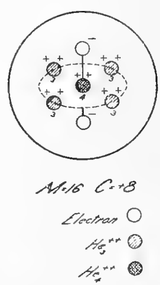


Fig. 6
Oxygen Nucleus



to be not incompatible, at least with the results of many of the experiments of Rutherford and of those who are so brilliantly cooperating with him to reveal to us the ultimate structure of matter.

J. C. McLennan

The Physical Laboratory,
University of Toronto,
December 29, 1921

PROGRESS IN METRIC STANDARDIZATION

Mark Twain remarked that people talked a great deal about the weather and yet he never heard of anybody doing anything about it. The same observation might also be made in reference to the metric system. As scientists we believe in it and through our organizations such as the American Association for the Advancement of Science, the American Chemical Society, etc., we pass resolutions in favor of its adoption, but we do little towards making its use more general. We use the metric system in certain parts of our work but we continue to purchase our chemicals and supplies on the basis of the so-called English "system." The American Chemical Society has resolved to "do something about it" and the first step is to purchase our chemicals and supplies on a metric basis and thus "clean our own house."

The manufacturers and dealers are entirely willing to cooperate, but they feel that it is absolutely necessary for the consumers to take the initiative. A list of some 40 manufacturers and dealers, who are ready to quote in metric units, has been compiled by the Metric System Committee. *Cf. J. Ind. and Eng. Chem.* 13, 1068 *Nov.* 1921. Several firms already use metric packages and some of them exclusively such as the Eastman Kodak Company, Powers-Weightman-Rosengarten Co., etc.

Users of chemicals are now asked to write their specifications in metric units in order to aid in this movement. Over 300 colleges and universities have already agreed to cooperate in the movement, with only one institution known to be opposed to the change. Over 250 technical firms have agreed to purchase their pure chemicals and chemical supplies in metric packages. Firms have been urged to write to the Committee "even if opposed to the movement." It is significant that less than 3 per cent. of those heard from are opposed, which prompts us to believe that in a short time pure chemicals in America may be packed exclusively in the standard metric packages as recommended by the Committee on Guaranteed Reagents and Standard Apparatus (*cf. J. Ind. Eng. Chem.* May 1921), Dr. W. D. Collins, Chairman.

We now ask that all scientists—physicists, biologists as well as chemists—make a point of ordering chemicals in metric units. It is not practicable to reach by letter all of the teachers of science in our schools and colleges as well as those using chemicals in the industries, hence we are making this general appeal so that the transition period may be made as short as practicable. We have had printed "stickers" stating that "orders must be filled and billed in metric units" which will be sent to any correspondent for the asking.

No scientist would willingly join a movement which would work an injury to American industry. We have considered the question whether the compulsory adoption of the metric system would be injurious to industry and we believe that it would be of distinct benefit not only in world trade but in our intercourse here at home. The DeLaval Separator Company has already changed over to the metric basis in a purely mechanical enterprise and they find that the cost of the change does not even "show up" in the manufacturing costs.

In education the saving by abolishing our out-of-date system would be enormous, estimated by Dr. Wolf to be an aggregate of a million years in a single generation. The promotion of understandings with other nations tends to the promotion of world peace and the cost of not adopting the system used by practically every nation in the world except the English and ourselves may far exceed in a single generation the cost of making the change.

We need local committees to get the metric system properly taught in the schools. Doctors are writing prescriptions in metric units voluntarily already on a small scale. Systematic effort would doubtless increase their number many fold. The old apothecary weights might be completely abandoned if effort were expended in that direction. Finally, legislation making the use of metric units obligatory would come as a matter of course when the public understood that prejudice and the supposed interest of a few gage manufacturers was keeping us from the only rational system of weights and measures.

Eugene C. Bingham
Chairman, Metric Committee
Lafayette College

THE BANDING OF BIRDS

On the seventeenth of January, 1922, in response to an invitation from Mr. L. B. Fletcher and others interested in the banding of birds, over a hundred ornithologists, licensed bird-banders and candidates for licenses, met at the Boston Society of Natural History Building in Boston and organized a new ornithological society to be known as the New England Bird Banding Association. The meeting was addressed by S. Prentiss Baldwin of Cleveland, Ohio, who, during the last six years, by introducing bird-trapping as a means of banding birds, has done so much to show the scientific possibilities of the work. The Bureau of Biological Survey in Washington was represented by Major E. A. Goldman, who spoke of the bureau's plans in connection with the movement, strongly endorsing the organization of the new association and recommending the formation of other organizations of the same character at appropriate localities in the United States and Canada.

Members of Audubon societies and bird clubs in several states, and of the Nuttall and Essex County Ornithological clubs, and state ornithologists were present at the meeting, as well as a representative of the Canadian game warden service.

At this writing, January 24, 1922, the association has an enrollment of about three hundred members who are scattered over all parts of the territory covered by the organization, namely, New England, Quebec, and the maritime provinces.

The following officers and councilors were elected:

President: Edward H. Forbush, Westboro, Mass.

First vice-president: Dr. Charles W. Townsend, Boston, Mass.

Second vice-president: James MacKaye, Cambridge, Mass.

Corresponding secretary and treasurer: Laurence B. Fletcher, Brookline, Mass.

Recording secretary: Miss Alice B. Harrington, Lincoln, Mass.

Councilors: A. Cleveland Bent, Taunton, Mass.; Dr. John C. Phillips, Wenham, Mass.; John E. Thayer, Lancaster, Mass.; William P. Wharton, Groton, Mass.; Aaron C. Bagg, Holyoke, Mass.; Charles L. Whittle, Cambridge, Mass.

It may be of interest to ornithologists generally to read an outline of the purposes and plans of the new association which has been formed under the stimuli furnished by the national movement, administered by the Bureau of Biological Survey; by the more general appreciation of the scientific aspects of bird banding as shown, in particular, by Mr. Baldwin's recent work; and by the interesting and valuable data already obtained by previous bird-banding operations.

In the beginning it was felt that the somewhat disappointing results secured from bird banding in the United States to date were due to the workers being too scattered and uncoordinated; to a lack of national support of the plan and the too general character of the ornithological problems bird-banding operations were expected to solve.

From a study of the situation we came to believe that we could obtain the best results:

1. By organizing a regional association of bird banders, meaning by this, bringing together a membership from an area possessing one or more migration highways, along which trapping stations could be established to furnish, by intensive attack, fairly speedy answers to certain specific migration problems, thus early demonstrating to members the scientific value of bird banding with the consequent stimulus to continue the work which it is expected will ultimately solve more ornithological riddles, aid in the solution of others and create new problems not now anticipated;

2. By having the members meet together as often as possible to discuss results, methods and

future plans and to gather inspiration from their fellows after the manner of scientific societies generally, in this way using the combined knowledge of the association to advance the work;

3. By appealing for the support of Audubon societies all over the country on the ground that bird banding is a bird-protection movement, since to an important extent it will be possible in the future to substitute an examination of a live bird for the study of a dead one;

4. By ensuring as far as possible the *permanence* of the movement by means of institutional trapping stations operated by or in connection with Audubon societies, natural history societies, bird clubs, departments of ornithology or zoology at colleges and universities, bird sanctuaries, state and national parks, etc., in addition to stations operated by individuals; and

5. By establishing a convenient local depository of all bird-banding records made by members (an exact copy of the same of course being sent to the Biological Survey) in appropriate quarters where they may be studied by members of the association and others.

Charles L. Whittle

Cambridge, Massachusetts

SCIENTIFIC EVENTS

CONFERENCE ON BUSINESS TRAINING OF THE ENGINEER AND ENGINEERING TRAINING FOR STUDENTS OF BUSINESS

The United States Commissioner of Education is calling a second public conference on commercial engineering on behalf of a committee on commercial engineering appointed by him to investigate business training of engineers and engineering training for students of business.

The conference will be held May 1 and 2 at the Carnegie Institute of Technology in Pittsburgh. President Arthur Hamerschlag of this institution is a member of the committee which is composed of prominent deans of schools of engineering, and of commerce in our larger universities, and of engineers and business men who are nationally known for their interest in the reduction of the costs of production, distribution, transportation, etc., through better training in schools and colleges of the personnel of industry and commerce.

The conference will be open to the public. Invitations to appoint delegates to the Pittsburgh Conference, however, will be sent by the commissioner of education to commercial and trade organizations, engineering and scientific societies, educational institutions and other groups as well as to prominent individuals.

Owing to the timeliness of the subject, the conference in Pittsburgh will even have greater national significance than the first public conference on this question, which was held in Washington two and one half years ago under the direction of this committee on commercial engineering of which Dr. Glen Levin Swiggett of the Bureau of Education is chairman. He says:

The four major topics of the conference will be presented and discussed at general and round table sessions by business men, educators and engineers, contributing to the construction of a cooperative program between education and business for the better coordination of all productive and distributive processes in trade and commerce. It is planned to have the second conference even more constructive than the first, since which time the curricula of 29 of the 119 engineering colleges reporting to the Bureau of Education have been favorably modified to include one or more of the four committee recommendations. Outstanding topics at the Pittsburgh conference will deal with the new problems that have recently arisen in modern industries, the solution of which demands a more scientific approach to include job analyses and personnel specifications and a translation of these into a new and teachable content for use in our engineering and commerce schools; with the training of the engineer for a better understanding of problems relating to community development; and with the training of the engineer for management of overseas engineering projects.

GIFT OF THE ROCKEFELLER FOUNDATION FOR A SCHOOL OF HYGIENE IN LONDON

According to a press dispatch to the New York *Times* the British minister of health announced on February 21 that the Rockefeller Foundation had offered to provide $2,000,000 toward the cost of building and equipping a school of hygiene in London. This offer is on the understanding that the British Government shall accept the responsibility of providing for appointing the staff and maintaining the school when established.

Such a school was recommended by the committee appointed early in 1921 to consider provision for post graduate medical examination in London, and the recommendation was further considered by an expert committee with the minister of health as chairman.

In view of the difficulty at present of financing the scheme, the whole case was presented to the Rockefeller Foundation as one in which it might think it well to cooperate in the general interest of progress in public health.

This gift follows the donation of £1,000,000 to the University of London and University College Hospital.

For providing the staff and maintaining the proposed school of hygiene, the government will have to allocate £125,000 spread over a period of five years. So long ago as 1915, the Institute of Hygiene planned a great central building in Marylebone Road, but the estimate at that date of £47,000 for the building alone made it impossible to proceed. In March of last year a new estimate was obtained and it was found that the cost would approximate £125,000. The British Government felt it impossible to allocate the necessary funds at a period of such financial difficulty as the present.

In June, 1920, the Rockefeller Foundation announced that it had provided endowment yielding £30,000 annually for the University of London to aid medical study. At that time it was said that the funds would be used to support a new staff in anatomy at the college, for an increase in the staff of physiology, for a full-time unit in obstetrics and for various items of increased laboratory and clinical service. In a statement issued at the time of the gift by Dr. George E. Vincent, president of the Rockefeller Foundation, it was said:

> Since the Rockefeller Foundation is cooperating with governments in many parts of the British Empire, it recognizes the importance of aiding medical education in London, where the training of personnel and the setting of standards for health work throughout the empire are so largely centered.

LECTURES IN CHEMICAL ENGINEERING

IN connection with the recently organized course of chemical engineering at Yale University, a series of lectures has been given during the winter by prominent technologists including:

Dr. H. C. Parmelee, editor of *Chemical and Metallurgical Engineering* (opening lecture, October 19, 1921), "The chemical engineer."

Mr. Fred Zeisberg, of the du Pont Company (October 26), "Manufacture of nitric acid."

Mr. A. E. Marshall, consulting engineer, Baltimore, Md. (November 1), "The manufacture of sulphuric acid and some points in the training of the chemical engineer."

Dr. Bradley Stoughton, consulting engineer, New York City, (December 7), "The rôle of iron and steel as relating to the manufacture and use of chemical equipment and processes."

Mr. L. D. Vorce, consulting engineer (December 15), "The electrolytic production of alkali and chlorine."

Mr. Walter E. Lummus, Walter Lummus Company, Boston, Mass. (January 18, 1922), "Modern methods of fractional distillation."

Dr. C. R. Downs, Barrett Company (January 25), "Distillation of coal-tar products."

Dr. Otto Mantius, consulting engineer, New York City (February 15), "Evaporation and evaporators."

THE SHELDON MEMORIAL

A FEW months ago, as already noted in SCIENCE, the Sheldon Memorial Committee was organized to receive subscriptions toward a foundation in honor of the late Dr. Samuel Sheldon, professor of electrical engineering and physics at the Polytechnic Institute of Brooklyn, 1889-1920.

As chairman of the committee, I am glad to report that we are now turning over to the Treasurer of the Polytechnic Institute $15,018, the sum so far paid in by more than 1,000 subscribers. There are still a few unpaid subscriptions and we are hoping to secure enough further pledges to raise the fund to at least $20,000. Although the sum raised was hardly sufficient really to endow a laboratory, the corporation of the institute has ordered that the Electrical Measurements Laboratory be known hereafter as the Samuel Sheldon Memorial Laboratory of Electrical Measurements and its members have collected among themselves an additional $1,000 for immediate improvements and the installation of a memorial tablet. In this manner, the entire fund raised by our committee will be invested in the form of a trust and the income used perpetually for the maintenance of this laboratory which will thereby become one of the best laboratories of electrical measurements in the country.

I wish also to note the general sentiments of esteem and admiration expressed toward Dr. Sheldon, the loyalty of several hundred former students to his memory, and the enthusiasm found within the splendid institution to which with such conspicuous success he devoted so many years of his life.

T. C. Martin,
Chairman

THE RAMSAY MEMORIAL FELLOWSHIP

The trustees of the Ramsay Memorial Fund have requested the National Research Council to nominate a fellow to devote his whole time to research in chemistry in some English university upon a stipend of 250 pounds sterling per year, with an additional allowance of 50 pounds for apparatus. The National Research Council has appointed a nominating committee consisting of F. G. Cottrell, chairman of the Division of Chemistry and Chemical Technology, National Research Council, Washington, D. C.; E. B. Mathews, chairman of the Division of Geology and Geography, National Research Council, Washington, D. C., and professor of mineralogy and petrography, Johns Hopkins University, Baltimore, Md.; and W. E. Tisdale, secretary of the Division of Physical Sciences, National Research Council, Washington, D. C.

This committee is willing to receive applications from any American chemists who have taken a degree with distinction in chemistry in a university or college within the United States, and who are now connected with a university or college, or have recently been graduated therefrom.

The appointment will be for the academic year 1922-1923, and the fellow is eligible for reappointment for a second year.

Applicants should furnish:

1. Certificates or other satisfactory evidence of birth, health, character, and academic or other distinctions.

2. A written application stating:

(*a*) Education and employment to date, and particularly the nature, extent, and place or places of his academic studies and research.

(*b*) Particulars of the work and place of work proposed; and

(*c*) The names and addresses of not more than three references well acquainted (one or other of them) with the health, character, capacity and career of the applicant, without, however, any written testimonials from them or others. One of the references should be a teacher under whom the candidate has studied, or a high official of his university, college, or other place of education.

These fellowships are open in chemistry, either pure or applied, and work may be carried on at any university, college, or other place of higher education, or an industrial laboratory within the British Empire. Their object, in this instance, has, in addition to the stimulation of research, the special earnest desire on the part of English scientists to cultivate the wider acquaintance and good fellowship which is so much to be desired between scientific men of the world.

The Ramsay Memorial Fund for research in chemistry within the British Empire was founded in 1920 to commemorate the services to chemistry of Professor Sir William Ramsay, K.C.B., F.R.S., with an initial endowment of £14,000. Since that time several special endowments have established additions to this fund, and special fellowships with appropriate regulations are granted under: The Glasgow Special Fund; Royal Hellenic Government Special Fund; Federal Government of Switzerland and of Swiss Subscribers Special Fund; Royal Italian Government Fund; Fund of the Honorary Advisory Council for Scientific and Industrial Research, Canada; Royal Swedish Government Special Fund.

Applications should be mailed before April 15 to

W. E. Tisdale,
Secretary

1701 Massachusetts Avenue,
Washington, D. C.

SCIENTIFIC NOTES AND NEWS

DR. VERNON KELLOGG, zoologist, secretary of the National Research Council, Washington, D. C., and John W. Davis, attorney, of New York City, formerly ambassador to Great Britain, have been elected trustees of the Rockefeller Foundation.

PROFESSOR JOHN MERLE COULTER, head of the department of botany at the University of Chicago and editor of the *Botanical Gazette*, has been elected a corresponding member of the Czecho-Slovakian Botanical Society.

COLONEL ARTHUR S. DWIGHT, of New York, was elected president of the American Institute of Mining and Metallurgical Engineers, at the annual meeting in New York City held last week.

MR. E. T. NEWTON, formerly paleontologist to the British Geological Survey, has been elected president of the Paleontographical Society in succession to the late Dr. Henry Woodward.

WE learn from the *Journal* of the American Medical Association that the University of Würzburg has awarded the Schneider prize for the best work on tuberculosis during the last ten years to Professor K. E. Ranke of the University of Munich. The award states that by his anatomic research on the primary complex and the secondary phase of tuberculosis, clinical understanding of the beginnings of tuberculosis has been deepened, and a basis of pathological anatomy provided for recognition of the incipient disease.

DR. ADOLPHO LINDENBERG, of the Faculty of Medicine and vice-president of the Society of Medicine, has been elected president of the Society of Biology recently founded in São Paulo, Brazil.

PHILIP SEABURY SMITH has resigned as chief of the Latin-American division of the Bureau of Foreign and Domestic Commerce to become associate editor of *Ingenieria Internacional*.

CAPTAIN A. W. FUCHS, formerly of the U. S. Public Health Service, has resigned to become sanitary engineer for the Missouri Pacific Railroad, with headquarters at Memphis, Tenn.

DR. HERBERT S. DAVIS, until recently professor of biology in the University of Florida, has entered the permanent service of the Bureau of Fisheries as fish pathologist. Dr. Davis has during several summers served the Bureau in the capacity of temporary investigator, first at the Beaufort Biological Station and later at the Fairport Biological Station, giving special attention to the parasites and the diseases of fishes.

MR. R. H. HEISING of the engineering laboratory of the Western Electric Company has been awarded the Morris Lieman prize of the Institute of Radio Engineers for the most important contribution to the radio art in the past twelve months. Recently his efforts have been devoted to the study of radio systems for extending Bell telephone service to locations which can not be reached by wire.

DR. S. K. LOY, chief chemist of the Standard Oil Company's refinery at Casper, Wyoming, has been appointed consulting chemist of the Bureau of Mines in connection with oil shale work.

PROFESSOR WILLIAM ERNEST HOCKING, Ph. D., Alford professor of natural religion, moral philosophy and civil polity, and Professor Alfred Marston Tozzer, Ph. D., professor of anthropology, have been appointed the professors from Harvard University for the second half of the year 1922-23 under the interchange agreement between Harvard University and the Western Colleges.

PROFESSOR B. E. FERNOW, formerly head of the College of Forestry, has returned to Ithaca from Toronto, Canada, to make his home with his son, Bernard E. Fernow, Jr., who is an instructor in the College of Mechanical Engineering of Cornell University.

AT the last annual meeting of the American Society of Mammalogists there was authorized the appointment of a Committee on Marine Mammals, with the intention that it should work primarily along the lines of conservation. The committee consists of the following: Dr. E. W. Nelson, chairman, U. S. Biological Survey, Washington, D. C.; Mr. Gerrit S. Miller, Jr., U. S. National Museum, Washington, D. C.; Dr. T. S. Palmer, U. S. Biological Survey, Washington, D. C.; Dr. Barton W. Evermann, California Academy Sciences, San Francisco, California; Dr. Robert Cushman Murphy, American Museum of Natural History, New York, N. Y.

Professor William M. Wheeler, dean of the Bussey Institution, Harvard University, will give at the Lowell Institute, Boston, a series of lectures on "Social Life Among Insects." The dates and subjects of the individual lectures will be:

February 27: "A comparison of animals and human societies. The social beetles."

March 2: "Wasps, solitary and social."

March 6: "Bees, solitary and social."

March 9: "Ants, their development, castes, [illegible]."

March 13: [illegible]

March 16: [illegible]

Dr. William K. Gregory, Ph. D., associate professor of vertebrate paleontology at Columbia University and curator of the Department of Comparative Anatomy of the American Museum of Natural History, will deliver on March 4, 11, 18 and 25 at the Wagner Free Institute of Science in Philadelphia, four lectures on "The Evolution of the Human Face."

Professor W. J. Mead, of the department of geology of the University of Wisconsin, gave a course of twelve lectures in metamorphic geology at the University of Chicago during the first half of the winter quarter.

Dr. Woods Hutchinson, of New York, addressed the staff of the Mayo Clinic on January 18; he discussed "Causes of high death rates reported."

Dr. John H. Stokes, of the Mayo Clinic, recently addressed Institutes in Memphis, Tennessee, and Louisville, Kentucky, as a special consultant of the United States Public Health Service.

Dr. Harold Hibbert, of Yale University, addressed the students of the Department of Chemistry of Oberlin College, on February 8, on "Recent work on the constitution of starch and cellulose." On February 10, he lectured to the Syracuse Section of the American Chemical Society on: "The role of alkali in the future development of the cattle-food, cellulose, wood-pulp, and liquid fuel industries," and, on the following day spoke to the graduate students of the department of chemistry of Syracuse University and of the New York State College of Forestry on "A review of recent work on the polysaccharides."

Dr. W. W. Swingle, of the zoology department of Yale University, lectured recently at Mount Holyoke on "The effect of thyroid secretion upon growth and development."

Charles Leonard Bouton, professor of mathematics at Harvard University, died on February 20, aged fifty-three years.

Charles Lewis Taylor, president of the Carnegie Hero Fund Commission and chairman of the Carnegie Relief Fund, died on February 3 in Santa Barbara, California, at the age of sixty-five years. He was prominent as a metallurgist and chemist.

Robert L. Jack, for many years government geologist in Queensland, died at Sydney, New South Wales, in November, at the age of seventy-six years.

Mr. J. Fischer-Hinnen, professor of electrotechnics and director of the Electrotechnic Institute of the Winterthur Technical College, died on January 13, at the age of fifty-two years.

Emile Rivière, well-known for his explorations of paleolithic caves of Mentone and the south of France, died in Paris on January 25, at the age of eighty-six years.

The ninetieth annual meeting of the British Medical Association will be held from July 25 to 29, at Glasgow, under the presidency of Sir William Macewen, F. R. S.

It is proposed to place a bronze memorial tablet to Professor Sheridan Delépine in the Public Health Laboratory at Manchester, and old pupils and friends have been invited to subscribe sums not exceeding one guinea. In connection with the matter a committee has been formed, including Sir Henry Miers, vice-chancellor of Manchester University; Sir Edward Donner, Dr. Niven, Medical Officer of Health of Manchester; Dr. Brinley, Dr. Slater, Mr. Heap, and Dr. Sidebothan.

A REPORT has been issued of the proceedings of the conference on the problem of the unusually gifted student, called by the Divisions of Educational Relations and of Anthropology and Psychology of the National Research Council. This conference was held on December 23, 1921, and was referred to in SCIENCE of January 20, 1922. A copy of this report in mimeographed form will be sent to any one interested upon application to Dr. Vernon Kellogg, chairman, Division of Educational Relations, National Research Council, 1701 Massachusetts Avenue, Washington, D. C.

WE learn from the London *Times* that the Commonwealth Government will place a warship at the disposal of astronomers who are going to visit the northwest of western Australia in September to observe the total eclipse of the sun on September 21. The apparatus is to be established at Wollal, a lonely point on the coast between Port Hedland and Broome. The party, for whom an observation camp will be created, includes Dr. W. W. Campbell, director of the Lick Observatory, California, and Mrs. Campbell; Dr. Moore and Dr. Trumpler, also of the Lick Observatory; Dr. and Mrs. Adams, of New Zealand; Professor Chant and three assistants from Toronto Observatory, and Australian astronomers. The Naval Meteorological Department is making arrangements for the reception of the visitors. The path of totality will be covered as follows: It begins in Abyssinia, and passes over the center of Italian Somaliland and across the Maldive Islands, where Mr. J. Evershed, director of the Kodaikanal Observatory (India), will be stationed Thence it passes across the Indian Ocean to Christmas Island, the most favorable of the places where observation is feasible. Two expeditions are going there, one a British expedition, from Greenwich, consisting of Mr. H. Spenser Jones, chief assistant, and Mr. P. J. Melotte, the discoverer of the eighth satellite of Jupiter; the other a joint Dutch and German expedition, which Professor Einstein may possibly accompany.

REFERRING to a report from Australia that the southern station of the Harvard College Observatory may be moved from Arequipa, Peru, to Queensland, the *Alumni Bulletin* states that there is no immediate prospect of such a change. An influential member of the Queensland government suggested recently that a site might be found there which would prove more advantageous than Arequipa, and received permission from Harvard to go so far as to have meteorological observations made to determine the conditions for astronomical work in Queensland. No definite offer of a site has been received, however, and it is said to be unlikely that any decision one way or the other will be made for the present.

PROFESSOR HOMER R. DILL, director of the vertebrate exhibit at the State University of Iowa, will conduct an expedition to the South Seas some time next year. The primary object will be the collection of fish, but it is hoped that many birds and small mammals may also be taken. Several months will be spent visiting various islands including the Marquesas, Society, Friendly, Samoan and Fiji groups. Stops may also be made in New Zealand and Japan. Other members of the party will include Mr. E. W. Brown, of Des Moines, who is financing the trip, and his wife and son, Robert Brown. The latter is at present studying under Professor Dill. Mrs. Brown, who has had considerable experience in fish painting, will serve as artist on this trip and make sketches of the different species as they appear in life. A former expedition in 1920 with the same personnel was made to the Hawaiian islands and as a result many species of fish were added to the university collection. The fish will be shipped back to the United States in large tanks which are now being constructed. A new preserving fluid discovered by Professor Dill was found to be satisfactory on the Hawaiian expedition and will be used again on this trip. It retains the natural coloring of the dead fish to a large extent, which is an important factor in the collection of many of the highly colored tropical species.

UNIVERSITY AND EDUCATIONAL NOTES

The Rockefeller Foundation has given six million dollars to Johns Hopkins University for the endowment and buildings of the School of Hygiene and Public Health.

It is planned to establish a forest experiment station in connection with the University of California. There are twenty million acres of forest lands in the state.

The five hundred members of the senior class at the Pennsylvania State College have voted unanimously to give the college $100 each, making a total of $50,000 as their class memorial endowment.

At Yale University the degree of master of science in civil engineering, electrical engineering, mechanical engineering, mining engineering, or metallurgical engineering may hereafter be awarded to holders of a bachelor's degree from a college or technical school of high standing who specialize for at least two undergraduate years in that branch of engineering in which the degree is to be taken.

Dr. M. C. Merrill, professor of horticulture at the Utah Agricultural College, Logan, Utah, has resigned his position at that institution to accept the deanship of the school of applied arts at the Brigham Young University, at Provo, Utah. Dr. Merrill will assume his new work on July 1.

Dr. Horatio B. Williams, assistant professor of physiology in the College of Physicians and Surgeons of Columbia University, has been promoted to be Dalton professor of physiology.

Dr. Karl Schlaepfer, of the University of Zurich, Switzerland, has been appointed associate in surgery at the Johns Hopkins Medical School. Dr. Ernst Huber, also of the University of Zurich, has been appointed associate in anatomy.

Professor W. H. Davis, of the Iowa State Teachers' College, has been granted a Ph.D. degree by the University of Wisconsin and has assumed his work in mycology and plant pathology at the Massachusetts Agricultural College, Amherst.

Mr. R. W. Palmer, of the Geological Survey of India, has been appointed senior lecturer in geology at the University of Manchester.

DISCUSSION AND CORRESPONDENCE

DUTY ON ENGLISH BOOKS

In a book-importer's catalogue we read:

"It may be noted that all foreign books can be imported free of duty, as well as English books, more than twenty years old at the date of importation."

Such, in fact, is the law of the land; but, in its application we have found grave modifications.

Importing a series of English scientific magazines some months ago we were informed that the shipment was in the hands of an importing or forwarding agency and would be seen through the customs and sent on upon payment for services and duty charges. In compliance with this request an amount covering charges for services and the portion of the series dutiable at the usual fifteen per cent. was forwarded the agency. The books arrived safely, apparently untouched or undisturbed in any way by customs officials. The dutiable portion constituted one fourth the entire shipment. After some time a bill came requesting payment for duty on the remaining three-fourths of the shipment, on that portion of the series printed over twenty years ago. Inquiry elicited the information that duty had been demanded and had been paid by the agency on the whole shipment. Further inquiry established the fact that duty on the whole shipment had been based on a certain precedent where an importer of books had brought in this country an integral "set" of books, some less, some more than twenty years old and that the "set" was looked upon as all dutiable, indivisible. So in the "spirit" of the law our magazines were all dutiable, whatever might be their age or the age of the majority of them. So the law might call, as it did in our case, for a duty of $6.00, but its "spirit" called for $18.00 more.

Conclusion for individual importers: see to it that your foreign exporters do not send you the older and newer numbers of magazines in the same box or shipment.

We can scarcely refrain from suggesting, in the present depleted state of our Treasury Department, that all revenue laws should be constructed for "spirit" attachments.

G. D. HARRIS
CORNELL UNIVERSITY

ALTERNATE BEARING OF FRUIT TREES

IN view of the heightened interest in the alternate bearing of fruit trees and in fruit bud formation it may be interesting to quote the following passage from the *Magazine of Horticulture* for 1847, volume 13, page 438. The note was written by Charles M. Hovey, editor of the magazine, author of several well-known horticultural works, and often called the father of the American strawberry, after a visit to the Pomological Gardens at Salem, Massachusetts, of Robert Manning, one of the most thorough and accurate students of horticulture in the early days when amateur interest in fruits ran high:

> Passing a Baldwin apple tree in full bearing, Mr. Manning stated that it was one on which he tried the experiment of changing the bearing year. It is well known that the Baldwin only bears every other year. To obviate this was the object of Mr. Manning; and, in the spring of 1846, he spent nearly two days in cutting off all the blossoms. It had the desired effect; this year, the tree is completely loaded with fruit. This experiment is valuable, for it shows that, in a large orchard, when the trees, by chance, nearly all fruit the same year, any number of them can be made to fruit in the alternate year simply by the labor of destroying all the blossoms.

HAROLD B. TUKEY
N. Y. AGRICULTURAL EXPERIMENT STATION,
GENEVA, NEW YORK

THE WRITING OF POPULAR SCIENCE

TO THE EDITOR OF SCIENCE: In looking through the "List of One Hundred Popular Books in Science" prepared by the Washington Academy of Sciences for the guidance of libraries with limited income, one is struck by the number of foreign books. There are thirty-five British authors, two French (Fabre and Maeterlinck) and one German (Einstein); that is, in searching for the best books on the various sciences, regardless of nationality, it was found necessary to go abroad for 38 per cent. of them.

This is curious since in writing for American readers an American author has a decided advantage in that he understands their point of view and can use more or less local illustrations and comparisons and make allusions to familiar things, which are important factors in the popular presentation of scientific questions.

In spite of this natural handicap on the foreign author, British books form more than a third of this carefully selected list, so it is evident that the British are doing better work in the popularization of science than we are, a conclusion that is confirmed by a comparison of imported and domestic books in publishers' catalogues. We have in this country, for instance, nothing to compare in style of writing and attractive illustrations with the "Outline of Science" edited by Professor J. Arthur Thomson, which is now being published in parts at 1 shilling, 2 pence, as was Wells' "Outline of History." I may add that Science Service, which has been scouring the country for a year for popular science writers, has been obliged to go to England for them in many cases.

This is difficult to account for since our American schools give much more attention to the sciences and to the teaching of English composition than do the British schools and since we have such an abundance of fluent and facile writers in fiction and journalism and since we have a wider reading public than any other country. But it is questionable whether the interest of the American people in scientific questions has kept pace with the growing importance of science in human life. In fact some say that science is losing ground in popular esteem. For instance, Dr. Alfred H. Brooks, of the U. S. Geological Survey, said in his recent presidential address to the Washington Academy of Sciences:

> I venture the opinion that there is to-day relatively less popular knowledge of science and less interest in its methods and achievements than there was a generation ago.

This is a discouraging statement in view of the unprecedented expenditure of money on scientific education in American schools.

EDWIN E. SLOSSON

SCIENCE SERVICE,
WASHINGTON, D. C.

QUOTATIONS

WILLIAM JENNINGS BRYAN ON EVOLUTION[1]

THE only part of evolution in which any considerable interest is felt is evolution applied to man. A hypothesis in regard to the rocks and plant life does not affect the philosophy upon which one's life is built. Evolution applied to fish, birds and beasts would not materially affect man's view of his own responsibilities except as the acceptance of an unsupported hypothesis as to these would be used to support a similar hypothesis as to man. The evolution that is harmful—distinctly so—is the evolution that destroys man's family tree as taught by the Bible and makes him a descendant of the lower forms of life. This, as I shall try to show, is a very vital matter.

* * * * * *

The latest word that we have on this subject comes from Professor Bateson, a high English authority, who journeyed all the way from London to Toronto, Canada, to address the American Association for the Advancement of Science the 28th day of last December. His speech has been published in full in the January issue of SCIENCE.

Professor Bateson is an evolutionist, but he tells with real pathos how every effort to discover the origin of species has failed. He takes up different lines of investigation, commenced hopefully but ending in disappointment. He concludes by saying, "Let us then proclaim in precise and unmistakable language that our faith in evolution is unshaken," and then he adds, "our doubts are not as to the reality or truth of evolution, but as to the origin of species, a technical, almost domestic problem. Any day that mystery may be solved." Here is optimism at its maximum. They fall back on faith. They have not yet found the origin of species, and yet how can evolution explain life unless it can account for change in species? Is it not more rational to believe in creation of man by separate act of God than to believe in evolution without a particle of evidence?

* * * * * *

The objection to Darwinism is that it is *harmful,* as well as groundless. It entirely changes one's view of life and undermines faith in the Bible. Evolution has no place for the miracle or the supernatural. It flatters the egotist to be told that there is nothing that his mind cannot understand. Evolution proposes to bring all the processes of nature within the comprehension of man by making it the explanation of everything that is known. Creation implies a Creator, and the finite mind cannot comprehend the Infinite. We can understand some things, but we run across mystery at every point. Evolution attempts to solve the mystery of life by suggesting a process of development commencing "in the dawn of time" and continuing uninterrupted up until now. Evolution does not explain creation; it simply diverts attention from it by hiding it behind eons of time. If a man accepts Darwinism, or evolution applied to man, and is consistent, he rejects the miracle and the supernatural as impossible. He commences with the first chapter of Genesis and blots out the Bible story of man's creation, not because the evidence is insufficient, but because the miracle is inconsistent with evolution. If he is consistent, he will go through the Old Testament step by step and cut out all the miracles and all the supernatural—the virgin birth of Christ, His miracles and His resurrection, leaving the Bible a story book without binding authority upon the conscience of man.

* * * * * *

Christians do not object to freedom of speech; they believe that Biblical truth can hold its own in a fair field. They concede the right of ministers to pass from belief to agnosticism or atheism, but they contend that they should be honest enough to separate themselves from the ministry and not attempt to debase the religion which they profess.

And so in the matter of education. Christians do not dispute the right of any teacher to be agnostic or atheistic, but Christians do deny

[1] From an article in the New York *Times* for February 25. The editor states that Mr. Bryan will be answered by Professor Henry Fairfield Osborn and Professor Edwin Grant Conkin in the issue for March 2.

the right of agnostics and atheists to use the public school as a forum for the teaching of their doctrines.

The Bible has in many places been excluded from the schools on the ground that religion should not be taught by those paid by public taxation. If this doctrine is sound, what right have the enemies of religion to teach irreligion in the public schools? If the Bible cannot be taught, why should Christian taxpayers permit the teaching of guesses that make the Bible a lie? A teacher might just as well write over the door of his room, "Leave Christianity behind you, all ye who enter here," as to ask his students to accept an hypothesis directly and irreconcilably antagonistic to the Bible.

Our opponents are not fair. When we find fault with the teaching of Darwin's unsupported hypothesis, they talk about Copernius and Galileo and ask whether we shall exclude science and return to the dark ages. Their evasion is a confession of weakness. We do not ask for the exclusion of any scientific truth, but we do protest against an atheist teacher being allowed to blow his guesses in the face of the student. The Christians who want to teach religion in their schools furnish the money for denominational institutions. If atheists want to teach atheism, why do they not build their own schools and employ their own teachers? If a man really believes that he has brute blood in him, he can teach that to his children at home or he can send them to atheistic schools, where his children will not be in danger of losing their brute philosophy, but why should he be allowed to deal with other people's children as if they were little monkeys?

We stamp upon our coins "In God We Trust"; we administer to witnesses an oath in which God's name appears; our President takes his oath of office upon the Bible. Is it fanatical to suggest that public taxes should not be employed for the purpose of undermining the nation's God? When we defend the Mosaic account of man's creation and contend that man has no brute blood in him, but was made in God's image by separate act and placed on earth to carry out a divine decree, we are defending the God of the Jews as well as the God of the Gentiles; the God of the Catholics as well as the God of the Protestants. We believe that faith in a Supreme Being is essential to civilization as well as to religion and that abandonment of God means ruin to the world and chaos to society.

Let these believers in "the tree man" come down out of the trees and meet the issue. Let them defend the teaching of agnosticism or atheism if they dare. If they deny that the natural tendency of Darwinism is to lead man to a denial of God, let them frankly point out the portions of the Bible which they regard as consistent with Darwinism, or evolution applied to man. They weaken faith in God, discourage prayer, raise doubt as to a future life, reduce Christ to the stature of a man, and make the Bible a "scrap of paper." As religion is the only basis of morals, it is time for Christians to protect religion from its most insidious enemy.

SCIENTIFIC BOOKS

James Hall of Albany, Geologist and Palæontologist, 1811-1898. By John M. Clarke. Pp. 565, illustrated. Albany, 1921 (S. C. Bishop, $3.70, net).

In this book we have a very informative and highly entertaining history, not only of Professor James Hall, but of most of the other pioneers in American geology and paleontology as well. It is replete with interest for all men of science.

Hall was an extraordinary man in many ways, turning out a prodigious amount of geologic work, and furnishing, by his dynamism, an inestimable "creative impulse to study and research." He was sensitive to a remarkable degree, irascible, and with a surpassing ambition. His nervous system always taut, he "played on a harp of a thousand strings." In consequence he appears to have been in trouble with most of his associates, and yet he was "a confiding man, forever trusting the plausible stranger, even while distrusting his most devoted friends." He lost much money in mining!

Hall's scientific career began in 1836 and for sixty-two years he dominated Paleozoic geology, and more especially paleontology, in

North America. Thirteen great quarto volumes and at least a five-foot shelf of works on paleontology are his enduring monuments.

The wonderful Fourth District of western New York was Hall's "patent" and in it he labored for five years unraveling its geology, "the most excellent piece of field work he ever did," in the course of which was established a large part of the New York System of geological formations. Then came the ever widening *Palæontology of New York,* the dominant note of Hall's long life. An insatiable collector, without ever knowingly having a duplicate fossil, he sold the worked-up collections only to buy and collect others with the money so obtained. Appropriations or none by New York or other states, he went on constantly garnering more material.

As one reads the book, the thought comes readily that New York State has been the mother of geologists—one almost comes to the belief that all American geologists between 1843 and 1890 came from the Empire State or got their training there. We also see the passing show of the master minds that developed the geology of the entire Mississippi Valley, since they were all for one reason or another worshippers at the Albanian shrine. "His influence guided official geologic movements in every state where they were inaugurated, and in many his hand took a helmsman's part." Hall's influence was also great in Canada between 1843 and 1869, since his relations with the director of the Geological Survey of Canada, Sir William Logan, "were openly harmonious."

Hall's zenith of scientific attainments came between 1857 and 1861. Some years before, he presented at the Montreal meeting of the American Association for the Advancement of Science his "most notable performance in philosophical geology," *The Geological History of the North American Continent.* In this essay, published in 1861, he set forth two essential propositions in regard to mountain making, and they are the fundamentals on which our modern conception of these structures depends. These are:

1. That ranges of folded mountains exist only where sediments have uniformly accumulated to maximum thickness and that such maximum accumulation is possible only by corresponding depression of the sea bottom along the edges of continents delivering such sediments. . .

2. That folded mountains result from the crumpling of the upper layers only of these accumulated deposits, a consequence of the adjustment of the later sediments to a deepening but contracting depression.

When Hall was sixty years of age, he was "at the threshold of his greatest productiveness," and he worked in this way:

Of all the corps of men engaged upon this work, Mr. Hall himself was, in these days, the most diligent. Nothing that entered into his publications escaped his criticism and review and he was keen and quick in the preparation of his manuscript. Up and at his desk soon after break of day, with a cup of tea and a panada at his elbow, he found his quiet hours before his assistants came around. And after they had gone there were the evening hours which seldom found him away from his work room. It was his habit when at work to sit before his desk on a revolving piano-stool; his backbone needed no support and an easy chair he abhorred. But alongside his desk he kept, for his callers, a deep scoop-shaped great chair into which the visitor shriveled as he sank down into insignificance near the floor, while his vis-à-vis, erect on his stool, towered majestically over him. It was a strategic advantage and in many an engagement commanded the enemy's works.

When the reviewer went to Albany in 1889 as Hall's private assistant, the latter was a picturesque old man:

His round, full-bodied figure, his heavy snowy beard running well up over his ruddy cheeks, an always erect carriage and a square level look out from under thick brows and over his Moorish nose; dressed in an old coat and in trousers which buttoned down the sides after the fashion of 1830, he was bound to attract attention and curiosity. Every morning . . . his man Tom drove him from his home in a broken-down, one-seated cart which had once owned a top but lost it long since, drawn by a broken-down old nag which had also seen better days and had like as not been taken in exchange for apples or old specimen boxes, his capacious snow-crowned figure capped with a chimney-pot hat towering above his diminutive driver—the jogging figure through the Albany streets was sure to compel notice.

Extolled by LeConte as the "founder of American geology," and by McGee as the "founder of American stratigraphy," said by Dana to be the man without whom "the geological history of the North American continent could not have been written," Hall's present biographer concludes that he "was in truth the apostle of historical geology." Much praise is due Dr. Clarke for the lively way in which he sets Hall—and many of his contemporaries—before us in these pages. The task was a great one, attended with peculiar difficulties, and its accomplishment reflects high credit upon the author. The paleontologic sun rose in New York in 1836, and its warmth still radiates from the Empire State throughout the North American continent!

CHARLES SCHUCHERT

SPECIAL ARTICLES

THE SYNTHESIS OF FULL COLORATION IN PHLOX

IN the issue of *Genetics* for March, 1920, the writer published facts bearing on the color of the flower blade in *Phlox Drummondii.* Certain F_1 purples that were full-colored and self-colored appeared as the progeny of two plants whose blades were a clear white. These F_1 purples, when self-pollinated, gave rise to an F_2 group comprising several types of corolla. A bluing factor in heterozygous condition in the F_1 individuals doubled the number of F_2 colored sorts. Ignoring the differences caused by this factor there were in the F_2 group the following general types (illustrated in colors in Plate 1 in *Genetics,* Vol. 5):

1. Showy full-colored purple or rose type resembling the F_1. The color is evenly suffused over the blade, *i. e.,* the blade is self-colored.

2. A lighter type whose color is bright pinkish or light purplish. This kind also has its color uniformly suffused over the blade.

3. Dusky type whose dull magenta color is merely stippled on to the blade giving the flower the appearance of a dusty or dirty-looking white.

4. Pure white-bladed type.

Proceeding to the F_3 generation it was found that the lighter uniformly colored Type 2 never gave rise to duskies (Type 3) on inbreeding, nor did the duskies ever contain plants of Type 2 among their offspring. Moreover, neither of these two types, on self-pollination, ever produced Type 1. The deep-colored F_2 plants of Type 1 were capable of throwing out Types 2 and 3 besides repeating themselves. Such analysis led to the hypothesis that full or deep coloration in *Phlox* must be due to the presence together of the second and third types, or rather to the genes for these two types, which are not allemorphic.

During the past year this hypothesis was tested out by the actual putting together, through hybridization, of Types 2 and 3. In all, seven matings of Types 2 and 3 were made yielding 59 offspring and from every crossing the progeny were both full-colored and self-colored.

Type 2 + Type 3 = Type 1.

This synthesis supplements and confirms the author's earlier work on the genetic relationship of color types in *Phlox Drummondii.*

J. P. KELLY
PENNSYLVANIA STATE COLLEGE

THE PROPOSED FEDERATION OF BIOLOGICAL SOCIETIES

A CONFERENCE of officers of a number of biological societies was held in Toronto on December 27, 1921, to discuss the feasibility of closer cooperation among these societies. This conference was the outgrowth of two somewhat informal meetings in Chicago, the first in December, 1920, upon the initiative of the secretary of the American Society of Naturalists, the second in April, 1921, at the instance of the officers of the American Society of Zoologists and of the Botanical Society of America. At the request of those in attendance at the second conference the call for the Toronto meeting was issued by the Division of Biology and Agriculture of the National Research Council. The discussion of the Toronto conference was in a measure directed in accordance with a program arranged by the chairman of the Division of Biology and Agriculture, in consultation with the secretaries of the American Society of Naturalists, the Botanical Society of America, and the American Society of Zoologists. Under the chairmanship of Professor L. R. Jones, the following topics were developed:

I. The federation of biological societies; the idea and possible plans for its realization: C. A. Kofoid, C. E. Allen, F. R. Lillie.

II. Some of the biological problems which federation may help to meet:

1. The needs in the field of genetics: R. A. Emerson, L. J. Cole.
2. Society publications: J. R. Schramm.
3. Correlation of meetings and programs: A. F. Shull, W. C. Allee.

These speakers, and other members of the conference in informal discussion, developed a variety of ways in which a federation or some form of cooperation would aid in the solution of problems that are now pressing. It was urged that more adequate outlets for publication might thereby be provided; that larger editions of larger publications could be published more cheaply than the present small journals with limited circulation; that abstracting, which is very inadequately done for zoological literature, could thus be fostered; that biology could thereby be popularized and given more influence in everyday affairs; that correlation of programs, with respect to place and time, would be rendered less difficult; that programs could be arranged around the larger biological principles, rather than under the headings Botany and Zoology; that formation of new societies or organizations could be initiated or given direction; and that adjustment to changes in the grouping of interests, such as that now presented in the field of genetics, would be facilitated.

It was evident from the discussion that the general idea of federation was practically unanimously approved by the conference, and the following resolutions were adopted:

Resolved, 1. That it is the sense of this meeting that the inter-society conferences should be continued to consider the feasibility of federation of the biological societies and to develop plans for the said federation; and

2. That for the purpose of advancing these plans each society, as well as Sections F, G and O of the American Association for the Advancement of Science, be requested to designate its president and secretary as members of an inter-society council which shall be authorized (1) to deal with all matters of common interest, such as coordination of programs, that are consistent with the existing regulations of the constituent societies; and (2) to draw up proposals for a constitution and by-laws of a federation of the societies in question, and to present them for action at the next annual meeting.

Considerable discussion arose as to the details of the proposed federation of societies, but it was realized that these could not be effectually determined in a single brief meeting, and it was decided to leave these matters to the inter-society council provided for in the resolutions. Plans were made for securing prompt action upon the resolutions by all biological societies in session at Toronto and it was informally understood that the proposed council might invite representatives of other sections of the American Association or of other societies if it so desired.

A further resolution was adopted, requesting the Division of Biology and Agriculture to call the first meeting of the proposed inter-society council at a date sufficiently early to admit of deferred meetings and the completion of a plan of federation before the next annual meeting of the societies. The first meeting will probably be called in April.

The organizations represented in the conference at Toronto were as follows: 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 of Economic Entomologists, American Society of Agronomy, Entomological Society of America, Sections F, G and O of the American Association for the Advancement of Science, and the Division of Biology and Agriculture of the National Research Council.

A. Franklin Shull,
Secretary of the Conference

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THE ORGANIZATION OF KNOWLEDGE[1]

IN an admirable introduction to Herbert Spencer's Synthetic Philosophy, by Alfred W. Tillet, occurs the suggestive observation that "one volume after another might be glanced at or even carefully read and no idea whatever obtained as to Spencer's *aim*." Even the *Study of Sociology,* in the words of this author, "does not give any definite idea of the aim of Spencer's work" but no one "even superficially familiar with a moderate portion of Spencer's monumental contributions to knowledge can fail to be impressed by the fact that it is from end to end an organized system of scientific knowledge."

What after all is the real difference between scientific and general knowledge, or between organized and unorganized information? Is it not rather a difference in structure than in function, for, as said by Karl Pearson, "the classification of facts, the organization of their sequence, and relative significance, is the function of science," which must be the objective of every attempt to gather and classify the knowledge extant on any particular subject. The moment we desire to apply a given train of thought to some practical purpose we are confronted by the necessity of understanding facts in their relative significance.

Yet so difficult is the practical task of arriving at sound conclusions in the presence of some complex phenomenon that even civilized man reasons as a rule in disregard of scientific principles, indifferent to the value or necessity of organized knowledge as a substitute for disorganized or chaotic information. The cause of this anomaly is of course quite obvious; the former process requires painstaking care in the accumulation and classification of facts,

[1] Address of the vice-president and chairman of Section K—Social and Economic Science, Toronto, December, 1921.

while the latter is simply a convenient form of guesswork opinion, often aided by a good memory and a sound intuition. Unfortunately the truth is frequently unnecessary to the attainment of the objects of every-day existence, and there is much to be said for the view given expression to by M. Anatole France "that in the majority of cases truth is likely to fall a victim to the disdain or insults of mankind and to perish in obscurity." For unhappily, in the words of this brilliant Frenchman, "truth is inert, is not capable of modification, is not adapted to the machinations which would enable her to win her way into the hearts and minds of man" while "falsehood on the other hand possesses the most wonderful resources." Yet in the long run truth does prevail, at least in all large projects in the pursuit of knowledge or profitable trade or long range undertakings just as we build a different foundation for a pyramid than for a cowshed.

The science of forecasting has perhaps nowhere been more completely developed than in the vast businss of insurance, and of no branch of commercial enterprise can it be said with less fear of successful contradiction than of insurance that it rests its principles and policies upon the lasting and, in fact, indestructible basis of truth. Likewise, it might be said that the fame of Sir Francis Bacon rests largely upon his conception of applied science as a process of pure induction or the orderly method of arriving at trustworthy conclusions on the basis of experiment and observation or of natural laws having "the dual characteristic of universality and reality."

The inductive process of reasoning is essentially one of *fact gathering* and of classification and analysis. But systematic fact gathering as a science is of comparatively recent origin, while the urgency of organized knowledge as a prerequisite to true scientific endeavor is as yet, at least in the larger sense, only in a stage of embryonic development.

Fault has been found with Sir Francis Bacon for the barrenness of the results flowing from his laborious observations and classifications. This, as said by Church, is due to the fact that "he had a radically false and mechanical conception, though in words he earnestly disclaims it, of the way to deal with the facts of nature." The fault was one of the limitations of knowledge inherent in the age in which he lived rather than of Bacon's theory of the human understanding and of the primitive conception of the comparative value of collective phenomena or statistics, which even to this day is far indeed from having reached the status of a true science. Church is also of the curious opinion that the cause of Bacon's defect was a non-mathematical mind; that he took no notice of the invention of logarithms and that he was impatient of the subtleties of astronomical calculations. In very truth, however, the source of Bacon's transcending intellectual powers were conditioned by this very limitation of his knowledge, for as observed by Church in a subsequent passage "with all his mistakes and failures the principles on which his mode of attaining a knowledge of nature was based were the only true ones and they had never before been propounded so systematically, so fully, and so earnestly."

But Bacon suffered much more from the shortcomings of his age and its follies than from defects in his method of scientific reasoning. What to-day is known as Economics, Sociology, and Statistics, was far from having been recognized as an urgent need of a Science of Progress in which the lessons of mankind's experience are relied upon at least in commerce if not in government as controlling the rational conduct of mankind. This conception, however vaguely perceived, rests upon the larger truth, as pointed out by Herbert Spencer, that "ultimately mankind will discover a constant order even among the most involved and obscure phenomena." It is with this process that the present discussion is concerned; the organization of knowledge as differentiated from the mere gathering and accumulation of facts regardless of their interrelation or interdependence for useful purposes as the case may be.

The organization of knowledge for the present purpose is meant to include all manner of descriptive data; all observations whether objective or subjective, all that is cognizable and recorded in the realm of human experience or as a natural phenomenon; in brief, what is Fact and Evidence, useful in the endless struggle to perfect human relations individually or collectively in the pursuit of all that concerns a higher and more effective standard of life, labor, and social happiness.

The principle is laid down as incontrovertible that most of the ills from which mankind suffers are the result of chaos and confusion in the boundless domain of knowledge and the misunderstanding of the why and wherefore of life in the higher and larger sense. This applies as much to the earning of a livelihood or success in commerce and trade as to the affairs of nations and questions of peace and war. A League of Nations not based upon completely organized and unified knowledge is as foredoomed to failure as a merchant adventure in ignorance of the market to which it applies. Yet less progress has been made in the direction of organizing the data of human experience on the basis of a well-considered plan than has been made in the case of any other single branch of science or business enterprise. Of the collection of data there is no end, nor of the accumulation of books and the making of card indexes; but this is often not an aid but rather a hindrance to the organization of knowledge in the sense and for the purpose indicated. It is largely due to this defect in the Baconian philosophy that the practical results of Bacon's theories fall so far short of their theoretical possibilities. In the same sense it is a safe statement to make that the practical value of a public library at the present time is but a fraction of its possible utility were it properly conceived on the principles of organized knowledge.

It was the opinion of Herbert Spencer that "The sciences can not be arranged rationally in a serial order." Yet numerous have been the attempts to classify the sciences from Bacon and Spencer to modern workers, including the fragmentary observations of Mercier. Perhaps the most useful remarks on classification are those of Jevons in the second volume of his "Principles and Science," but in this as in all similar discussions the true objective, the organization of knowledge, is lost sight of. Nearer to the point are Spencer's data on Sociology but wholly impractical for everyday needs, being rather a classification of information than of knowledge or verifiable evidence.

Nor is the question much advanced by such a learned work as "The Organization of Thought" by Professor Whitehead, although it is properly observed that "first-hand knowledge is the ultimate basis of intellectual life," and the further and extremely interesting and practically valuable conclusion that "The second-handedness of the learned world is the secret of its mediocrity. It is tame because it has never been scared by facts," and finally that "The main import of Sir Francis Bacon's influence does not lie in any particular theory of inductive reasoning which he happened to express, but in the revolt against second-hand information in which he was the leader." (p. 43).

This is precisely the point raised in this protest against the apathy of the so-called scientific mind, which is often satisfied with doubtful or incomplete information because forsooth it is a task of colossal difficulty to collect and properly organize the information on almost any subject whatever. But the difficulty arises chiefly out of an unorganized or disorganized state of mind, habituated to a pretense of knowledge full well known to be imperfect and incomplete. The defects or deficiencies are therefore often made up by the use of mathematics, by every conceivable method of abstract reasoning as a substitution for the want of sufficient concrete evidence which more systematic and qualified research would bring forth.

Completely unified knowledge, from the viewpoint of Spencer, is unattainable in any field of human endeavor, but the approximately complete organization of the knowledge extant on any particular subject at the present time is not only feasible but an imperative *duty*. The use of mathematics is, under such circumstances, more of a hindrance and a pretense than a help. What is wanted is *more* and better understood control of organized information.

The organization of knowledge involves as a first consideration the synthetic collection of facts, and a fact in the present sense is construed as defined by Webster, as "Anything that is done or happens, as an act or deed, anything actually existing, and anything strictly true." But aside from this narrow definition of facts in the more restricted sense the organization of knowledge involves as a secondary consideration the collection and classification of information, which may or may not be strictly true but of relative value sufficient for the purpose. Information is defined as "knowledge acquired or derived, or as timely specified knowledge, sufficient for the ordinary needs of life and the basis of the large majority of judgments upon which human conduct is regulated." To these preliminary definitions must be added the term knowledge itself or "the clear and certain apprehension of the truth or assured rational conviction." This is not knowledge in the ordinary sense of the term, for we *know* much of what is not clearly apprehended at all. As said by Webster, "Knowledge is *all* that the mind knows, from whatever source derived or obtained or by whatever process; the aggregate of facts, truths, or principles acquired or retained by the mind, including alike the intuition native to the mind and all that has been learned respecting phenomena, causes, laws, principles, literature, etc."

With these principles clear in mind the task of the organization of knowledge is less difficult. It is immaterial what subject is selected; the Seal Fisheries of Alaska or the Climatic Conditions of the Falkland Islands; The Development of the Export Trade in the Basin of the Amazon River or The Theory, Practice, and Results of Insurance. The process of organizing the facts of any branch of knowledge is the same however much the nature of the data may vary, or their extent in time and place. Facts must first be looked upon as information—as mere knowledge irrespective of intrinsic worth; they are the raw material which, subjected to qualified critical and impartial consideration, forms the ground work of science inductively conceived. Science has been defined as "Knowledge gained and verified by exact observation and correct thinking," and also as the sum of universal knowledge, or in other words "an exact and systematic statement of knowledge concerning some subject or group of subjects." Now a systematic statement of knowledge is organized knowledge, and in this sense much of what is called scientific falls far short of the required essentials of a true science. Webster's definition is admirable but of itself incomplete. For it would seem of the first importance to emphasize the need of organized knowledge as a conception of science in the more restricted sense of the word.

This must have been recognized by Webster, who goes on to qualify his definition of science as follows: "Knowledge of a single fact not known as related to any other, or of many facts not known as having any mutual relation, or as comprehended under any general law, does not reach the meaning of science," for, he adds, "science is knowledge reduced to law and embodied in a system." This process is primarily one of organizing the data of science and of subsequent classification and analysis, out of which the principles of science are logically evolved by a process of pure induction. It is held that this process of organization aiming at complete unification of the knowledge of any particular subject or group of subjects is as yet but very imperfectly realized in the manner most conducive to practical results.

In other words, the objective of organizing knowledge is the accessibility of facts useful for the purpose of selection for particular and practical purposes. In the words of M. Poincare, "Scientists believe that there is a hierarchy of facts and that a judicious selection can be made," and furthermore that "The most interesting facts are those which can be used several times, those which have a chance of recurring." He then asks the question "Which then are the facts that have a chance of recurring?" and he replies that in the first place simple facts "although facts which appear simple even if they are not so in reality will be more easily brought about again by chance."

It is upon this conception that a practical science of organized knowledge on any subject must rest. Simple facts are the ground work of sound reason or the common sense of every-day questions; facts which are known to recur with regularity, particularly such as are in the form of statistics "systematized numerical facts collectively" considered and which form the basis of judgments concerned with forecasting the future more or less in conformity to the principle of or the law of probability. This has been defined as "the ratio of chances favoring an event to the total number of chances for and against it." Obviously no sound judgment involving the future can be arrived at without a knowledge of what has taken place in the past, and yet an immense number of opinions are rendered in total disregard of the lessons of past experience. But as M. Poincaré observes, "although it is with regular facts that thought ought to begin, as soon as the rule is well established, as soon as it is no longer in doubt, the facts which are in complete conformity with it lose their interest, since they can teach us nothing new." Thus, while on the one hand the lessons of experience are only too often ignored or set aside, there is on the other frequent failure to recognize the limitations of experience and to scorn the "exception which becomes important."

The foregoing brief exposition of certain principles of science applied to the systematic collection of facts in the accepted sense will serve the purpose of emphasizing that in its final analysis all fact gathering, fact arrangement, and fact comparison has for its primary objective the approximate certainty of the truth in its application to the needs of every-day life. At least in this sense my own efforts have been construed not upon a well-defined theory but in coincident adaptation to my needs, strongly influenced by the profound conviction that only the broadest understanding of any given subject is likely to prove trustworthy, that all collateral or related facts must be taken into account, that the knowledge must be sufficient in quantity as well as extended in point of time while absolutely free in its gathering from any bias or prejudice.

The procedure of fact gathering is much more arduous than is assumed by amateurs satisfied with the collection of mere information and the mechanical indexing of data divorced from practical use. In my judgment it is of the very first importance that the fact gatherer should be the fact user, or, in other words, the one to apply the results of his research to the solution of the problems of every-day life. Nothing is more likely to be harmful than when the fact gathering is done mechanically or without a definite objective.

The organization of knowledge, in its final analysis, is concerned with the task of assembling the facts of human experience in a form conveniently available and adaptable to every-day needs. In brief, the very purpose of organization and classification is to bring order out of chaos, and yet, in the words of Boutroux, "In the reality of things, the right eternal, mathematical order which science considers from its own point of view serves to obscure an order that is invisible, subtle, supple and untrammeled and therefore all the more beautiful." But mankind can not do without the latter any more than the former and it is therefore of the utmost importance that the knowledge organized or arranged and classified shall be as nearly as possible complete or inclusive of all the experience that has been had in a given matter. For as further observed by Boutroux, "It is beyond dispute that our reasonings are susceptible to being in harmony with facts," for "when they are out of harmony we do not consider that reasoning is a conscious instrument but rather that we have insufficient data, that our field of opportunity is too limited." Hence the supreme need of a clear grasp of the methods of inductive reasoning as opposed to those of deductive logic, since the former is based on experience while the latter is not.

The practical ideal of good judgment in matters of our every-day living needs is expressed by Spedding, the biographer of Bacon, in the words "I doubt whether there was ever any man whose evidence upon matters of fact may be more absolutely trusted," yet it is equally true, as observed by Cowley, quoted by Robinson, that "Bacon missed success in detail because he was striving to encompass nearly the whole field of nature in a life which was engrossed with work enough of other kinds to keep a strong man busy." But Bacon suffered even more from the absence of a clear recognition on the part of the age in which he lived of the truth fundamental to his aims, that information and belief are not a substitute for a knowledge of facts and a recognition of their relative importance. The purpose of the Baconian philosophy is contained in the prediction that "Men's power over nature would be increased a thousand fold when they learned to interpret her with the humility of truth seekers casting aside all prepossessions," a prediction realized in no small measure in modern life freed from a vast amount of the credulity, deliberate falsehood, and class bias, which mar the greatest achievements of Bacon's time.

But mankind is still a long distance from having recognized that truth alone can make us truly free. There is, no doubt, a considerable degree of practical utility in common errors. Since all of our human relations are based on relative conceptions of truth the margin of error may be large or small as circumstances permit, but only for short range efforts. It matters little whether the distance I am to walk is a mile, or nine-tenths, or even less in my estimation, but it makes a world of difference whether the calculated position at sea is correct within a small fraction of the longitude and latitude determined by the sextant. And just as surely as small errors repeated and accumulated lead to disaster at sea, so more serious errors in conduct, individual or social, may defeat a course laid out in ignorance of the truth.

The clearest recognition of this principle of right action is the statement by Mill in his discourse on "Fallacies of Observation," in connection with which it is said that "A fallacy of misobservation may be either negative or positive; either non-observation or mal- observation." This important distinction is explained in part that "It is non-observation when all the error consists in overlooking or neglecting facts or particulars which ought to have been observed. It is mal-observation when something is simply unseen or seen wrong; when the fact or phenomenon instead of being recognized for what it is in reality is mistaken for something else."

Both errors are of such common occurrence in every-day life that they are the rule rather than the exception among those whose judgments are relied upon as a matter of course in the conduct of affairs of the first importance. Mill recognized this limitation of the average understanding, pointing out in his discussion of Fallacies that "In the conduct of life—in the practical business of mankind—wrong inference, incorrect interpretation of experience, unless after much culture of the thinking faculty are absolutely inevitable; and with most people after the highest degree of culture they ever attain, such erroneous inferences, producing corresponding errors in conduct, are lamentably frequent." Yet as clearly as this is stated and admitted as a fact of every-day experience, generation after generation grows up in ignorance of the inherent limitations of the human understanding, the serious danger of unorganized knowledge, and the menace of a continuous stream of mere information much of which is only guesswork, possibly grossly false in matters of detail, while all of it, by itself, may be totally unrelated to the practical needs of every-day life.

There is an imperative demand for accuracy in public utterance which falls lamentably short of the ideal. Statesmen utter weighty opinions on matters of verifiable knowledge obtuse to the implication of wilful ignorance, if not wilful deception. Even in high places the most vague distinctions prevail between what is mere opinion and what is fact and truth. Almost half a century ago George Cornwall Lewis in a very readable treatise on the "Influence of Authority in Matters of Opinion" called attention to the need of a clear grasp of this distinction, holding that "a large proportion of the general opinions of mankind are derived merely from authority and are entertained without any distinct understanding of the evidence on which they rest." Authority in this sense means "the principle of adopting the beliefs of others on a matter of opinion without reference to the particular grounds on which that belief may rest." The profound error implied in the blind or unreasoning acceptance of the views of others is the most serious menace to present-day civilization, and the growing habit of accepting as conclusive the views of men possibly as ill-informed as they may be influenced by wrongful motives, simply because they audaciously emphasize and reemphasize mere opinions as statements of fact, involves the very integrity of the intellectual life of the age.

The half-educated, but possibly well informed, do not realize the truth that "the formation of opinion by authority can never (except by indirect means) produce any increase or improvement of knowledge or bring about the discovery of new truths," or, in other words, progress for its attainment depends upon intellectual virility, independence of thought, and judgments impartially arrived at. In the large majority of matters men must rely upon the opinions of others, but here again, in the words of Lewis, "It is of paramount importance that truth and not error shall be accredited; that men when they are led by opinion should be led by safe guides." Hence the importance of an intellectual standard which shall insist upon fact gathering, reflective analysis, and verifiable knowledge in all matters fairly within the compass of a mind of average intelligence. It was the weakness of the German educational system, so largely copied or adopted in this country, that it made respect for authority its cornerstone to the infinite harm of the countless many who fell victims to the soul-deadening policy of the Super-State.

Essentially progress and discovery depend, in the words of Karl Pearson, upon a disciplined imagination and while "the man with no imagination may collect facts" it is equally true that "he cannot make great discoveries." As perhaps the most illustrious examples, he cites Farraday and Darwin, who were both fact gatherers but at the same time gifted with a brilliant imagination. But the imagination will fail unless it is a disciplined one, and all discipline leads, unconsciously perhaps, to the development of the critical faculty. Yet this faculty is to-day the least regarded—looked upon as mere fault-finding, when in very truth, in the words of Pearson, "Criticism is the essence of the scientific use of the imagination, in fact the very life blood of science."

An excellent practical illustration is E. Ray Lankester's essay on the "History and Scope of Zoology," originally contributed to the Ninth Edition of the Encyclopædia Britannica. (Reprinted in his "Advancement of Science," London, 1890). The author observes that "The possibility of verification established verification as a habit; and the collection of things (or facts) instead of the accumulating of reports (or mere information) developed a new faculty of minute observation." But it did much more. It developed at the same time the judgment qualified to draw correct conclusions both as to the nature of things and causation. To-day there is the most serious danger that the ever-increasing amount of mere information on countless questions as wide apart as the universe, made accessible anywhere to those who can read—through books, newspapers, and motion pictures, will, in the absence of a clear recognition of the fundamental principles of the limitations of the human understanding, lead to hopeless confusion in matters essential to every-day living. There was never a greater fallacy uttered than "Knowledge is Power," for it is by no means mere knowledge or information that gives support to creative intelligence, but the understanding alone aids the disciplined imagination ever on the search for new truths or the larger and better use of the truths or facts already known.

Sir E. Ray Lankester refers to the immense influence of the Royal Society in the seventeenth century when "It laid down definite rules for its guidance, designed to ensure the collection of solid facts and the testing of statements embodying novel or remarkable conclusions." Nothing would give more substantial furtherance to the cause of truth than if this practice were adapted to-day by all scientific bodies as a first essential to conserve the precious intellectual heritage of the past against the menace of falsification and error and ridicule. To-day, unfortunately, there is not the serious jealousy against the inroads of the imposter and amateur now into one branch of science, now into another. Conversely, there is need of a broader scientific spirit, of a more hearty encouragement of all seekers after truth, in place of the narrow-minded attitude so often displayed by men who could be of the greatest aid to those who are doing pioneer work outside of the recognized field of the scientist of the academies. Sir E. Ray Lankester illustrates this point by calling attention to the fact that "The delay in the establishment of the doctrine of organic evolution was due not to the ignorant and unobservant but to the leaders of zoological and botanical science," an attitude of hostility which has by no means passed away.

I can not do better than draw one further observation from Sir E. Ray Lankester's essay: "Outside the scientific world an immense mass of observations and experiments had grown up in relation to this subject (genetics). From the earliest times the shepherd, the farmer, the horticulturalist, and the 'fancier' had for practical reasons made themselves acquainted with a number of biological laws and successfully applied them without exciting more than an occasional notice from the academic students of biology." But, he adds, "It was one of Darwin's great merits to have made use of these observations and to have formulated their results to a large extent as the laws of variation and heredity."

Over-specialization is developing a type of scientific mind as much to be guarded against as the credulous and ignorant. The limitations further emphasize the necessity of a broad scientific spirit anxious to give furtherance to the seeker after truth in whatever direction and by whatever methods useful results may be obtained. For, in its final analysis, every discovery rests primarily upon the power of observation or fact gathering, and discrimination and aptitude in fact classification and analysis, which may or may not require the aid of modern instruments of precision. Modern man is only too apt to forget the vast achievements of the ancients. The four greatest inventions of an earlier period were all made without the modern aids to scientific discovery, but by men gifted with a disciplined imagination. Printing, Gunpowder, Steam, and the Compass did more to change the face of the world and the fortunes of mankind than Electricity, Wireless Telegraphy, Motion Pictures, and the Graphophone.

The foregoing observations have been included in the present discussion to further emphasize the view that a true organization of knowledge is essential to the future of scientific discovery, as well as to the needs of the more complex life of to-day and of the years to come. But more than this would I try to make clear the conclusion that science in the more restricted technical sense should do more to encourage the development of science in the larger or more universal sense, and therefore enlist the aid of any and all means available in place of a narrow spirit of aloofness unworthy of the aims and ideals of the sincere seeker after truth.

Frederick L. Hoffman

The Prudential Insurance
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Newark, N. J.

(*To be concluded.*)

THE FIFTH YEAR OF THE TROPICAL RESEARCH STATION

The Fifth Expedition of the New York Zoological Society to the Tropical Research Station at British Guiana, sailed on the "Maraval" on February first, with nine members under Director William Beebe. As in previous years, the chief assistant is Mr. John Tee-Van. Mr. Paul Howes, who was a member of the first expedition, will work on the field staff. The artist is Miss Mabel Cooper who is completing her remarkable series of drawings from the life of living reptiles, amphibians and fishes. The party will continue tropical research at Kartabo until after the long rainy season, when a sub-station will be established upriver at Kaieteur Falls for the study of this elevated fauna, which differs considerably from that of the coast.

The researches of Director Beebe on the syrinx of birds will be continued, as well as intensive studies on primitive living types in their environment, especially *Peripatus,* the hoatzins, the armored catfishes, and on the entire environmental complex. The remaining hoatzin material for the American Museum group will be collected and data completed for one hundred large colored plates to be issued in a series of volumes uniform in size with Director Beebe's "Monograph of the Pheasants." It is hoped that the Station may be kept open throughout the year and through the succeeding winter of 1922-1923, to permit a number of British zoologists to come from England and begin work at the Station. Moving pictures of mammals, birds, and reptiles will be taken of all the subjects studied, and large mirrors have been secured for photographing in the deep jungle.

The work in the Tropical Research Station during the year 1921 may be best presented in calendar form. From January 1 to March 15 the expedition continued in the field, each member pursuing his or her particular line of research. Unusual discoveries were made in the Director's study of the syrinx of birds, for example, that in certain decapitated birds every note can be reproduced by manipulation of the lungs and trachea. On February 12 an important trip was made to Kaieteur Falls, the party including Mrs. Theodore Roosevelt and four members of the Station's staff. Many new and interesting specimens were collected and the ground thoroughly surveyed for the establishment of a sub-station another year. The Falls are the highest in the world, eight hundred and ten feet in all, about five times as high as Niagara. Upon return to Kartabo the regular exploration and research were resumed. The expedition returned to New York in April. Owing to a very serious fire on board the steamer at St. Kitts, the entire collection, instruments and equipment required a thorough overhauling and repairing. The photographic negatives especially had to be removed from their envelopes and washed, and the microscope boxes reconstructed. The collection of live animals brought to the Zoological Park included the Crested Curassow, South American Rattlesnake, Boa, Giant Anteater, Capuchin Monkey and Caiman. The most notable was a young Red Howling Monkey, George by name, the first ever brought up successfully and established in the collections of the Zoological Society.

The members of the 1921 expedition are now widely scattered. Professor J. F. M. Floyd returned to his department in the University of Glasgow; Dr. Alfred Emerson now holds the position of Assistant Professor in the University of Pittsburgh, and Clifford Pope is engaged in herpetological work in central China with the American Museum Asiatic Expedition. During the period of May to December Director Beebe completed the manuscript and proof of Volume III of the Pheasant Monograph, and completely finished the manuscript of Volume IV. The entire British Guiana collections were catalogued, index files established, and much of the vast quantity of material arranged and correlated ready for publication after another season's accretions. Several weeks were devoted to perfecting a new method of hand-colored lithography, which will be put into operation next year in issuing the series of one hundred large colored plates, together with life histories. During October to December, in aid of publicity, Director Beebe gave about twenty-five lectures in various cities, dealing with the work and activities of the Tropical Research Station. Addresses were also made before the New York Academy of Sciences, the American Geographical Society and the Annual Meeting of the Trustees of the New York Zoological Society. During the year twenty-six publications were issued.

H. F. O.

ZOOLOGICAL SOCIETY,
FEBRUARY 17, 1922

GRANTS FOR RESEARCH MADE BY THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE Committee on Grants held its annual meeting in New York on January 1, 1922, and distributed four thousand dollars which was assigned by the council of the association for the current year. Three members of the committee, Messrs. Crew, Parker, and Stebbins, having retired at the end of 1921, the present organization of the committee is: Robert M. Yerkes, *Chairman;* F. R. Moulton, *Secretary;* E. G. Conklin, C. Judson Herrick, Arthur B. Lamb, George T. Moore, E. L. Nichols, and David White.

Following is the list of grants for 1922:

PHYSICS

One hundred and fifty dollars to Professor A. W. Smith, Ohio State University, in support of his work on the latent heat of fusion and on the specific heat of metals.

One hundred and fifty dollars to Professor L. R. Ingersoll, University of Wisconsin, in support of his work in magneto-optics.

One hundred and fifty dollars to Professor F. C. Blake, Ohio State University, for partial payment toward the cost of an X-ray spectrometer.

CHEMISTRY

Two hundred and fifty dollars to Dr. A. W. Rowe, Evans Memorial Hospital, Boston, for the study of the basal metabolic rate in pregnancy.

Two hundred dollars to Professor Harold Hibbert, Yale University, for a study of the oxidation potentials in related organic substances.

One hundred dollars to Professor W. C. Rose, School of Medicine, University of Texas, in support of a study of blood changes in nephritis.

ASTRONOMY

Two hundred dollars to the American Association of Variable Star Observers for a portable house to go with the telescope purchased from a previous grant.

One hundred dollars to Miss Caroline E. Furness, Vassar College, additional to previous grant for determining proper motions of stars.

One hundred dollars to Dr. Sebastian Albrecht, Dudley Observatory, additional to previous grant for assistance in study of stellar spectra.

GEOLOGY

Two hundred and fifty dollars to M. Ferdinand Canu of Versailles, France, in further support of his work on bryozoa.

One hundred and fifty dollars to Dr. August Foerste, High School, Dayton, Ohio, toward travel and office expense in the preparation and description of arctic fossil cephalopods.

ZOOLOGY

Two hundred and fifty dollars to Professor Hermann J. Muller, University of Texas, to carry out studies on mutations in flies.

Two hundred dollars to Professor S. O. Mast, Johns Hopkins University, to carry on work on locomotion of amœba.

BOTANY

One hundred and twenty five dollars to Dr. Ralph C. Benedict, Brooklyn Botanic Garden, in further support of a study of the fern genus Nephrolepis.

Two hundred and fifty dollars in support of Botanical Abstracts for the current year.

One hundred and twenty five dollars to Professor John T. Buchholz, University of Arkansas, in support of work on pollen tubes.

PSYCHOLOGY

Four hundred dollars to Professor Raymond Dodge, Wesleyan University, for the development of an instrument for recording eye movements.

Three hundred dollars to Professor Franklin O. Smith, Johns Hopkins University, for the purchase of a monochromatic illuminator to be used in research on color vision.

PHYSIOLOGY

Two hundred dollars to Professor Fred T. Rogers, Baylor Medical College, for a study of the marsupial brain.

Two hundred dollars to Professor Frank P. Knowlton, Syracuse University, in further support of the study of the blood flow and gaseous metabolism of the thyroid gland.

One hundred and fifty dollars to Professor Frank A. Hartman, University of Buffalo, to aid in the further study of suprarenal insufficiency.

Joel Stebbins,
Secretary Committee on Grants.
Urbana, Illinois

SCIENTIFIC EVENTS

THE EXHIBITION OF THE ROYAL PHOTOGRAPHIC SOCIETY

The Royal Photographic Society of Great Britain is holding its sixty-seventh annual exhibition in September and October of this year. This is the most representative exhibition of photographic work in the world, and the section sent by American scientific men heretofore has sufficiently demonstrated the place held by this country in applied photography. It is very desirable that American scientific photography should be equally well represented in 1922, and, in order to enable this to do be done with as little difficulty as possible, I have arranged to collect and forward American work intended for the Scientific Section.

This work should consist of prints showing the use of photography for scientific purposes and its application to spectroscopy, astronomy, radiography, biology, etc. Photographs should reach me not later than Thursday, June 15. They should be mounted but not framed.

I should be glad if any worker who is able to send photographs will communicate with me as soon as possible so that I may arrange for the receiving and entry of the exhibit.

A. J. Newton
The Eastman Kodak Company,
Rochester, N. Y.

FRENCH EXCHANGE PROFESSORS IN ENGINEERING

The *Pennsylvania Gazette* reports that Professor Jacques Cavalier, rector of the University of Toulouse, has begun his term at the University of Pennsylvania as the first exchange professor appointed by the minister of public instruction in France in accordance with an arrangement made by the committee of American universities on exchange with France of professors of engineering and applied science. The plans made by the committee stipulate that the French exchange professor shall spend one month at each of the following universities: Columbia, Cornell, Harvard, Johns Hopkins, Massachusetts Institute of Technology, University of Pennsylvania and Yale, and that a representative of American technical schools shall spend a year visiting and lecturing before the chief French engineering and technical schools.

Professor Cavalier is an eminent scientist and well known as an investigator in the field of metallurgical chemistry. He was formerly professor of applied chemistry at the University of Rennes, and he is now rector of the University of Toulouse. During the war he was attached to the ministry of munitions. Since his appointment to the post of rector of the University of Toulouse he has devoted much of his time to questions related to technical education.

During his stay in America he hopes to thoroughly study the organization administration and methods of instruction in our own schools and place before men interested in technical education the principles underlying scientific education in France. It is believed that this exchange of professorships will serve to develop a cordial relationship between engineering and technical schools in both countries. Professor Cavalier will lecture before the staff and graduate students of the department of chemistry on questions related to his own investigations in applied chemistry, and he will also deliver three illustrated lectures in French at Houston Hall on Wednesdays, March 1, March 8 and March 15, on 'The French universities," "Student life in France," and the "Evolution and development of the French universities." Both as a savant and scholar, Professor Cavalier is well equipped to speak on the advanced studies now carried on in French universities, as well as to discuss their organization.

The committee of American universities has appointed as its representative in France this year Professor Arthur E. Kennelly, professor at Harvard and the Massachusetts Institute of Technology. Professor Kennelly has met with so much success in his mission that the number of institutions to be visited by him has been doubled in order that more universities could hear his lectures on the development of scientific education in this country.

OFFICERS OF ENGLISH SCIENTIFIC SOCIETIES

Elections to office in English societies devoted to physical sciences are reported in *Nature* as follows:

The annual general meeting of the Physical Society of London was held on February 10, and the following officers and members of council were elected: *President:* Dr. A. Russell. *Vice-presidents:* Lord Rayleigh, Professor T. Mather, Mr. T. Smith, and Professor G. W. O. Howe. *Secretaries:* Mr. F. E. Smith, "Redcot," St. James's Avenue, Hampton Hill, and Dr. D. Owen, 62 Wellington Road, Enfield. *Foreign Secretary:* Sir Arthur Schuster. *Treasurer:* Mr. W. R. Cooper. *Librarian:* Dr. A. O. Rankine. *Other Members of Council:* Mr. C. R. Darling, Professor C. L. Fortescue, Dr. E. Griffiths, Dr. E. H. Rayner, Mr. J. H. Brinkworth, Mr. J. Guild, Dr. F. L. Hopwood, Dr. E. A. Owen, Dr. J. H. Vincent, and Dr. G. B. Bryan.

The following officers and members of council of the Royal Astronomical Society were elected at the anniversary meeting on February 10: *President:* Professor A. S. Eddington. *Vice-presidents:* Dr. J. L. E. Dreyer, Sir F. W. Dyson, Professor A. Fowler and Professor H. F. Newall. *Treasurer:* Col. E. H. Grove-Hills. *Secretaries:* Dr. A. C. D. Crommelin and the Rev. T. E. R. Phillips. *Foreign Secretary:* Professor H. H. Turner. *Council:* Professor A. E. Conrady, Dr. J. W. L. Glaisher, Mr. P. H. Hepburn, Mr. J. Jackson, Dr. H. Jeffreys, Professor F. A. Lindemann, Dr. W. H. Maw, Professor T. R. Merton, Professor J. W. Nicholson.

At the annual general meeting of the Royal Meteorological Society on January 18 the following officers were elected: *President:* Dr. C. Chree. *Vice-presidents:* Mr. C. L. Brook, Mr. W. W. Bryant, Mr. R. H. Hooker and Dr. E. M. Wedderburn. *Treasurer:* Mr. W. Vaux Graham. *Secretaries:* Mr. J. S. Dines, Mr. L. F. Richardson and Mr. Gilbert Thomson. *Foreign Secretary:* Mr. R. G. K. Lempfert. *Council:* Dr. J. Brownlee, Mr. D. Brunt, Mr. C. J. P. Cave, Mr. J. E. Clark, Mr. R. Corless, Mr. Francis Druce, Mr. J. Fairgrieve, Col. H. G. Lyons, Mr. Henry Mellish, Sir Napier Shaw, Dr. G. C. Simpson and Mr. F. J. W. Whipple. Communications should be addressed to the secretaries at 49 Cromwell Road, South Kensington, S.W.7.

THE GEOLOGICAL SOCIETY OF CHINA

On January 27, 1922, there was organized in the Geological Survey quarters in Peking, the Geological Society of China with 22 charter members (fellows). The aim of the society is to unite all working geologists in China into a scientific body for the advancement of the science of geology and its kindred subjects in general, and the geology of China in particular. The society will hold an annual meeting for the presentation and discussion of papers, for election of officers and transaction of business. Other meetings will be held during the year when deemed desirable. The membership consists of fellows and associates, the former comprising active workers in geology and kindred sciences, including paleontology, mineralogy, petrology, mining geology, etc., the latter including advanced students in these sciences. The society will issue a publication under the name "Bulletin of the Geological Society of China." The following officers have been elected:

President: Dr. H. T. Chang. *Vice-presidents:* Dr. W. H. Wong and Professor J. S. Lee. *Secretary:* Mr. C. Y. Hsieh. *Treasurer:* Mr. H. T. Li. *Councilors:* Dr. V. K. Ting, Dr. J. G. Andersson, Dr. A. W. Grabau, Professor Leigh Wang, Dr. C. Y. Wang (Hupeh), Mr. C. Tuan.

THE SCHOOL OF HYGIENE AND PUBLIC HEALTH OF THE JOHNS HOPKINS UNIVERSITY

As was noted in last week's Science the Rockefeller Foundation has made a gift of $6,000,000 to the Johns Hopkins University for endowment and buildings for the school of hygiene and public health.

Since this school was opened in 1918 the Foundation had furnished the funds required for its maintenance from year to year. With the acceptance of the present gift the trustees of the university assume full responsibility for the future needs of the school as they develop.

This new type of institution places emphasis upon the development of preventive medicine and upon the training of health officers. Under the direction of Dr. William H. Welch the school has made substantial progress in the four years since it was established. Twenty-seven states and ten foreign countries are now represented in the student body numbering 131. The faculty of the school comprises scientists in the fields of bacteriology and immunology, sanitary engineering chemical hygiene, physiological hygiene, medical zoology, epidemiology, vital statistics and public health administration.

The regular courses of study lead to the degrees of doctor of public health, doctor of science in hygiene, and bachelor of science in hygiene. A certificate in public health is given to those completing certain special courses. Short courses or institutes are provided for health workers in service who cannot be absent from their positions for more than a few weeks at a time. Last year thirty-six health officers from eight states took these short intensive courses.

Up to this time the school has been housed in old buildings, situated in the center of the city of Baltimore, and formerly used by Johns Hopkins University for laboratories of physics, chemistry and biology. The present gift, in addition to providing endowment, will make possible the erection of the new building for the school on a site adjacent to the Johns Hopkins Medical School and Hospital.

Work on the main building, the plans for which already have been drawn, is expected to start this summer. It will be located on a site which has already been acquired at the southeast corner of Monument and Wolfe streets and is so designed as to admit of its liberal expansion. The contract for its erection will be let as soon as the architects, Archer & Allen, of Baltimore, have completed drawing the detailed specifications.

The enterprise will be part of a general scheme of building to be started by the university this year, including in addition to the new school of hygiene, which will cost $1,000,000, $800,000 for the new Woman's Clinic and a new pathological building, the contracts for which have already been let; $500,000 for a new chemical laboratory at Homewood and between $400,000 and $500,000 for dormitories at Homewood.

SCIENTIFIC NOTES AND NEWS

DR. JOHN CASPER BRANNER, the distinguished geologist, president emeritus of Leland Stanford University, died on March 1 at the age of 71 years. He was the second president of the university, succeeding Dr. David Starr Jordan, who now is chancellor emeritus.

A MEETING to initiate the Gorgas Foundation Memorial was held at Birmingham, Ala., on March 4. Among the speakers was Sir Auckland Geddes, the British ambassador, who said: "The name Gorgas will live long after the peoples of earth have forgotten the heroes of the world's greatest war."

DR. HUBERT WORK has taken the oath of office as postmaster general. Dr. Work, whose home is at Pueblo, Colorado, is president of the American Medical Association. President Harding's cabinet contains a physician and an engineer, which represents a new development of political institutions in the United States.

PROFESSOR SOLON I. BAILEY, of the Harvard College Observatory, sailed on March 1 from New York to Peru to take charge of the Harvard astronomical station at Arequipa. He is accompanied by Mrs. Bailey and by Miss Annie J. Cannon of the observatory staff.

DR. HENRY H. RUSBY, who was forced through illness to quit the leadership of the Mulford Biological Exploration of the Amazon Basin, has arrived in New York, his health being now much improved. Dr. Rusby turned the leadership over to Dr. W. M. Mann, assistant curator of the Division of Insects, National Museum. Dr. O. E. White, of Brooklyn Botanical Gardens, has charge of the botanical work.

PROFESSOR DOUGLAS W. JOHNSON, of Columbia University, delivered the Heilprin Memorial Lecture before the Geographical Society of Philadelphia on March 1. Preceding the lecture, Professor Johnson received from President Bryant the Elisha Kent Kane Medal, awarded to him by the council of the society.

ACCORDING to a press dispatch the Belgian geologist, Professor Scouppe, of the University of Ghent, has just returned from the Belgian Congo where he located two radium deposits, said to be the richest in the world. Professor Scouppe christened the mineral "Curite." The Belgian authorities have started the construction of a plant at Hoboken near Antwerp, which, it is said, will produce one gram of radium from nine tons of the mineral.

At a meeting of the C. M. Warren Committee of the American Academy of Arts and Sciences, held on Tuesday, February 21, it was voted to make the following grants: To Professor R. F. Brunel, of Bryn Mawr College, $200 to assist him in his work on the study of the action of halogen hydrides on unsaturated compounds. To Professor V. K. Krieble, of Trinity College, $100 to aid his investigation of the nature of asphalts. It was voted by the committee that applications for grants would be considered at three stated meetings of the committee each year. Applications for grants should be in the hands of the chairman of the committee, Professor James F. Norris, Massachusetts Institute of Technology, Cambridge, by the first of February, May or November.

Mr. G. V. Colchester has been appointed to the post of geologist on the Geological Survey of the Anglo-Egyptian Sudan in succession to Mr. C. T. Madigan, who now holds a lectureship in geology at Adelaide University.

Mr. Howard T. Graber has been elected secretary of the Digestive Ferments Company, Detroit. Mr. Graber retains his former duties as director of the Chemical Laboratory and chairman of the publicity committee.

Mr. Edmund B. Stiles, formerly with the Subsurface Department of the Bureau of Economic Geology of the University of Texas, and W. Armstrong Price, formerly paleontologist for the West Virginia Geological Survey and lately with the Transcontinental Petroleum Company in Tampico, are now engaged in subsurface studies for F. Julius Fohs, chief geologist of the Humphreys Oil Company, at Dallas, Texas.

The fifth Hanna lecture was delivered on February 24 at the Medical Library, Cleveland, by Professor Joseph Barcroft, F.R.S., fellow of Kings College, Cambridge, England, on the subject of "The physiology of life at high altitudes."

Dr. A. C. Crehore, of the Nela Research Laboratory, gave a series of lectures from February 14 to 23 at the University of Illinois on the general subject: "Modern theories of the structure and behavior of atoms."

Dr. Lyman J. Briggs, of the Bureau of Standards, gave an illustrated lecture before the Franklin Institute in Philadelphia on February 15, on "The resistance of the air."

Dr. Henry S. Washington gave recently a series of four lectures to the students in the Geological Department of McGill University on the subjects of "The distribution of metals in the earth's crust," "Isostacy and rock deformation," "Petrographical classification," and "Co-magmatic regions."

Professor Roger Adams, of the University of Illinois, lectured before the Columbus Section of the American Chemical Society on February 20 on "Synthetic drugs."

Mr. B. G. Lamme, chief engineer of the Westinghouse Company, lectured at the Ohio State University on February 24, under the auspices of the University Branch of the American Institute of Electrical Engineers. Following the lecture, there was a smoker by the members of the Society for the Promotion of Engineering Education. Mr. Lamme, Mr. C. S. Coler, of the educational department of the Westinghouse Company, and Dr. W. H. Kennerson, of Brown University, addressed this meeting on various phases of engineering education.

Additional lectures at the Brooklyn Botanic Garden this spring are as follows: On March 23 at 3:30 p.m., "The flora of Greenland: Its affinity to surrounding Arctic lands and probable history," Dr. Morton P. Porsild, director of the Danish Arctic Station, Disko, Greenland; and on April 16 at 4 p.m., "The virgin forest of Java," by Professor J. P. Lotsy, director of the Museum, Haarlem, Holland.

Maj. James E. Mills, U. S. Army, delivered the following series of lectures at the University of North Carolina on February 24 and 25:

"Chemical warfare," to the student body; "The properties of a substance that determine its use in chemical warfare," to the students of chemistry; "Chemical warfare—methods of attack and defense," to the Elisha Mitchell Scientific Society.

DR. FRANK BOTTOMLEY died of pneumonia on January 16 at the age of 47. Dr. Bottomley had done valuable work in chemistry and physics. As *Nature* notes, heredity and environment conspired to make him a man of science. His great-grandfather was Dr. James Thomson, professor of mathematics in Glasgow University; his great-uncles were Lord Kelvin and James Thomson, F.R.S., professor of engineering in Queen's College, Belfast, and Glasgow University; while his father is the present Dr. James Thomson Bottomley, F.R.S., of Glasgow University.

THE President has approved a joint resolution accepting the invitation of Brazil to participate in an international exposition to be held in Rio de Janeiro, from September to November, 1922, in commemoration of the centenary of the independence of Brazil. A deficiency appropriation act approved December 15, 1921, carries an appropriation of $1,000,000 for this purpose. Under the terms of the joint resolution exhibits are provided of farming, cattle industry, mining, mechanics, transportation, communication, commerce, science, fine arts, forestry, fisheries, and manufacturing.

ACCORDING to the *Journal* of the American Medical Association, a society has been organized at Freiburg i. B., the headquarters in the publishing house of T. Fischer, which aims to publish the *Bildarchiv,* the purpose of which is to collect and make possible the rational utilization of scientific illustrations for teaching and other purposes. Besides a central headquarters for negatives and illustrations, it is proposed to make possible the publication of illustrations in a more perfect form than would be possible for private individuals.

THE topics appointed for discussion at the next international congress on the history of medicine are: (1) The principal foci of epidemic and endemic diseases of the middle ages in the Occident and the classic Orient, and (2) The history of anatomy. The congress is to be held at London on July 24-29, 1922, Professor Singer, of Oxford, to preside. The officers of the International Society for the History of Medicine are Giordano, of Venice; Singer, of Oxford; Jeanselme and Menetrier, of Paris, with Tricot-Royer, president. Laignel-Lavastine is the secretary. His address is rue de Rome, 45, Paris.

THE Tenth International Congress of Otology will be held in Paris from July 19 to July 22, 1922, under the patronage of M. Bernard, minister of education, and will be presided over by Professor Pierre Sebileau.

PUBLICATION of the *Geographic News Bulletins,* distributed weekly to schools for the past two years by the National Geographic Society through the Bureau of Education, but recently discontinued because of restriction of franking privilege by the Government, will be resumed. A charge will be made for postage.

THE trustees of the American Medical Association have made an appropriation of $1,500 to further meritorious research in subjects relating to scientific medicine and of practical interest to the medical profession, which otherwise could not be carried on to completion. Applications for small grants should be sent to the Committee on Scientific Research, American Medical Association, 535 North Dearborn Street, Chicago, before March 15, 1922, when action will be taken on the applications at hand.

THE *Journal* of the Washington Academy of Science reports that by a proclamation of President Harding, signed January 24, a 593-acre tract in the Nevada National Forest has been set aside as the Lehman Caves National Monument. The area remains a part of the National Forest, but can be used for no purpose which interferes with its preservation as a national monument. The caves are in a limestone formation at the base of Mt. Wheeler, at an altitude of 7,200 feet, and contain a remarkable series of stalactites and stalagmites.

FOR the purpose of encouraging research work on glass, the research committee of the

Glass Division of the American Ceramic Society has made arrangements for providing glass of desired composition and desired form for investigators in this field. The material will be supplied free of charge and no limitations as to the nature of the research will be imposed. The recipients of the material will be under no obligations except that of publication of the results of their investigations. The committee, however, requests that wherever possible the *Journal* of the American Ceramic Society be given preference in reporting the results. Persons who are interested are requested to address their inquiries to one of the following members of the committee on research: E. C. Sullivan, Corning Glass Works, Corning, New York; E. W. Washburn, University of Illinois, Urbana, Illinois; R. B. Sosman, Geophysical Laboratory, Washington, D. C.

UNIVERSITY AND EDUCATIONAL NOTES

Williams College alumni are planning to raise $1,500,000 during the coming spring. One million of this sum, of which $200,000 has been pledged as a contingent gift by the General Education Board, is to provide adequate endowment for professors' salaries. The remaining $500,000 is to be used towards more complete facilities for physical education.

Northwestern University has been notified that the General Education Board, of New York (the Rockefeller Foundation) has appropriated $600,000 for increase of faculty salaries, provided the university raises $1,400,000.

At the Tulane University of Louisiana School of Medicine, New Orleans, it is planned to erect a new modern hospital on the university campus at a cost of between $1,000,000 and $2,000,000. The hospital will be in connection with the medical school of the university.

State appropriations of the New York legislature for the College of Agriculture at Ithaca include $83,000 for the construction of a new wing on the main building of the Veterinary Building, and $183,000 for equipment for the new Dairy Building. This budget is somewhat larger than usual and will permit more extension work by the college.

Dr. Marion Edwards Park, dean of Radcliffe College, has been elected president of Bryn Mawr College, to succeed M. Carey Thomas, who retires at the end of the present academic year.

Professor William F. Osgood, of the mathematics department, has been appointed acting dean of the Graduate School of Arts and Science of Harvard University for the second half year. Dean Haskins is on leave of absence for that period so that he may recuperate after an attack of influenza.

Professor J. W. Barton, associate professor of psychology in the School of Education of the University of Idaho, has been promoted to a full professorship of psychology. Mr. C. W. Chenoweth (M.A., Harvard) has been elected associate professor of philosophy.

Dr. Henri Claude, associate professor and physician to the Saint-Antoine Hospital, has been appointed to the chair of clinical mental diseases and diseases of the brain in the Paris School of Medicine, to succeed the late Professor Dupré.

Dr. George J. Heuer, associate professor of surgery at the Johns Hopkins Medical School, has accepted the professorship of surgery in the Medical College of the University of Cincinnati.

DISCUSSION AND CORRESPONDENCE

PRACTICABLE SUBSTITUTES FOR GRAIN ALCOHOL

Use of ethyl or grain alcohol for laboratory purposes has long involved certain difficulties connected with securing it tax-free and preserving it for its intended uses only. Since the passage of the various prohibition statutes the observance of the necessary regulations governing its use occasions far more trouble, while those who are interested in putting it to unscientific uses make the guardianship of the precious fluid a serious responsibility. Substitutes for grain alcohol, which would be unpotable and free from internal revenue taxation and prohibition regulations, are greatly desirable. Ordinary denatured alcohol, while useful for some laboratory purposes, is not satisfactory for most uses because of the character of the denaturants; and the use of a special denaturing formula is so involved in regulations as to be almost impossible.

A considerable series of experiments has shown that *isopropyl* and chemically pure *methyl* alcohols will fulfill practically any use for which alcohol is needed in biological work. It is indicated that inhalation of fumes of isopropyl alcohol does not have dangerous consequences; certainly, in any properly ventilated place the fumes would not be a danger. The experience of those who work in factories where methyl alcohol is produced, and who at times inhale the fumes in large quantity, shows that there is also little to be feared from its use in the laboratory. Experiments along this line are in progress. Probably most persons would prefer to use isopropyl alcohol for those purposes which might cause considerable quantities of the fumes to be inhaled. But both alcohols can be used with perfect safety for histological or other ordinary purposes. Out of consideration for those who consider alcohol a beverage all containers of both these alcohols should display warning labels.

The commercial grade of isopropyl alcohol contains 91 to 92 per cent. of the alcohol, while the similar grade of ethyl alcohol is 95 to 96 per cent. A purer grade of isopropyl alcohol, 98 to 99 per cent., can be supplied by the manufacturers, which can be made anhydrous by ordinary procedures.

"Chemically pure" methyl alcohol is practically anhydrous, and being less hygroscopic than ethyl alcohol is more useful and reliable for such purposes as dehydrating tissues than the anhydrous ("absolute") ethyl alcohol. As it contains only a trace of acetone it is entirely without the disagreeable odor of ordinary wood alcohol.

Both isopropyl and methyl alcohols have been tested against ethyl alcohol in the preparation of reagents, and in histological work done with such reagents and stains, as well as in the preservation of museum specimens. No differences could be detected in favor of either of them, except that the methyl alcohol proved much more satisfactory as a dehydrating agent.

In addition to the advantage that methyl and isopropyl alcohols have of being free from vexatious regulations and the danger of irregular use, they possess the additional merit of competing in price with the tax-free commercial ethyl alcohol.

LAWRENCE E. GRIFFIN
REED COLLEGE

IRIDESCENT CLOUDS

ON the afternoon of January 21, beginning before four and lasting perhaps an hour, an unusual set of iridescent cloud phenomena was seen in the southwest. Low in the sky, partly hiding the sun, were thick clouds edged with brilliant gold, which remained practically stationary. Higher up the sky was for the most part clear, with occasional cirro-cumulus clouds, many finger-shaped and pointing downward to a point north of the sun. The edges of these clouds were quite definite, and surrounding the tips and sides were two or three alternate narrow parallel bands of bright pink and green, the outer band in most cases being pink and the color extending at times 45° from the sun. Some of the clouds showed flocculent edges, giving an appearance of a colored fringe and one cloud broke up entirely into horizontal flecks and disappeared as it passed the zenith. Besides these were detached clouds which showed brilliant iridescent colors throughout the whole. One thin flocculent cloud showed small uniformly distributed flecks of pink and green, a larger one showed four irregular vertical bands of pink and green which covered the whole cloud, several glowed with lurid irregular patches of colors such as are seen in a thin film of oil on water. In one case a small spot of dark rose appeared against a misty blue background, rapidly grew into a pillar of vivid mottled colors, and then stretched out toward the northeast to form a white streamer all the way across the sky, its western portion being bordered with the characteristic pink and green bands.

These colors appear to be characteristic interference effects. Stoney[1] describes almost identical phenomena and states the conditions under which there would be formed crystals of such orientation and thickness that light reflected to the observer from the front and back surfaces of the crystal would produce interference. The explanation based on diffraction which McConnel[2] offers in criticism of Stoney's article does not seem to fit the phenomena observed here. His theory does satisfactorily explain the effects which he observed during a winter spent where similar phenomena were frequent, but there the brightest colors were within a range of from 3° to 7° from the sun and the farthest distance at which he could ever detect any color was 23°. He says that according to Stoney's theory the most brilliant effects might reasonably be expected somewhere about 20°-30° from the sun "for which we should look in vain." There were in this case few if any iridescent colors within the area where he found them most brilliant, and certainly beyond 23° they were very brilliant. It would therefore appear that there are these two different types of phenomenon.

Mabel A. Chase

Mount Holyoke College,
South Hadley, Mass.

QUOTATIONS

THE PROPOSED SUPPRESSION OF THE TEACHING OF EVOLUTION[1]

The mode of origin of species was practically discovered by a little-known German paleontologist by the name of Waagen in 1869, but, like the great discovery of Mendel in heredity, this truth has been long in making its way, even among biologists. Waagen's observations that species do not originate by chance or by accident, as Darwin at one time supposed, but through a continuous and well-ordered process, has since been confirmed by an overwhelming volume of testimony, so that we are now able to asemble and place in order line after line of animals in their true evolutionary succession, extending, in the case of what I have called the édition de luxe of the horses, over millions of years. We speak to the earth from Eocene times onward to the closing age of man, and it always teaches us exactly the same story. These facts are so well known and make up such an army of evidence, that they form the chief foundation of the statement that evolution has long since passed out of the domain of hypothesis and theory, to which Mr. Bryan refers, into the domain of natural law.

Evolution takes its place with the gravitation law of Newton. It should be taught in our schools simply as Nature speaks to us about it, and entirely separated from the opinions, materialistic or theistic, which have clustered about it. This simple, direct teaching of Nature is full of moral and spiritual force, if we keep the element of human opinion out of it. The moral principle inherent in evolution is that nothing can be gained in this world without an effort; the ethical principle inherent in evolution is that the best only has the right to survive; the spiritual principle in evolution is the evidence of beauty, of order, and of design in the daily myriad of miracles to which we owe our existence. This is my answer to Mr. Bryan's very natural solicitude about the influence of evolution in our schools and colleges—a solicitude not inherent in the subject itself, but in the foolishness and conceit of certain of the teachers who are privileged to teach of the processes of life.

It would not be true to say that the evolution of man rests upon evidence as complete as that of the horse, for example, because we have only traced man's ancestors back for a period of 400,000 years, as geologic time was conservatively estimated in 1893 by Secretary Walcott of the Smithsonian Institution, Washington; whereas, we have traced the horse back for a period of 3,000,000 years, according to similar estimates of geologic time.

The very recent discovery of Tertiary man, which I have just described in *Natural History* (November-December, 1921), living long before the Ice Age, certainly capable of walking in an erect position, having a hand and a foot fashioned like our own, also a brain of suffi-

[1] *Phil. Mag.*, s. 5, Vol. 24, p. 87.

[2] *Phil. Mag.*, s. 5, Vol. 24, p. 423.

[1] Extracts from articles in the New York *Times* for March 5, in answer to the article by Mr. Bryan from which extracts were printed in the last issue of Science.

cient intelligence to fashion many different kinds of implements, to make a fire, to make flint tools which may have been used for the dressing of hides as clothing, constitutes the most convincing answer to Mr. Bryan's call for more evidence. It once more reminds us of the ignorance of man of the processes of Nature, and sets a new boundary beyond which digging in the earth for more of truth must be directed. This Foxhall man, found near Ipswich, England, thus far known only by the flint implements he made and his fire, is the last bit of evidence in the direction of giving man a descent line of his own far back in geologic time. It tends to remove man still further from the great lines which led to the man apes, the chimpanzee, the orang, the gorilla and the gibbon. This is not guess work, this is a fact. It is another truth which we shall have to accept regardless of its effect. No naturalist has ever ventured to place man so far back in geologic time as this actual discovery of the Foxhall man places him. In this instance again truth is stranger than hypothesis or speculation.

Nearer to us is the Piltdown man, found not far from 75 miles to the southwest of Ipswich, England; still nearer in geologic time is the Heidelberg man, found on the Neckar River; still nearer is the Neanderthal man, whom we now know all about—his frame, his head form, his industries, his ceremonial burial of the dead, also evidence of his belief in a future existence; nearer still is the Cro-Magnon man, who lived about 30,000 years ago, our equal if not our superior in intelligence. This chain of human ancestors was totally unknown to Darwin. He could not have even dreamed of such a flood of proof and truth. It is a dramatic circumstance that Darwin had within his reach the head of the Neanderthal man without realizing that it constituted the "missing link" between man and the lower order of creation. All this evidence is to-day within reach of every schoolboy. It is at the service of Mr. Bryan. It will, we are convinced, satisfactorily answer in the negative his question: "Is it not more rational to believe in the creation of man by separate act of God than to believe in evolution without a particle of evidence?"

HENRY FAIRFIELD OSBORN

Is it any more degrading to hold that man was made through a long line of animal ancestry than to believe that he was made directly from the dust? Surely the horse and the dog and the monkey belong to higher orders of existence than do the clod and the stone. Whether we accept the teachings of evolution or the most literal interpretation of the Biblical account we are compelled to recognize the fact that our bodily origin has been a humble one; as Sir Charles Lyell once said, "It is mud or monkey." But this lowly origin does not destroy the dignity of man; his real dignity consists not in his origin but in what he is and in what he may become.

If only the theological opponents of evolution could learn anything from past attempts to confute science by the Bible they would be more cautious. It was once believed universally that the earth was flat and that it was roofed over by a solid "firmament," and when scientific evidence was adduced to show that the earth was a sphere and that the "firmament" was not a solid roof, it was denounced as opposed to the Scriptures. Those who have visited the Columbian Library in the Cathedral of Seville will recall the Bible of Columbus with marginal notes in his own handwriting to prove that the sphericity of the earth was not opposed to the Scriptures, and a treatise written by him while in prison to pacify the Inquisition. To-day only Voliva and his followers at Zion City maintain that the earth is flat, and the heavens a solid dome, because this is apparently taught by the Scriptures.

The central position of the earth in the universe with all heavenly bodies revolving around it was held to be as certain as holy writ. All the world knows the story of "Starry Galileo and His Woes" at the hands of the Inquisition, but the Copernican theory was opposed not only by the Roman Catholic Church, but also by the leaders of the Reformation. Martin Luther denounced it as "the work of a fool"; Melanchthon declared that it was neither honest nor decent to teach this pernicious doctrine, and that it should be repressed by severe measures, and John Wesley declared that it "tended toward infidelity." Even as late as 1724 the Newtonian theory of gravity was assailed by eminent authorities as "atheistic," since "it drove God out of His universe and put a law in His place."

The conflict between geology and Genesis as to the days of creation and the age of the earth lasted until the middle of the last century, and students of Dana's geology will recall the reconciliation between the two which that great man devoutly undertook. But, by the ultra-orthodox, he and other Christian geologists were denounced as infidels and as impugners of the sacred record. It took three hundred years to end this conflict, if it may be said to be wholly ended now, but certainly no intelligent person now believes that the earth was made just 5,926 years ago and in six literal days.

And now comes Mr. Bryan in this twentieth century of enlightenment preaching a new *auto de fe,* attempting to establish an inquisition for the trial of science at the bar of theology! He proposes to prohibit the teaching of evolution by fine and imprisonment, to repeal a law of nature by a law of Kentucky. He proposes to gather into the fold of his narrow theology all existing public and private schools, colleges and universities and to allow evolutionists and agnostics to found their own schools. In view of the fact that, with the exception of a few sectarian institutions, all our colleges and universities are dedicated to "the increase and diffusion of knowledge among men," that for a generation at least they have turned away from the teaching of dogmatic theology to the cultivation of science, literature and art, that they have during this period received great benefactions for the expressed or implied purpose of carrying on this work in the spirit of freedom to seek, to find and to teach the truth as God gives men to see the truth—in view of these considerations it may well be asked whether it would not be more fitting for Mr. Bryan to establish his own institution for teaching his own views of science and theology, as Dowie, for example, did at Zion City, rather than to attempt to convert existing institutions to that purpose.

Scientific investigators and productive scholars in almost every field have long since accepted evolution in the broadest sense as an established fact. Science now deals with the evolution of the elements, of the stars and solar system, of the earth, of life upon the earth, of various types and species of plants and animals, of the body, mind and society of man, of science, art, government, education and religion. In the light of this great generalization all sciences, and especially those which have to do with living things, have made more progress in the last half century than in all the previous centuries of human history. Even progressive theology has come to regard evolution as an ally rather than as an enemy.

In the face of all these facts, Mr. Bryan and his kind hurl their medieval theology. It would be amusing if it were not so pathetic and disheartening to see these modern defenders of the faith beating their gongs and firing their giant crackers against the ramparts of science.

EDWIN GRANT CONKLIN

NOTES ON WOODS

WEST INDIAN BOXWOOD

THERE has been much confusion regarding the identity of the so-called West Indian boxwoods. One of the first on the market was the "amarillo" of Venezuela, *Aspidosperma Vargasii* DC. (Apocynaceæ), but this has been very largely superseded by the "zapatero," *Casearia præcox* Griseb. (Samydaceæ or Flacourtiaceæ). A third, the "baitoa" of San Domingo, appears on the market in considerable quantity, though it is inferior in quality to the other two. It has just been determined that this wood is produced by *Phyllostylon brasiliensis* Capanema (= *P. rhamnoides* Taubert = *Samaroceltis rhamnoides* Poisson) of the family Ulmaceæ. It occurs not only in Hispaniola and eastern Cuba but also in Brazil and Argentina. The important distinguishing features of this wood are as follows: (1) About half of the vessels are filled with calcium carbonate. (2) The wood fibers are supplied with a thick gelatinous layer. (3) The vessel segments, wood parenchyma strands and some of the rays are in horizontal seriation. The "ripple marks" are not always distinct in the wood but are readily visible on the surface of the inner bark. (See Bul. Tor. Bot. Club, 48: 297-306).

The statement, which appears so persistently in books, that West Indian boxwood is supplied by *Tabebuia* (*Tecoma*) *pentaphylla* B. & H. f. (Bignoniaceæ), is incorrect. Authentic specimens of the wood of this species have been examined by the writer and they have none of the characters of a boxwood. This error arose in 1884 and was due to an improper identification of a specimen of "zapatero" in the Royal Botanic Gardens, Kew. The correct identity of this wood was established twenty years later but the error persists. (See Kew Bul. Misc. Inf., 1904, pp. 11-12, and 1914, pp. 214-219).

BRAZILIAN TULIP-WOOD

THIS beautiful wood has been used for a great many years for inlay and cabinet work. In typical specimens the background of yellow is striped with rose-red; in others the red predominates. In a paper on "Storied or tierlike structure of certain dicotyledonous woods" (Bull. Tor. Bot. Club, 46:260) the writer made this statement:

"The only representative of the Lythraceæ included in the list is *Physocalymma scaberrimum* Pohl, variously known as Brazilian tulip-wood, rose wood, 'páo de rosa,' 'cego machada,' 'grão de porco' and 'sebastião de arruda.' Writers all seem to be in agreement in referring this wood to the species mentioned, but the specimens examined by the writer, which are evidently the same as those described by Wiesner (Rohstoffe d. Pflanzenreiches, 2:975), appear to belong to the Leguminosæ. They certainly do not resemble other available material of the Lythraceæ."

Very recently, through the courtesy of the New York Botanical Garden, the writer had opportunity to study the wood of *Physocalymma* and was enabled to determine positively that the Brazilian tulip-wood of commerce is not of that genus. Unquestionably it is a legume but exact identification is not at the moment possible.

COFFEE-WOOD

THE wood principally used in the manufacture of umbrella handles comes mostly from Venezuela where the name "granadillo" seems to be applied to it. In the New York trade it is known as "coffee-wood" or "brown ebony"; also as "mesquite." In European markets it is called "partridge-wood." All of these names, with the exception perhaps of "coffee-wood," are also applied to entirely different woods.

The identity of this wood has not been positively determined, but from the evidence at hand it appears to be *Cæsalpinia Ebano* Karst. This wood is known as "ebano" in Venezuela as is also that of *C. punctata* Willd. The writer has not had opportunity to examine the latter but the structure and properties of *C. Ebano* agree very closely with that of the wood on the market.

It is said that part of the trade is supplied by a wood from Mexico but no samples known to be of this source are available for comparison.

ROSEWOOD

THERE are many woods on the market under the name of "rosewood." Some derive the name from the scent of the wood, others from the color, and still others for no apparent reason at all.

The Surinam rosewood or "rozenhout" owes its name to its fragrance and is the source of an essential oil of commerce. The identity of this wood has only recently been established by Gonggrijp (De Indische Mercuur, Apr. 23 and 20, 1920) as *Aniba* sp. (near *panurensis* Mez.).

The true Brazilian rosewood has been variously ascribed to the genera *Jacaranda, Dalbergia,* and *Machærium.* The first is an error arising from a confusion of the local name, "jacarandá," with the generic. A specimen of the true rosewood collected by Mr. H. M. Curran with botanical specimens has been identified as *Dalbergia nigra* Fr. All. Certain varieties are recognized in the trade, based largely on variations in color, but the structure indicates a single species. There are other woods called "jacarandá" in Brazil which are likely species of *Machærium* but they lack the scent of the true rosewood and are distinct in structure from it.

The botanical status of the Honduras "rosewood," which is considered the best wood in the world for xylophone bars, has not been determined. It is unquestionably one of the Leguminosæ and may prove to be a species of *Dalbergia*.

COCOBOLO

THIS wood, which is used so extensively in the manufacture of knife handles, comes from Panama, Costa Rica, Nicaragua and Mexico. The tree in Panama has been positively determined as *Dalbergia retusa* Hemsley, and the wood is exported as "rosewood"; the Nicaraguan species is *Dalbergia hypoleuca* Pittier in ed. and is locally known as "nnambar"; that of Mexico, called "granadillo," is very likely a new species.

Workmen in factories where cocobolo is used are likely to suffer from an acute dermatitis resembling ivy-poisoning. Many are apparently immune while others are highly susceptible. A person once infected becomes more rather than less susceptible to the poison. The only known means of infection is through the fine dust arising in working the wood. Some investigators believe the irritation is due to an oil, others to an alkaloid. (See Raw Material, 4: 11: 402-406, November, 1921, for fuller account). According to Boorsma (L'Institut Botanique de Buitenzorg, 14: 19, 1902) small amounts of alkaloid occur in the following species: *Dalbergia litoralis* Hassk, *D. Junghuhnii* Benth., and *D. Championii*.

The East Indian satinwood, *Chloroxylon Swietenia* DC., causes a dermatitis very similar to that from cocobolo. (See Cash, Brit. Med. Jour., Oct. 7, 1911). An alkaloid, chloroxylin, has been found which is considered to be the source of the infection. (Manson Ault, J. Chem. Soc. 1909, 95:964).

"REDWOOD" AND SATINÉ

THE "redwood" or "quira" of Panama has been determined to be *Platymiscium dubium* Pittier. A wood of similar structure from Nicaragua is on the New York market under the name of "Yama cocobolo" or "Yama rosewood." It is also called "leather-wood."

The "redwood" of Brazil is from the tree named *Brosimum parænse* by Huber. It is known locally as "muirapiranga" and "conduru de sangue" and is similar to the Peruvian "palo de sangre." It is not now on our market but dealers are in receipt of samples which indicate that it may be expected. The name of "Brazilian cardinal wood" has been suggested for it. It has good cabinet qualities and retains its bright red or cardinal color. It is much like, and may prove to be identical with, the "satiné" or "bois de féroles" of French Guiana. Owing to the confusion of the names "bois de féroles" with the generic name *Ferolia*, the satiné has been incorrectly ascribed to *Ferolia* (*Parinarium guaianensis* Aubl. (Rosaceæ). (See Stone's "Les bois utilés de la Guyane Francaise." Ann. d. Musee Col. de Marseille, 1917).

Wood specimens of satiné rulianné have been received from the Forest Service of Surinam and agree perfectly with the material described by Stone (*loc. cit.*) under that name. Leaves and twigs from the same tree as the wood specimens have been examined by Dr. Standley of the Smithsonian Institution and he says that the material agrees best with *Brosimum paraense* Huber, though in the absence of fruit (which the Conservator of Forests has undertaken to procure) such identification is only provisional. If this identification proves to be correct it will likely follow that Aublett's *Ferolia guianensis* is a synonym, since his description seems to fit this tree.

The satiné rubanné growing in the tropical rain forest of Surinam attains a diameter of two feet and has a white latex in the bark. The Arowak Indians call it "oolemeriballi," "warimiaballi," and "sokonéballi," while the negro letterwood-hunters have named it "ajeersi," meaning "it looks like it," that is, it looks like the letterwood or snakewood (*Piratinèra guianensis* Aubl.).

KAKATARA-BALLI

THIS is a dull-white wood of British Guiana described by Stone and Freeman as No. 46 in their list of Timbers of British Guiana. A microscopic examination reveals that the ground mass is composed of spiral fiber-tracheids, the vessels have scalariform perforations with many bars, and the rays are large and composite or heterogeneous. The natural conclusion is that this wood must be from some species of *Ilex*.

This finding has since been confirmed by the Forestry Officer of British Guiana.

SAMUEL J. RECORD
YALE UNIVERSITY

SPECIAL ARTICLES

GENETICS OF THE VIENNA WHITE RABBIT

IN the second edition of his text-book[1], Dr. Erwin Baur described a cross between two white varieties of rabbit which produced colored young. One of the white varieties is the familiar pink-eyed albino, the other is called Vienna White and is described by Baur as differing from the albino variety only in the color of the eyes, which are blue. He explains the production of colored young in this cross as due to the complementary action of two independent color factors, like the well known cases among plants in which a cross between two white-flowered varieties produces progeny bearing colored flowers.

It happens that the colored young rabbit figured by Baur as resulting from the cross was Dutch marked, and this led Punnett to suppose that the blue-eyed white parent was really a Dutch rabbit in which the white areas had attained a maximum extension so as to cover the entire coat. This interpretation seemed reasonable to me until I recently obtained in some breeding experiments animals similar to Baur's Vienna Whites, when it became clear that they have no relation to Dutch marking, and also that the relation of Vienna White to albinism is much closer than Baur had supposed.

The color factor of Vienna White is in fact an allelomorph of albinism. If Baur had used in the cross with Vienna White an albino whose parents were *yellow,* he would not have obtained colored young but only blue-eyed whites or albinos, which result would have shown that the two white varieties are not due to complementary factors but to allelomorphic conditions of one and the same factor.

The case is strictly analogous with that of the silver agouti guinea-pig as worked out by Castle and Wright[2] several years ago. The so-called color factor has in guinea-pigs several allelomorphic states, as shown by Wright. The two with which we were then concerned produce respectively (1) the ordinary albino or all-white coat associated with pink-eyes and (2) a condition in which the coat develops black pigment but no yellow pigment, and the eyes are red, not pink. By suitable crosses the gene for yellow coat can be introduced into the red-eyed variety. But since (1) the gene for yellow inhibits the development of *black* pigment in the coat and (2) the gene for red-eye (the color allelomorph) inhibits the development of *yellow* in the coat, it follows that the coat, in what is genetically a red-eyed yellow animal, contains *neither* black nor yellow pigment and so is white. Only the red eye-color then serves to distinguish the animal from an albino. It is in fact a red-eyed white in appearance, but genetically is a red-eyed yellow and if crossed with yellow animals will produce yellow young.

Now in rabbits we have a strictly parallel situation. The chinchilla[3] rabbit corresponds with the red-eyed silver agouti guinea-pig. Its coat contains black pigment but not yellow. If we cross chinchilla with albino, we obtain chinchilla young, not gray, indicating that chinchilla and albinism are allelomorphs, not complementary factors. If the albino parent carries the gene for yellow coat, then in F_2 we obtain chinchillas, albinos, and "blue-eyed whites." The last are obviously yellow chinchillas. I have not been able to obtain as yet the Vienna White variety from Europe, but those who have them can easily put this interpretation to the test by crossing Vienna White with a yellow coated variety. If my interpretation is correct, they will obtain yellow young from the cross.

[1] Einführung in die experimentelle Vererbungslehre, Berlin, 1914.

[2] Carnegie Institution of Wash., Publ. No. 241, 1916.

[3] Castle, W. E., Genetics of the chinchilla rabbit, SCIENCE, April 22, 1921.

But the reader may inquire, how was it that Baur obtained a black-coated rabbit by crossing Vienna White with albino. The answer is that the rabbit which he figured was not an ordinary black but a *black chinchilla.* Examined critically the coat would, I think, have been found to be not jet black, but sepia, and the eyes to give a red reflection indicating less heavy pigmentation than ordinary black. Baur gives evidence of the less heavy pigmentation of the eye in Vienna White by calling the eye "blue." We have noted the same fact in guinea-pigs but have stressed the increased red reflection in calling the eye "red." The non-agouti red-eyed guinea-pig has been called "sepia" by Wright to distinguish it from ordinary black. Similarly one might call the black chinchilla rabbit "sepia." I have obtained such individuals in F_2 from the cross of chinchilla with albino.

W. E. Castle

Bussey Institution,
February 16, 1922.

THE AMERICAN SOCIETY OF AGRONOMY

The program of the annual meeting held at New Orleans, La., November 7-8, 1921, was as follows:

Monday, November 7

Symposium on Nitrogen in Its Relation to Soils and Crops

Leader: J. G. Lipman

Our inventory of soil nitrogen: C. F. Marbut.

The effect of timothy on the disappearance of nitrates: James A. Bizzell.

Nitrogen economy in soils: Firman E. Bear.

The nitrogen inventory as affected by livestock versus grain farming: C. G. Williams.

Green manuring in relation to the nitrogen content of soils: M. J. Funchess.

Nitrogen in relation to crop production in the Middle West: S. D. Conner.

The influence of calcic magnesic materials upon the outgo of nitrates in lysimeter leachings: W. H. MacIntire.

A glance at the present and future supplies of fertilizer nitrogen: S. B. Haskell.

Agricultural and commercial values of nitrogenous plant foods: A. W. Blair.

Monday Evening

Annual dinner. Presidential address: "The agronomic placement of varieties," Chas. A. Mooers, agronomist and vice-director, Tennessee Agricultural Experiment Station.

Tuesday, November 8

Symposium on Teaching Crops and Soils Courses.
Leader: L. E. Call.

Some of the teaching problems of the Southern agronomist: J. R. Fain.

Progress in standardizing the elementary courses in soils: M. F. Miller.

A plea for experimental work on methods in crops teaching: S. B. Haskell.

What should constitute the recitation work of a five-year course in elementary farm crops: W. C. Etheridge.

Report of the committee on intercollegiate crops contests: A. C. Arny.

Tuesday Afternoon

General Agronomic Papers.

The terminology of the subdivisions of agriculture and some of the broader factors relating to plant production: C. V. Piper.

The salt requirements of agricultural plants: A. G. McCall.

The standardization of field experiments: A. T. Wiancko.

The control of cotton diseases by the use of potash fertilizers: L. E. Rast.

The influence of fertilizers on yield and maturity of soybeans: Geo. L. Schuster.

A new muck soil problem and its solution: M. E. Sherwin, R. B. Etheridge, A. Dunham.

Soil types as a basis for soil investigations: P. E. Brown.

The potassium-nitrogen ratio of red clover as influenced by potassic fertilizers: Paul Emerson, John Barton.

The following were elected officers of the society for the ensuing year:

L. E. Call, Manhattan, Kansas, *president.*

D. E. Stephens, Moro, Oregon, *first vice-president.*

A. B. Conner, College Station, Texas, *second vice-president.*

P. E. Brown, Ames, Iowa, *secretary-treasurer.*

C. A. Mooers, Knoxville, Tenn., *representative on the Council of the A. A. A. S.*

C. F. Marbut, Washington, D. C., *representative to the National Research Council.*

P. E. Brown,
Secretary

SCIENCE

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Vol. LV MARCH 17, 1922 No. 1420

DOCTORATES CONFERRED IN THE SCIENCES BY AMERICAN UNIVERSITIES IN 1921

THROUGH the generous cooperation of the registrars of the various American universities granting doctorates in the sciences, the Research Information Service of the National Research Council is able to offer the following compilation of doctorates granted during the collegiate year 1920-1921. Through this same cooperation statistics are now available for the period 1916-1919. The information for these three years has not been compiled heretofore and therefore was lacking in the tables as published last year (SCIENCE, 52, 478, 514). These figures are of value as an indication of the academic activity during the World War. As would be expected, the number of doctorates fell off as the size of the American army increased (1917, 372; 1918, 293; 1919, 180). This is a confirmation of the acknowledged fact that the scientific men of the country played an increasingly important part in the activities of the army and navy.

In 1921 there were 332 doctorates conferred in the natural sciences by 32 institutions, as compared with 323 by the same number of institutions in 1920. (The figures reported in 1920 by institutions and by subjects have been corrected in certain cases from later information). It is interesting that the figures for 1917 should be so much higher than those for any other year reported in the tables. How long will it be before those figures are again reached?

Marked changes in the order of institutions are in the shift of Minnesota from nineteenth place in 1920 to tenth place in 1921, and of George Washington from tenth place in 1920 to twenty-sixth place in 1921. Comparisons of this kind are of uncertain significance because the number of degrees granted by an institution during any collegiate year depends upon many factors.

DOCTORATES CONFERRED IN THE SCIENCES BY AMERICAN UNIVERSITIES

	'12	'13	'14	'15	'16	'17	'18	'19	'20	'21
Chicago	37	16	28	53	53	39	55	28	43	42
Cornell	28	30	36	26	24	38	30	21	35	33
Columbia	36	27	21	27	34	37	24	11	24	27
Yale	21	19	13	20	24	25	9	4	23	27
Harvard	15	22	28	33	16	39	15	14	28	25
California	12	9	11	16	17	23	16	16	14	22
Johns Hopkins	23	21	18	23	22	24	7	7	21	21
Illinois	15	11	18	17	26	24	23	15	22	19
Wisconsin	14	5	17	8	22	17	16	9	24	15
Minnesota	2	2	3	4	7	9	10	8	4	16
Ohio State	5	0	0	1	2	8	7	3	6	8
Princeton	7	7	7	4	19	5	8	3	10	8
Iowa	3	2	2	2	2	3	9	4	5	7
Mass. Inst. Tech.	6	1	2	2	3	4	4	1	8	7
Michigan	8	10	5	15	10	13	8	4	9	7
Clark	6	13	7	10	9	12	4	5	4	6
Pennsylvania	9	9	5	11	16	7	10	8	5	5
Stanford	3	5	2	2	0	4	0	2	4	5
Brown	4	1	4	5	2	3	9	2	2	4
Nebraska	0	2	1	3	0	2	1	2	0	4
New York	2	3	1	3	0	6	0	2	2	4
Radcliffe	0	0	0	0	0	1	0	1	1	3
Washingt'n Univ.	1	3	1	5	0	2	2	1	3	3
Bryn Mawr	3	0	2	0	3	2	1	1	1	2
Cincinnati	1	2	2	0	2	1	1	1	2	2
Geo. Washington	2	1	2	4	5	8	3	3	9	2
N. Carolina	0	0	1	2	2	0	1	1	0	2
Pittsburgh	1	5	0	4	0	5	1	2	2	2
Catholic	1	0	0	2	1	2	4	0	1	1
Indiana	4	1	2	4	3	2	4	1	5	1
Kansas	0	0	0	0	0	0	0	0	1	1
Syracuse	0	0	0	0	0	0	4	0	2	1
Missouri	0	1	1	1	3	2	3	0	2	0
Northwestern	0	0	0	1	3	3	2	0	0	0
Notre Dame	-	-	-	-	-	0	1	0	0	0
Washington	-	-	-	-	-	0	1	0	0	0
Virginia	2	2	1	0	2	1	0	0	1	0
Boston	1	2	0	0	0	1	0	0	0	0
Totals	273	234	241	309	332	372	293	180	323	332

DOCTORATES DISTRIBUTED ACCORDING TO SCIENCES

	'12	'13	'14	'15	'16	'17	'18	'19	'20	'21
Chemistry	78	68	71	85	115	108	75	54	96	134
Zoology	20	26	25	32	33	30	33	24	38	36
Botany	30	28	34	40	36	37	39	23	48	29
Physics	30	22	23	31	35	32	17	18	19	28
Psychology	29	24	12	22	19	32	30	21	38	26
Bacteriology	6	3	6	4	4	11	11	6	7	19
Mathematics	22	21	25	23	34	30	23	7	19	16
Geology	23	14	13	26	17	24	14	5	17	11
Physiology	12	2	8	8	14	18	11	1	13	8
Astronomy	2	11	2	7	6	5	0	1	4	5
Geography	0	1	0	3	3	3	1	0	3	5
Anatomy	6	1	2	5	1	3	5	0	3	4
Anthropology	0	3	2	6	1	4	2	0	2	4
Agriculture	11	8	9	9	6	19	18	12	8	3
Metallurgy	0	0	0	1	1	0	1	1	0	2
Engineering	2	0	4	2	2	5	4	1	5	1
Pathology	2	2	1	2	2	6	8	6	3	1
Mineralogy	0	0	0	1	0	0	0	0	0	0
Meteorology	0	0	0	0	0	1	1	0	0	0
Paleontology	0	0	4	2	3	4	0	0	0	0
Totals	273	234	241	309	332	372	293	180	323	332

THESES DISTRIBUTED ACCORDING TO SUBJECT

Agriculture

CORNELL: Charles Loring Allen, "Effect of age of sire and dam on the quality of offspring in dairy cows."

ILLINOIS: Jacobus Stephanus Marais, "Comparative agricultural value of phosphates of aluminium, iron and calcium." William Barbour Nevens, "Amino acid content and nutritive value of proteins of cottonseed meal."

Anatomy

MINNESOTA: Leroy Adelbert Calkins, "Morphometry of human fœtus with special reference to obstetric dimensions of the head." Homer Barker Latimer, "Postnatal growth of the body. Systems and organs of the single-comb Leghorn chicken." John Charmley McKinley, "Intraneural plexus of fasciculi and fibers in the sciatic nerve." Hjalmar Laurits Osterud, "Postnatal growth and development of reproductive tract in female albino rat."

Anthropology

CALIFORNIA: Guy Montgomery, "Studies in primitive folksong." Eda Lou Walton, "Navaho traditional poetry."

HARVARD: Andrew Affleck Kerr, "Similarities in material culture between old and new world." Samuel Kirkland Lothrop, "Ceramics of northern Costa Rica and western Nicaragua."

Astronomy

CALIFORNIA: Priscilla Fairfield, "Indeterminate cases of the orbit problem." Hamilton Moore Jeffers, "Investigation of the orbits of the two components of Taylor's comet (1916 I)." Jessica May Young, "Cause of the non-appearance of certain periodic comets on their predicted returns."

CHICAGO: Alice Hall Farnsworth, "Comparison of photometric fields of 6-inch doublet, 24-inch reflector and 40-inch refractor with some investigation of the astrometric field of the reflector." Edison Pettit, "Form and motions of solar prominences."

Bacteriology

CALIFORNIA: Laurence Fleming Foster, "Growth, viability and metabolism of *Streptococcus hemolyticus*."

CHICAGO: Paul Roberts Cannon, "Effects of diet on the intestinal flora." John Everett Gordon, "I. Relationship of pneumococcus to acute infections of upper respiratory tract in man. II. Gram negative cocci in acute infections of the upper respiratory tract." Bernard Wernick Hammer, "Volatile acid production of *S. lac-*

ticus and the organisms associated with it in starters."

CORNELL: Aaron Bodansky, "Enzyme studies on *Solanum elæagnifolium.*" Charles Milton Carpenter, "Bacteriology of female reproductive organs of cattle and its relation to diseases of calves." Harrison August Ruehe, "Effect of the process of manufacture on germ content of bulk condensed milk." William Alonzo Whiting, "Possible relationship existing between the grouping of bacteria in market milk and the utensil flora."

HARVARD: Boris Aronovitch, "Soluble toxic substances produced by the organisms of the colon-typhoid group." George Hoyt Bigelow, "Allergy in pneumonia as evidenced by intracutaneous reaction." Leland David Bushnell, "Bacteria found in spoiled canned asparagus." Dwight Lewis Sisco, "Epidemiological study of food poisoning."

JOHNS HOPKINS: Howard Benjamin Cross, "Phagocytosis in relation to terminal infections."

KANSAS: Noble P. Sherwood, "Studies on complement."

MASSACHUSETTS INSTITUE OF TECHNOLOGY: Murray Philip Horwood, "Investigation of public health and sanitation of certain urban communities in Oklahoma."

MINNESOTA: Winifred Mayer Ashby, "Destruction of transfused blood in normal subjects and in pernicious anemia patients."

YALE: Harry Asher Cheplin, "Transformation of intestinal flora with special reference to the implantation of *Bacillus acidophilus.*" Barnett Cohen, "Effects of temperature and hydrogen ion concentration upon viability of *Bacterium coli* and *B. typhosum* in suspensions in water." Charles Shelby Gibbs, "Factors that govern production of diphtheria toxin in artificial culture media."

Botany

CALIFORNIA: Frederick Monroe Essig, "Morphology, development and economic aspects of *Schizophyllum commune* Fries." Alice Maria Ottley, "Revision of Californian species of *Lotus.*" Albert Julius Winkler, "Internal browning of the yellow Newtown apple."

CHICAGO: Scott Verne Eaton, "Sulfur content of soils and its relation to plant nutrition." Hope Sherman, "Respiration of dormant seeds." Perry Daniel Strausbaugh, "Dormancy in the plum."

CORNELL: Sarkis Boshnakian, "Genetics of squareheadedness and of density and the relations of these to other characteristics in wheat." James Marshall Brannon, "Influence of certain sugars on plants with particular reference to dextrose and levulose." William Moore, "Spreading and adherence of arsenical sprays." Harry Ashton Phillips, "Effect of climatic conditions on fruit trees in relation to blooming and ripening dates." Thomas Wyatt Turner, "Mechanism of physiological effects of certain mineral salts in altering the ratio of top growth to root growth in seed plants." Thomas Kennerly Wolfe, "Biometrical study of characters in maize."

HARVARD: Edward Franklin Gaines, "Genetics of bunt resistance in wheat." Felix Gustaf Gustafson, "Respiration of certain lower fungi." Herbert Kendall Hayes, "Inheritance in wheat and maize. I. Inheritance of seed and spike characters in crosses between varieties of *Triticum vulgare* Vill. II. Production of high protein maize by Mendelian methods. III. Critical analysis of methods of maize breeding." Ondess Lamar Inman, "Respiration as related to injury and recovery." James Plummer Poole, "Comparative anatomy of the leaf of the Cycads with reference to the cycadofilicales."

ILLINOIS: Cecil Frederick Patterson, "Growth in seedlings of *Phaseolus vulgaris* in relation to humidity and temperature."

INDIANA: Flora Charlotte Anderson, "Development of flower and embryogeny in *Martynia Louisiana* Mill."

IOWA: Raymond Albert French, "Apogamous reproduction of *Lactuca Ludovinciana* (Nutt) Riddell."

MICHIGAN: Carl Downey LaRue, "Results of selection within pure lines of *Pestalozzia guepini* desm."

MINNESOTA: Paul Work, "Effects of nitrate of soda on the nutrition of the tomato."

PENNSYLVANIA: Charles Homer Arndt, "Growth of field corn as affected by iron and aluminium salts."

STANFORD: L. J. M. BAAS-BECKING, "Origin of vascular structure in the genus *Botrychium.*"

WASHINGTON UNIVERSITY: Robert William Webb, "Germination of spores of certain fungi in relation to hydrogen ion concentration." George Miller Armstrong, "Sulfur nutrition of fungi as affected by hydrogen ion concentration."

WISCONSIN: Eloise Gerry, "Oleoresin production: Microscopic study of effects produced on the woody tissues of southern pines by different methods of turpentining." James Geere Wickson, "Value of certain nutritive elements in development of the oat plant and their relation to chemical composition of grain and straw."

Yale: Albert Frederick Hill, "Vegetation of Penobscot Bay Region, Maine."

Chemistry

Brown: Samuel Reed Damon, "Bacteria as source of the growth-promoting principle, water-soluble B; identity of water-soluble B and the antineuritic vitamine."

California: Dwight Cooley Bardwell, "Hydrogen as a halogen in metallic hydrides." Theophil Frederic Buehrer, "Critical solution temperatures of white phosphorus with various liquids." Paul Steere Burgess, "Drained marsh soil, unproductive for peas." William Henry Hampton, "Potential of the iron electrode." Thorfin Rustin Hogness, "Surface tensions and densities of liquid mercury, cadmium, zinc, lead, tin, and bismuth." Sherwin Maeser, "Physical and chemical properties of some tertiary amine-oxide derivatives."

Chicago: Steward Basterfield, "Derivatives of isourea and their pharmacological action." Henry Leon Cox, "Derivatives of linolic acid." Frank Louis DeBeukelaer, "Derivatives of phenylethyl- and phenyldiethylacetic acids." Lillian V. Eichelberger, "Transformation of maleic to fumaric acid." Warren Walter Ewing, "Attraction of mercury for other liquids." Leo Finkelstein, "I. Determination of radium in meteorites by the emanation method. II. Measurement of ranges of alpha particles by modified Bragg apparatus." Aubrey Chester Grubb, "Chemical reactions in the corona." Robert Stern Landauer, "Triatomic hydrogen." Louis Melvin Larsen, "I. Nitrotriphenylamines. II. Oxidation of diaminophenols." George Ross Robertson, "Organic derivatives of arsenic." Frank V. Sander, "Preparation and resolution of *dl*-1, 3-dihydroxybutyric acid." James H. C. Smith, "I. Estimation of sodium hyposulfite. II. Arsenic derivatives of phenylaminoacetic acid." Herman Vance Tartar, "Constitution of murexide and theory of dyes." Harry Benjamin VanDyke, "Study of distribution of iodine in thyroid gland." Edgar Wertheim, "Preparation of *dl-p-sec.*-butylphenylhydrazine. Resolution of *dl-p-sec.*-butylaniline." Ying Chang Cheng, "Cohesion, adhesion, tensile strength, tensile energy, negative surface energy, interfacial tension and molecular attraction."

Cincinnati: Joseph Laurence Donnelly, "Quantitative study of the action of monochloracetic acid upon various amines." Edward Charles Mason, "Pharmacological action of lead in organic combination."

Clark: Charles Buell Hurd, "Equilibria between calcium, hydrogen and nitrogen." Walter William Lucasse, "Specific conductance of concentrated solutions of sodium and potassium in liquid ammonia." Edward Zeitfuchs, "Vapor pressure of mixture of ammonia and xylene in neighborhood of their critical solution temperature. Molecular weight of sodium tellurium complex in liquid ammonia."

Columbia: Howard Adler, "Formation of addition compounds between formic acid and metallic formates; factors affecting stability of these compounds." David John Beaver, "Effect of certain electrolytes on stabilizing and precipitating gold sols." Jacob Julius Beaver, "Compound formation in phenol-cresol mixtures." Mary Letitia Caldwell, "Experimental study of certain diamino acids." Arthur William Davidson, "Formation of addition compounds between sulfuric acid and metallic sulfates." Te Pang Hou, "Iron tonnage." Norma Eva Johann, "Composition of ammonium phosphomolybdate and the determination of phosphorus." Samuel Jacob Kiehl, "Hydration of sodium metaphosphate to orthophosphate in varying concentrations of hydrogen ion at 45°." Victor Kuhn La Mer, "Effect of temperature and concentration of hydrogen ions upon rate of destruction of the antiscorbutic vitamine." Leland Judson Lewis, "Hydrolysis of fats by reagents made from cymene." Ernest Elmer Lyder, "Thermal decomposition of oil shale." Alice R. T. Merrill, "Experimental studies of cystine." Martin Meyer, "Dehydrothiotoluidine, its isomers, homologues, analogues and derivatives." William Alvin Mudge, "Saturated potassium chloride calomel cell." Francisco A. Quisumbing, "Conditions affecting determination of reducing sugars by Fehling solution." Harold Lester Simons, "Mechanism of hydrolysis of sucrose by invertase." Jesse Wilbur Stillman, "Determination of copper by electrolytic deposition." Paul Miller Giesy, "Placental hormone."

Cornell: Archibald Mortimer Erskine, "Reaction between hydrazine and hydrogen peroxide." Axel Ferdinand Gustafson, "Effect of drying soils on water-soluble constituents." Archie Bernhard Hoel, "Edison storage cell." Howard Campbell Jackson, "Neutralization of cream for buttermaking." Stuart Deming Jackson, "*o*-Cresolsulfonphthalein and some of its derivatives." Louise Kelley, "*p*-Hydroxybenzoyl-*o*-benzoic acid and some of its derivatives." Alexander McTaggart, "Influence of certain fertilizer salts on the growth and nitrogen content of some legumes." John Graham Thompson, "Removal of silicon from zirkite ore in the electric furnace."

GEORGE WASHINGTON: Carl D. Garby, "Hydrogen ion concentration and acidity of corn meal undergoing spoilage."

HARVARD: Goodwin LeBaron Foster, "Glucose to nitrogen ratios of the phlorhizinized dog, cat and rabbit and the depancreatized dog." Lee Irvin Smith, "I. Addition reactions of unsaturated ketones. II. Bromination of acetoacetic ester. III. Action of alkalis on nitrocyclopropanes." Charles Phelps Smyth, "Solid thallium amalgams." Benjamin Leslie Souther, "I. Hydroxypyridines. II. δ-Ketonic nitriles." Philip Francis Weatherill, "I. Change in volume of potassium chloride upon solution in water. II. Revision of the atomic weight of silicon."

ILLINOIS: Manson James Bradley, "Decomposition processes applicable to certain products of coal carbonization." John Bernis Brown, "The highly unsaturated fatty acids of fish oils." George Hopkins Coleman, "Action of nitrogen trichloride on ethyl chloride, benzene, toluene and benzyl chloride." Max Shaw Dunn, "Preparation, properties and metabolic behavior of deaminized proteins." Robert Edman Greenfield, "Chemical reactions in water purification using the hydrogen electrode." John Abderdeen Gunton, "Reinvestigation of the proximate composition of *Rhamus frangula*." Leonard Francis Yntema, "Ultraviolet arc spectrum of yttrium."

JOHNS HOPKINS: William Herbert Bahlke, "Vapor pressure of aqueous solutions of lithium chloride at 20° C." David Charles Jones, "Ternary critical solution temperatures as criteria of liquid purity." John Fitch King, "Structure of liquid mixtures from the standpoint of dielectric constant refractive index density." Simon Klosky, "Silica and impregnated silica gels." Isaac Newton Kugelmass, "Rate of solution of colloidal ferric hydroxide." William Lloyd Linton, "Compressibility of liquids and mixed organic liquids." Benjamin Simon Neuhausen, "System ammonia-water as a basis for the theory of the solution of gases in liquids." Hugh Klemme Parker, "Vapor pressure of aqueous solutions of cane sugar at 20° C." Florence Powdermaker, "Prematurely senile rats." James Edwin Sharp, "Proposed method for obtaining a constant measurable surface of mercury for measuring absolute adsorption."

MASSACHUSETTS INSTITUTE OF TECHNOLOGY: John Campbell, "Continuous process for production of perchlorates from alkali chlorides." William Richard Hainsworth, "Effect of high pressures on the hydrogen-calomel galvanic cell." David Burger Joubert, "Equation of state for methane." Max Knobel, "Activities of the ions of potassium hydroxide in aqueous solution." Melville Johnston Marshall, "Heat of adsorption of gases and vapors on charcoal." Charles Baldwin Sawyer, "Nitrogen in steel."

MICHIGAN: Frederick Franklin Blicke, "Quinoidation in the triarylmethyls and in the salt-like derivatives of the triaryl carbinols." Dwight Clark Carpenter, "Anomalous osmose of electrolytes with colloidion membranes." Wesley George France, "Transference numbers of sulfuric acid and the influence of gelatin on transference numbers by the concentration cell method." Roy Kenneth McAlpine, "Atomic weight of antimony." Frederick William Sullivan, Jr., "Diphenyl-α-naphthylmethyl and the color of free radicals." Frederick Hawley Currens, "Separation of old ytterbium from gadolinite."

NEBRASKA: Thos. Jefferson Thompson, "Substituted succinic acids and reactions of benzyl cyanide."

NEW YORK: Ernest Raymond Lilley, "Some relations between petroleum and coals, and their application." Thomas Marshall Smith, "Hydrated oxalic acid as an analytical standard." George Watkins Wilson, "Catalytic oxidation of benzene."

NORTH CAROLINA: Troy Monroe Andrews, "New derivatives of 2, 3, 8-tribromojuglone." Iva Welborn Smithey, "Bromination of 2-amino-*p*-cymene."

OHIO STATE: Carlton Edgar Curran, "Reactions of nitrosophenol and N-chloroquinonimine with aromatic amines." Ora L. Hoover, "Oxidation of acetol." Samuel Morris, "Potassium dichromate and iodine as ultimate standards in analytical chemistry." Charles Ferdinand Rudmann, "Oxidation of methane." Lily Bell Sefton, "Oxidation of acetone and isopropyl alcohol."

PENNSYLVANIA: Ernest Carl Wagner, "Methylation of *p*-aminophenol by formaldehyde."

PITTSBURGH: Harvey Gerald Elledge, "Solubility of the calcium and magnesium salts of palmitic, stearic and oleic acids." Frederick Horace Garner, "Carbonization of lubricating oils in internal combustion engines."

PRINCETON: Robert Martin Burns, "Adsorption of gases by metallic catalysts." Gregg Dougherty, "Hydrogenation of benzene." Charles DeWitt Hurd, "Rearrangements of some new hydroxamic acids related to heterocyclic acids and to diphenyl and triphenylacetic acids." Harvey Alexander Neville, "Catalysis in the interaction of carbon with steam and with carbon dioxide." Robert Norton Pease, "Analysis of molecular volumes from the point of view of the Lewis-Langmuir theory of molecular theory."

RADCLIFFE: Alice Helen Graustein, "Action of halogens and of halogen acids on a δ-ketonic nitrile."

STANFORD: Neil Preston Moore, "Comparative study of fractionating still-heads." Norris Watson Rakestraw, "Chemical factors in fatigue. I. Effect of muscular exercise upon certain common blood constituents."

WASHINGTON: Edwin Blake Payson, "Thelypodium and its immediate allies."

WISCONSIN: Frederick Lincoln Browne, "Thermal chemistry of colloids. II. Heat of coagulation of ferric oxide hydrosol with electrolytes." Alfred E. Koehler, "Protein sulfur." Roland Edward Kremers, "Azulene and other constituents of the volatile oil of milfoil." Henry Baldwin Merrill, "Separation of certain acidic oxides with selenium oxychloride." Frank Wilson Parker, "I. Methods of studying the concentration and composition of the soil solution. II. Classification of the soil moisture." John Henry Schmidt, "Action of arsenic acid and arsenous chloride upon aniline and the preparation of phenarsazine oxide and its derivatives." Hosmer Ward Stone, "Preparation of pure selenic acid; determination of indices of refraction of selenic and selenous acids." Alvin Strickler, "Electric endosmose." William John Trautman, "Reduction of certain compounds by means of silicon."

YALE: Laura Tuttle Cannon, "Condensation of citral with certain ketones and the synthesis of some new ionones." George Raymond Cowgill, "I. Vitamine-B and the secretory functions of glands. II. Relation between vitamine-B and the nutrition of the dog." Edwin John Fischer, "Synthesis of β-chloroallyl chloride from dichlorhydrin." Zalia Jencks Gailey, "Regeneration of blood, with particular emphasis on the iron factor." François Archibald Gilfillan, "Catalytic study of some dehydration and addition reactions of ethyl alcohol." Henry Rudolf Henze, "Factors influencing condensation of hydantoins with compounds containing the carbonyl group." William John Horn, "Mechanism of alkylation in the pyrimidine series." Edward Benedict Hunn, "Utilization of *p*-dichlorobenzene for syntheses in the diphenic acid series." Erwin Burr Kelsey, "Synthesis of thiohydantoins from alkyl-substituted aminoacetanilides." Helen Swift Mitchell, "Choice between adequate and inadequate diets as made by rats and mice." Edith Holloway Nason, "Utilization of oil of cassia for the synthesis of cinnamyl alcohol." William Thornton Read, "Methods of synthesizing hydantoin compounds possessing hypnotic action." Robert Chester Roberts, "Chemical and pharmacological study of some new derivatives of diphenic acid."

Engineering

CORNELL: Nee Sun Koo, "Investigation of the one-hinged steel arch and its comparison with other types."

Geography

CHICAGO: Robert Swanton Platt, "Resources and economic interests of the Bermudas." Helen Mabel Strong, "Geography of Cleveland."

NEW YORK: Alfred Marius Nielson, "Economic geographic conditions influencing seaport development in the U. S."

YALE: George McCutcheon McBride, "Land tenure in Latin America." Stanislaus Thomas Novakovsky, "Climate and weather of the Russian Far East."

Geology

BRYN MAWR: Helen Morningstar, "Fauna of the Pottsville formation of Ohio below the Mercer limestones."

CALIFORNIA: Alfred Russell Whitman, "Re-study of the Cobalt district."

CHICAGO: George Charlton Matson, "Phosphate deposits of Florida."

COLUMBIA: Harold Lattimore Alling, "Mineralography of the feldspars."

IOWA: Walter Henry Schoewe, "Origin and history of the extinct Lake Calvin, Iowa."

JOHNS HOPKINS: Edmund Maute Spieker, "Molluscan fauna of the Zorritos formation of northern Peru."

NEBRASKA: Jerome Benjamin Burnett, "Geological study of northeastern Coahuila, Mexico."

OHIO STATE: Guy Woolard Conrey, "Geology of Wayne County, Ohio."

WISCONSIN: William Oscar Blanchard, "Geonomic interpretation of the cuesta of southwestern Wisconsin." Clifton Sherwin Corbett, "Some hydrous aluminium silicates as schist-making minerals."

YALE: Malcolm Havens Bissell, "Triassic area of the new Cumberland Quadrangle, Pennsylvania."

Mathematics

CALIFORNIA: Nina May Alderton, "Involutory quartic transformation in space of four dimensions." Paul Harold Daus, "Normal ternary continued fraction expansions for the cube roots of integers." Daniel Victor Steed, "Lines on the hypersurface of order $2n$-3 in space of n dimensions."

CHICAGO: Mayme Irwin Logsdon, "Equivalence and reduction of pairs of hermitian forms." Irwin Roman, "Transformation of waves through a symmetrical optical instrument." William L. G. Williams, "Fundamental systems of formal modular seminvariants of the binary cubic." Frank Edwin Wood, "Certain relations between the projective theory of surfaces and the projective theory of congruences."

COLUMBIA: Jesse Douglas, "Certain two-point properties of general families of curves: the geometry of variations."

ILLINOIS: Beulah May Armstrong, "Mathematical induction in group theory." William Edmund Edington, "Abstract group definitions and applications."

IOWA: Eugene Manasseh Berry, "Diffuse reflection."

JOHNS HOPKINS: Flora Dobler Sutton, "Certain chains of theorems in reflective geometry."

PRINCETON: Philip Franklin, "Four color problem."

RADCLIFFE: Rachel Blodgett, "Determination of the coefficient in interpolation formulæ and a study of the approximate solution of integral equations."

SYRACUSE: Jung Sun, "Some determinant theorems."

YALE: Malcolm Cecil Foster, "Rectilinear congruences referred to special surfaces."

Metallurgy

COLUMBIA: Sze-Moo Ling, "Refractory materials from the viewpoint of binary and ternary equilibrium diagrams."

GEORGE WASHINGTON: Raymond W. Woodward, "Manufacture and properties of steel plates containing zirconium and other elements."

Pathology

MINNESOTA: Charles Edward Nixon, "Substance concerned in the colloidal gold test and the nature of the reaction."

Physics

CALIFORNIA: William Harry Bair, "Spectra of some compound gases in a vacuum tube."

CHICAGO: Ira Garnett Barber, "Secondary electron emission from copper surfaces." Otto Koppius, "Comparison of thermionic and photoelectric work-functions in platinum." Louallen Frederick Miller, "Pressure shifts in a calcium arc." John Preston Minton, "Sensitivity of normal and defective ears for tones of various frequencies."

CORNELL: Jacob Roland Collins, "Influence of certain dissolved substances on the infra-red absorption of water." Guy Everett Grantham, "Study of some infra-red absorption spectra." Lewis Richard Koller, "Factors influencing the resistance of sputtered platinum films."

HARVARD: Hector John MacLeod, "Variation with frequency of the loss of energy in dielectrics."

ILLINOIS: Charles Steven Fazel, "Time and pressure measurements in the corona." Charles Francis Hill, "Measurement of mercury vapor pressure by means of the Knudsen pressure gauge."

JOHNS HOPKINS: Gregory Breit, "Behavior of inductance coils at frequencies of radiotelegraphy." Robert Allen Castleman, Jr., "Magnetic rotary dispersion in transparent liquids." Louis Bryant Tuckerman, "Theory of columns of ductile materials." Jan Stephanus van der Lingen, "Fluorescence of mercury vapor." Milton Sheldon Van Dusen, "Thermal conductivity of some heat insulators."

MINNESOTA: John George Frayne, "Anilateral dynamic characteristics of three electrode thermionic amplifiers." Ada Frances Johnson, "Method of measuring ionic mobilities by observations on the self-repulsion of ions." Joseph Valasek, "Piezo-electric activity of Rochelle salt under various conditions."

Nebraska: Leo Gerard Raub, "Study of the cathode fall in helium and argon with wire cathodes."

Ohio State: Alva Wellington Smith, "Measurement of inductance and capacity by an electrometer method. Effect of a superposed constant magnetic field upon the alternating current permeability and energy losses in iron."

Pennsylvania: Anton David Udden, "Ionization potential of selenium."

Princeton: Henry DeWolf Smyth, "Radiating potentials of nitrogen."

Stanford: Frank Clark Hoyt, "Intensities of X-rays of the L-series III. Critical potentials of the platinum and tungsten lines."

Wisconsin: Grover Rawle Greenslade, "Spectral distribution of the energy radiated from metallic surfaces at high temperatures."

Yale: John Stuart Foster, "Relative intensities of the Stark effect components of lines in the spectrum of helium." Elias Klein, "Spark spectrum of gallium in air and in hydrogen." Irvin Henry Solt, "Dispersion of a limited wave train."

Physiology

Brown: Edgar Allen, "Oestrous cycle in the mouse." James Walter Wilson, "Biochemistry of vitamine-A."

Chicago: Thomas Leon Patterson, "Gastric contractions in amphidia and reptilia."

Clark: Samuel Ernest Pond, "Velocity of contraction-wave in muscle."

Columbia: Albert Baird Hastings, "Physiology of fatigue; physico-chemical manifestations of fatigue in blood." Ethel W. Wickwire, "Reciprocal reaction in the cardio-vascular system."

Cornell: John Stephens Latta, "Histogenesis of dense lymphatic tissue of the intestine (Lepus); development of lympathic tissue and blood-cell formation."

Minnesota: Chester Arthur Stewart, "Vital capacity of lungs of children in health and disease."

Psychology

Brown: Sze-Chen Liao, "Quantitative study of non-intellectual elements."

California: Dorothy M. H. Yates, "Study of some high school seniors of exceptional intelligence."

Chicago: Forrest Alva Kingsbury, "Group intelligence scale for primary grades." Helen Lois Koch, "Influence of mechanical guidance upon maze learning." Katherine Eva Ludgate, "Effect of manual guidance upon maze learning." Margaret Wooster, "Certain factors in the formation of new spatial co-ordination."

Clark: Carroll Cornelius Pratt, "Qualitative aspects of bitonal complexes." Matsusaburo Yokoyama, "Affective tendency as conditioned by color and form."

Columbia: Florence Edith Carothers, "Psychological examinations for college freshmen." Margaret Evertson Cobb, "Adenoids and diseased tonsils; their effect upon general intelligence." Herbert Wesley Rogers, "Some empirical tests in vocational selection."

Cornell: Anna Kellman Whitchurch, "Illusory perception of movement on the skin."

Harvard: Harrison LeRoy Harley, "Development of psychological tests for office clerks." Joseph Paul Hettwer, "Studies on the conditioned reflex." William Moulton Marston, "Systolic blood pressure and reaction-time symptoms of deception and of constituent mental states."

Iowa: Cordia C. Bunch, "Measurement of acuity of hearing throughout the tonal range." Glenn Newton Merry, "Voice inflection in speech." Hazel Martha Stanton, "Inheritance of specific musical capacities." Benjamin Franklin Zuehl, "Measurement of auditory acuity with the pitch range audiometer."

Johns Hopkins: Curt Paul Richter, "Behavior of the rat."

Minnesota: Raymond Otto Filter, "Character traits." Oscar Julius Johnson, "St. Paul non-verbal intelligence examination for primary pupils." Calvin Perry Stone, "Analysis of the congenital sexual behavior of the male albino rat."

Pennsylvania: Karl Greenwood Miller, "Diagnostic study of fifty college students." Morris Simon Viteles, "Job specifications and diagnostic tests of job competency designed for auditing division of street railway company."

Yale: Willard Arthur Goodell, "Behaviorism and teleology."

Zoology

Bryn Mawr: Hope Hibbard, "Cytoplasmic inclusions in the eggs of *Echinarachnius parma.*"

California: William Ferguson Hamilton, "Coordination in the starfish."

Catholic University: Aloysius Fromm, "Vitreous body,—its origin, development and structure as observed in the eye of the pig."

CHICAGO: James William Buchanan, "Control of head formation in planaria by means of anesthetics." John Wood MacArthur, "Comparative study of susceptibility in planaria and other forms by means of electrolytes and vital dyes."

COLUMBIA: Robert Hall Bowen, "Insect spermatogensis. History of cytoplasmic components of the sperm in *Hemiptera*."

CORNELL: Hazel Elisabeth Branch, "Internal anatomy of *Trichoptera*." John D. Detwiler, "Biology of three little known clover insects." Dean L. Gamble, "Morphology of ribs and transverse processes in *Necturus maculatus*." Harry Hazelton Knight, "Insects affecting the fruit of the apple with particular reference to the characteristics of the resulting scars." Rowland Willis Leiby, "Polyembryonic development of *Copidosoma gelechiæ* with notes on its biology." Mortimer Demarest Leonard, "Revision of the dipterous family *Rhagionidæ* (leptidæ) in the United States and Canada." John Thomas Lloyd, "Biology of North American caddis worms." Helen Elizabeth Murphy, "Metamorphosis of may-fly (*Ephemerine*) mouth-parts."

HARVARD: Samuel Wood Chase, "Mesonephros and urogenital ducts of *Necturus maculosus rafinesque*." William Harder Cole, "Transplantation of skin in frog tadpoles." Emmett Reid Dunn, "Salamanders of the family *Plethodontidæ*." Cleveland Sylvester Simkins, "Origin and migration of so-called primordial germ cells in the mouse and rat." George Carlos Wheeler, "Larvæ of subfamilies *Dolichoderinæ* and *Formicinæ;* developmental stages of ants."

ILLINOIS: Florence Sander Hague, "Studies on *Sparganophilus Eiseni Smith*." Ada Roberta Hall, "Effects of oxygen and carbon dioxide on the development of certain cold blooded vertebrates." Ezra Clarence Harrah, "North American Monostomes." Lewis Bradford Ripley, "Morphology and postembryology of *Noctuid* larvæ." Fenner Satterthwaite Stickney," "Head capsule of *Coleoptera*."

JOHNS HOPKINS: John Graham Edwards, "Effect of chemicals on locomotion in amœba." Alphonse M. Schwitalla, "Influence of temperature on the rate of locomotion in amœba."

MICHIGAN: Horace Burrington Baker, "Distribution of mussels in Douglas Lake."

MINNESOTA: George Henshaw Childs, "Digestive system of diplopods with special reference to parajulus." Samuel Alexander Graham, "Influence of physical factors of the environment on the ecology of certain insects in logs."

OHIO STATE: Carl John Drake, "Ecological and life-history studies of *Heteroptera*."

PRINCETON: Orren Williams Hyman, "Dimorphism of the spermatozoa of *Fasciolaria Tulipa*."

RADCLIFFE: Esther Wadsworth Hall, "Braconids parasitic on aphids and their life history."

STANFORD: K. Kunhi Kannan, "Function of the prothoracic plate in *Mylabrid* (Bruchid) larvæ."

WISCONSIN: Sarah Van Hoosen Jones "Inheritance in pigeons; checks and bars and other modifications of black."

YALE: John Spangler Nicholas, "Regulation of posture in the forelimb of *Amblystoma punctatum*." Leon Stansfield Stone, "Development of the cranial ganglia and the lateral line sense organs in *Amblystoma punctatum*."

CALLIE HULL
CLARENCE J. WEST
RESEARCH INFORMATION SERVICE,
NATIONAL RESEARCH COUNCIL,
DECEMBER 7, 1921

THE ORGANIZATION OF KNOWLEDGE

II

The aim of all organized knowledge is to increase the certainty of prediction, or as a practical question the science of forecasting, the urgency of which was never more apparent than it is to-day. As has been said by Jevons, "With the progress of any branch of science the element of chance becomes much reduced," for "Not only are laws discovered which enable results to be predicted . . . but the systematic examination of phenomena and substances leads to important and novel discoveries which can in no sense be said to be accidental." The application of this principle to the science of human relations is obvious, yet rarely recognized with the required degree of clearness. A vast amount of human activity continues to be carried on, crude as it may be, in disregard of past experience but of necessity as an adventure or speculation, the evil results of which are most likely to fall upon others than those directly concerned. It is not only true that "hopeless causes do not always fail" (in the temporary human sense), but that wrongful causes or courses may prove profitable—for a time—and to those directly concerned. It requires to be clearly kept in mind in considering civilization as a science of human relations that in this respect the interests of the individual and society may be diametrically opposed to each other. But just as the police powers control criminal propensities, so the powers of organized knowledge and of demonstrated experience hold in check the reckless intellectual speculations of the audacious but uninformed. In its final analysis the only cure of a fallacy is a demonstrated fact so clearly stated and properly applied that the truth must prevail and prove triumphant.

This conclusion is summed up by President David Starr Jordan in the remark that "The final test of truth is its livableness, the degree to which we trust our lives to it." However much falsehood may prevail and prove an individual advantage—for a time—in the long run it is only "by means of experience, personal and collective, that the human race maintains itself on earth." Such experience, also in the words of Jordan, "concerns itself chiefly with the relations of objects rather than with their ultimate constitution or their intimate nature," for "it gives the truth actually needed in actual life and it furnishes the means for the acquisition of more complete conceptions whenever in the intricacies of life such better knowledge is needed."

The principle here laid down is fundamental to a science of human relations. When the demand arises for practical knowledge, for safe guidance in affairs of business or state, the first essential need is a basis of agreed upon facts, only too often wanting in the case of those who essay upon leadership in the troubled waters of political, economic, or social controversy.

It is likewise with every question, great or small, upon which mankind stands in need of better knowledge to eliminate the prevailing error and misapplication of human effort. Only by organizing knowledge in the manner here suggested will it be possible to secure the future against the vast amount of erroneous conclusions which now hamper progress in practically every important direction in which further progress is most essential for the good of all mankind. No elaborate philosophical treatise on the "Foundations of Knowledge" or the "Human Intellect" meets this need. If typhus is at our door or sleeping sickness no vague advice on preventive measures, however well meaning, meets our needs of the situation or the expectations of the public. No philosophical platitude, no pious phrases of politics held the Indian in his struggle to survive in competition with an unlike civilization in some respects inferior to the moral and physical standards of primitive life.

In very truth it is much easier to evolve speculative theories about knowledge than to ascertain the truth or the facts concerning even the most commonplace matters of every-day existence. Herein lies the conflict between mathematics and statistics and the menace of over-emphasis of the mathematical judgment in matters which are largely questions of facts and not of philosophical inference. Because mathematics are useful—if not indispensable—in astronomy or engineering it does not at all follow that mathematical speculations can safely be applied to problems in biology or vital and social statistics. The practical truths of every-day life are relative and not absolute, all more or less conditioned by the human judgment, totally at variance with the ascertainment of the truth of physics or chemistry. The mode of reasoning most useful in sociology or political science is essentially different from the intellectual concept of accuracy in the transmission of sound waves or the transformation of energy applied to a steam engine or a turbine. Hence I am at a loss to understand the conclusion of Jevons that "As science progresses, its power of foresight rapidly increases until the mathematician in his study seems to acquire the power of anticipating matters and predicting what will happen in stated circumstances before the eye of man has ever witnessed the event." No mathematician gave a forecast of the coming of the great influenza epidemic of 1918-19, no weather forecast of a coming storm depends upon mathematics, no fall in prices or rise in wages needs the aid of the mathematician to prognosticate events depending largely on unforeseeable contingencies, and finally, no mathematician could have or did forecast the great war and its duration and consequential loss of life and property. But knowledge properly organized would aid enormously in developing the prophetic judgment free from bias or the influence of custom or tradition. Such organization should be the first instead of the last, the most important instead of the most neglected duty of the state. Without it the present chaos and confusion must continue, while the consequences must become more disastrous. Properly organized knowledge on the multitude of matters that concern the state and society would within a single generation do more to advance the cause of true civilization of science and human progress than any other discovery within the realms of possibility.

Nothing that I have said should be construed as opposed to original thought, to the fullest uses of the imagination, lead the conclusions where they may. Such speculations concern the individual and represent opinions which may or may not be accepted as a guide to action in the affairs of every-day life. I am concerned with judgments of a public or universal nature brought forward as a contribution to truth, based upon the ascertained and digested facts of human experience. I agree entirely with Professor Dearborn that it is wrong "to be forever putting facts into the mind while never providing time to use them in thought," and I also agree with his view that "rules for thinking are wholly unnecessary," just as I am convinced of the non-utility of a knowledge of technical grammar in the art of writing. But what belongs to the realm of the imagination is a thing apart in the life of a man who is conscious of his intellectual responsibility in matters of fact and particularly when the facts represent collective experience or conclusions drawn from assembled aggregates usually in the nature of statistical data. No man has a right or a privilege to say that he *knows* what to him is only a matter of belief. On all questions of public policy, where far-reaching consequences are involved in present-day action, it is the first duty of the statesman to make sure of his facts, to clearly differentiate facts from opinion, and to act with absolute impartiality upon the evidence. Accuracy of judgment will be conditioned largely by the state of organized knowledge and its intelligent coordination to the end in view. There is much lip service of coordination in science and government, but a woeful lack of it in practice. To the extent that knowledge is better organized such coordination will become more effective as a matter of course.

Much of what is said here is implied in learned philosophical discussions, failing, however, to emphasize the practical viewpoint as illustrated in every-day experience. Thus the really extraordinary essay on "The System of the Sciences," by the late Professor Ostwald, prepared for the inauguration of the Rice Institute, must needs aid materially the cause of a better method of systematizing knowledge, although failing in the most important particular of outlining a method of classification and arrangement by which the knowledge extant can be made more readily accessible. For illustration, the suggestion that "the ordering of facts and their relationship in each individual science is the first and most important function in its development" is explained as "a discoverer of new facts may not content himself with simply imparting these facts to the world at large, but only after having recognized and fixed them does there arise for him the new great essentially scientific duty of demonstrating the relationship borne by these new facts to the existing order of knowledge in a particular field and of thus rendering them real organic parts of the entire science in question." But this admirable principle is not elucidated as it should have been by some concrete illustration based on extended experience. For while it is perfectly true that "An ordering process of this kind in each particular science has always been the principle of all progress," this conclusion is far from being as clearly recognized as it should be.

Science, in the words of Karl Pearson,

"claims for its heritage the whole domain to which the knowledge can be legitimately applied," and this is amplified by the remark that "knowledge is essentially a description and not an explanation," it being held at the same time that the object of science is to describe in conceptual shorthand the routine of the past. Hence the importance of the fact-gathering process being made as thorough as it is required to be impartial. Pearson properly points out the limitations of Sir Francis Bacon's classification of the sciences, failing in the supreme essential of a "clear distinction between the material of knowledge and knowledge itself, between the real and the ideal, or between the phenomenal world and the unreal products of metaphysical thought."

This discussion of an adequate method of classification is most illuminating, and the different attempts that have been made "show how dangerous it is for any individual to attempt to classify the sciences even if he possesses Spencer's ability." Pearson disavows for his own system the pretense of "logical exactness." For, he remarks, "science is not a mere catalogue of facts, but is the conceptual model by which we briefly resume our experience of those facts." But it would have been to better advantage if these learned conclusions had been illustrated by a few concrete examples, for only in this wise can our actual shortcomings be brought home to us.

From Bacon and Compte to Jevons, Spencer and Pearson, the classification of the sciences has been confused with the organization of knowledge as a prerequisite for an adequate and satisfactory systematic outline of the order of the universe. Pearson's own classification into abstract, concrete, and biological sciences may possibly answer the purpose, but certainly not his amplification that these are united pair and pair "by applied mathematics and biophysics."

More has been claimed for mathematics than for any other branch of science. Granted that "It is the science of exact thought as applied to natural phenomena," it does not at all follow that it is essential or even advantageous in matters in which the approximate truth guides human actions—ever has and ever will, because of the variable conditions which govern our existence or the collective existence of all mankind. No one has essayed upon this question to better advantage than Sir William Hamilton in his discussion on "The Study of Mathematics as an Exercise of Mind." Thus, for illustration, the rather startling observation that "If we consult reason, experience, and the common testimony of ancient and modern times none of our intellectual studies tend to cultivate a smaller number of faculties in a more partial or feeble manner than mathematics." He quotes a German authority to the effect that "We shall first of all admit that mathematics only cultivate the mind on a single phasis. Their object is merely form and quantity. They thus remain, as it were, only on the surface of things without reaching essential qualities or their internal or far more important relations—namely, the feelings and the will—and consequently without determining the higher faculties of activity. So likewise on the other hand the memory and imagination remain in a great measure unemployed."

Sir William Hamilton was of the opinion that mathematics "do not cultivate the power of generalization" and what is even more important as a practical conclusion "the study of mathematics educates to no sagacity in detecting the fallacies which originate in the thought itself of the reasoner." It is of the utmost importance for the present purpose that this conclusion should be clearly grasped. It being held that the inductive process of reasoning, or from the particular to the general, is the only process by which, in the vast majority of cases, conclusions can be correctly arrived at, it must be self-evident that a process of reasoning by pure deduction can not likewise serve the same or a better purpose. Sir William Hamilton makes this point more clear in the statement that "The art of reasoning right is assuredly not taught by a process in which there is no reasoning wrong," or to use his own illustration, "we do not learn to swim in water by previous practice in a pool of quicksilver." The process of fact hunting, fact assembling, and fact analysis is the prerequisite for fact statements, and it is fact statements alone that are entitled to the serious consideration of those whose judgment and decision affects the present or future welfare of those concerned in the results of the forecasting process.

The organization of knowledge is concerned with the interpretation of the phenomena of every-day experience and not with a theory applied to their interpretation, indifferent to the facts or the nature of the facts considered. This conclusion is admirably set forth by Sir William Hamilton in the words that "Mathematics often afford us no assistance either in conquering the difficulties or in avoiding the dangers which we encounter in the great field of probabilities in which we live." It is, therefore, mere phraseology to say that "The leading characteristic of mathematics is that it deals with properties and ideas which are applicable to things just because they are things and apart from any particular feelings, emotions, or sensations in any way connected with them." (Whitehead). It is precisely the truth that mathematics deals with truth in the abstract that it is so largely inapplicable to questions in which the very best judgment can only represent an approximation to the ideal but nevertheless workable truth. Or, as Sir William Hamilton remarks, "Of observation, experiment, induction, analogy the mathematician knows nothing," yet it is of all these that organized knowledge must take cognizance if it is to serve the useful purpose of advancing the truth by which men live.

I can not for the present enlarge upon this view, recalling, however, the previously quoted remark of Professor David Starr Jordan that "The final test of the truth is its livableness, the degree to which we may trust our lives to it." No theory of probability, however useful in perfecting contingency calculations, can be safely applied to the countless questions upon which facts and mere facts alone will permit of a judgment "to which we may trust our lives." No mathematical figments can make up for deficiencies in knowledge of fundamental truth.

Limitations of space preclude an adequate discussion of the methods pursued in the organization of the library and information service of my office. The methods of organizing knowledge must necessarily vary in detail with the nature of the subject matter, but in my own experience of thirty years I have found no difficulty whatever in gaining a reasonable degree of control over a wide range of essentially different sets of facts and data, systematically arranged upon the principles of easy accessibility, completeness of experience as to time and place and reasonable economy in expense. All general information in my office other than such as is represented by books and pamphlets is first filed under a uniform envelop system arranged, however, in precisely the same manner as the books and pamphlets on the subject index plan.

The classification adopted rests upon the conception that the basis of modern progress is essentially economic, but the term economics is used in the broadest sense and made to include social and allied sciences and activities. The first division of organized knowledge in use in my office bears, therefore, the title "Economics." Under the second division is comprehended "Statistics and Information"; this section is sub-divided into United States and Foreign Countries. Both of these sections are sub-divided into about thirty minor divisions, which readily admit of being enlarged, if occasion should require; but I have found it more advantageous to avoid too many minor sub-divisions, so as to make the indexing of the information as automatic as possible. The fourth section is entitled "Labor and Industry," being practically technological, having to do with all industrial processes, labor conditions, occupational diseases, occupational accidents, etc. The fifth section bears the title "Public Health," but this is limited to the United States, simply as a matter of convenience, for in the general statistical information section public health is Sub-section 8, including, of course, vital statistics. The sixth and last section bears the general title "Science, Medicine and Research," including a vast range of more or less allied subject matters.

Throughout "information" consists chiefly of newspaper clippings, magazine articles, articles from technical periodicals, etc. Priority throughout is given to original sources of information, including any and all official reports, documents, etc., of value. Aside from the foregoing, there is a section on Graphics, which is becoming a matter entitled to separate consideration, on account of the growing demand for graphic publicity of social, medical and economic experience. As thus conceived, the organization of knowledge can be brought within the compass of six general divisions, which can easily be memorized and into which numerous special sub-divisions fit automatically on the principle of associated ideas.

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AMERICAN BIOLOGICAL STAINS COMPARED WITH THOSE OF GRÜBLER

IN a recent article[1] the writer called attention to the need of standardizing biological stains now that those of American manufacturers are on the market. In this article mention was made of the fact that the American stains had a rather bad reputation among biologists not necessarily because of their actual poor qualities, but merely because they are different from the Grübler stains which were standard before the war. It was stated at this time that the Society of American Bacteriologists was beginning an investigation of the American stains, and the cooperation of other scientific bodies was urged. Since the article in question was written much cooperation of this kind has been secured and the work has been put on a much broader basis. For this reason it seems well at the present time to insert in these pages a brief report on progress, particularly since many interesting results have already been obtained in comparing the various brands of stains.

Still more recently there appeared in this journal[2] a statement as to a project of the National Research Council on the standardization of biological stains. This work of the National Council is the out-growth of the investigations already made by the bacteriological society. Several of the national scientific organizations, notably the Botanical Society of America and the American Society of Zoologists, are already taking active part in the work. As a result there are now some forty bacteriologists who have taken part in the bacteriological tests of the stains, about fifteen zoologists who are examining certain stains for cytological and other histological work, and it is expected shortly to have a similar group of botanists taking part in the work. The hearty cooperation of all of these investigators, located in many different institutions all over the country, is one of the most pleasant surprises the work has brought out. The tests involved are often quite time-consuming and the willingness of the collaborators to carry them out without question of remuneration or credit for the work is felt to show that biologists in general are keenly interested in the subject. Without their eager cooperation the work would have been impossible, and much credit is due to all of them.

The work has brought out quite plainly that three series of tests are necessary in standardizing any particular stain: first it must be tested for bacteriological staining; second for histological staining; and third its chemical composition must be determined so far as the present status of dye chemistry makes this possible. At present three stains or groups of stains have been tested from the bacteriological standpoint: fuchsin, methylene blue, and the gentian and methyl violets. Of these, methylene blue and gentian violet are now being tested in histological work. In addition to these, histological tests are being made of safranin, hæmatoxylin, orange G and eosine. Chemical work, through the cooperation of the Department of Agriculture in the Color Laboratory, under Dr. Ambler, has been done on methylene blue, and similar tests are shortly

[1] H. J. Conn, The Production of Biological Stains in America, SCIENCE, N. S., 53: 289-290.

[2] The Standardization of Biological Stains, SCIENCE, N. S., 53: 289-290, 1921.

to be made of gentian violet. Although the work has only just begun, enough information has already been obtained so that certain public statements can safely be made.

In the first place, it has been learned that there is no justification for implicit faith in the Grübler stains. They are apparently not nearly as pure as those that are now made in America. It has for a long time been well known that certain Grübler stains were cut with inert material such as dextrin or salt, and the recent chemical tests that we have made show very plainly the greater percentage of color in nearly all the American samples examined. Possibly in some cases the greater concentration of the American stains may have been the cause of the poor results obtained with them, since the directions for preparing staining solutions are all based upon the Grübler stains. In the second place, it has been found that the Grübler stains are not as constant or uniform as it used to be supposed. Some examples of Grübler's methylene blue for example are entirely satisfactory for staining dried milk smears, while other samples, the authenticity of which can not be questioned, have the property of dissolving casein and washing the milk smears off of the sides. Furthermore, certain Grübler samples of orange G prove entirely satisfactory in the Fleming triple stain while other samples are very unsatisfactory, ranking with the poorest American samples in this respect. It has been noticed with much interest that when an investigator has been using for histological purposes a sample of some Grübler stain from his own laboratory, and also various unknown samples sent to him, in which another Grübler sample was included, he has invariably reported his own sample of the Grübler stain as much superior to the unknown sample. From this it has been concluded that the Grübler stains vary as much as the American stains and that a histologist naturally reports best results with that particular sample with which he has had experience.

As to the qualities of American stains, it can be said without hesitation that they are in general very good. This is particularly true of the bacteriological stains, to which for one reason or another the manufacturers have given most attention. Certain American methylene blues, in particular, are decidedly superior to any we were used to before the war. This statement is made on the basis of very severe bacteriological tests and of chemical analyses as well. There seems to be no question but that it will be possible to find American-made stains of practically all kinds desired by biologists as good or even better than those obtained from abroad.

The chief uncertainty in the situation at present is whether the producers of the stains will stay in the business. This matter may be settled one way or the other by action of Congress before this paper appears in print; but whatever is done in the matter, it is decidedly to be hoped that certain of the American stains which some of us biologists now invariably choose in preference to the Grübler products, will continue to be available to us.

H. J. CONN, *Chairman,*
Committee on Standardization of Biological Stains, National Research Council
GENEVA, N. Y.,
JANUARY 15, 1922

SCIENTIFIC EVENTS

THE STANDARDIZATION OF INDUSTRIES

BILLIONS of dollars can be saved by American industry if a comprehensive program of standardization is carried out, according to E. C. Peck of Cleveland, O., chairman of the standardization committee of the American Society of Mechanical Engineers. Mr. Peck writes:

> The German work is of special interest to those responsible for the management of American industries, not only because of its importance, but also because of the similarity in the historical conditions surrounding the national standardization movements in Germany and in America.

Mr. Peck says that mass production is no longer primarily an American development, but that the lesson of the war has brought home to European countries realization of its significance, so that to-day in these countries far reaching programs of industrial standardization are being carried out. These countries are employing systematic cooperative effort of industries functioning through national industrial associations, technical societies and government bureaus.

It behooves managers of American industries to intensify their efforts toward standardization or they will be left behind in the competition for world commerce. It is not enough that there be standardization work done by sections of industries and by individual firms, although such work, prior to the war, made possible a considerable amount of mass production, which attracted the attention of European industrialists.

To reap the full benefits the work must be broadened and intensified, and made national in its scope. This requires the joint effort of manager and engineer, of producer, distributor, consumer and independent specialist, all speaking through the organized bodies which represent their interests.

The many benefits of standardization are by no means limited to the production side. In the long run standardization is bound to be of even greater importance in the reduction of distribution and selling costs,—perhaps the most important problem of our economic system. A comprehensive program of standardization planned and carried out by our great national industries will mean the saving of hundreds of millions—even billions of dollars.

The American Society of Mechanical Engineers will take up the question of standardization and research at a five-day meeting to be held in Atlanta, Ga., beginning on May 8. The society in its statement on German progress says:

The standardization movement in Germany is particularly significant, since Germany is one of the three leading industrial countries. The industries of Austria, Holland, Sweden and Switzerland are so intimately related to those of Germany on account of geographical and other relationships that they are necessarily affected very largely by developments in Germany.

It appears that the work is being woven very intimately into the industrial fabric. The very large number of standards purchased by the industry, and the fact that the central organization has 5,000 firms which are cooperating members, are a sufficient indication of this.

There seems to be a striking analogy between the present standardization movement in Germany and the research movement developed there a generation ago. Whatever estimate one may place upon the rôle it played in German industries generally, every one agrees that research was fundamental in the development of their great chemical industries. The rôle which the Germans are expecting standardization to play in all their industries would be not unlike the rôle which research has played in their chemical work.

MORE "GLASS FLOWERS" AT HARVARD

The *Harvard Alumni Bulletin* states that Rudolph Blaschka, the artist who, at Harvard, with his father, modelled the famous "glass flowers" in the Botanical Museum at Harvard University, has begun work on a supplementary collection of glass models of grasses and sedges, which will be displayed on their completion in a room adjoining the Ware collection of glass flowers. Walter Deane, 70, formerly president of the New England Botanical Club, has consented to aid in providing Herr Blaschka with American material for the construction of the new models.

The Ware collection now on exhibition will be practically complete when twenty models and fifty magnified anatomical details, now in the artist's studio in Germany, have been transported to this country. It is unsafe to transport them under existing conditions, especially since their removal to Boston cannot yet be secured "in bond." Up to the time of the war the glass flowers were shipped direct to Boston and then, by the courtesy of the Custom House officials, were carried directly to the Museum in Cambridge and were unpacked safely at the University.

The collection now illustrates 160 families of flowering plants, 540 genera, and 803 species, and there are more than 3,200 analytical magnified details. The range of the exhibition is sufficiently extensive to give a clear idea of the relations of these important families and species to each other. The skill which has copied in glass every minute detail of structure of the plants has been devoted solely to Harvard University. All of the specimens which have been made since 1895 are the artistic handiwork of Rudolph Blaschka, who has carried on all of his study and his modelling single-handed in his studio in Germany.

THE NEW BUILDING FOR FORESTRY AT YALE UNIVERSITY

YALE'S new Forestry School building will cost about $300,000 and will be situated on Prospect Street, on the Sage-Pierson Square, on which several large laboratories are being erected, including the Osborne, Sloan, Harriman and Sterling structures. It is the gift of William H. Sage of Albany, a member of the Yale class of '65. The architect is William Adams Delano of New York City, Yale, '95.

The ground slopes from north to south abruptly and advantage has been taken of this fact to gain a full lighted story in the basement. While the building is three stories high at the north, it is practically four at the south.

The building will conform in architectural treatment and material with the others on this quadrangle. It will be of fireproof construction, with slate roof. The ground floor will contain the Forest Club room with a fireplace and ample windows to the west. Wood for the panels has been offered by the New York Lumber Trade Association and a great variety of woods will be used without destroying the architectural quality of the room. On the same floor will be the laboratory for testing woods, requiring heavy machinery and solid foundations.

On the first floor is the library, a room 24 by 40 feet and 14 feet high, which will be divided into alcoves by book cases. This will be purely a departmental library. On this floor will also be the administrative offices, and a large lecture or assembly room to seat about 150 people.

On the second floor will be two class rooms, a drafting room and a silver-culture laboratory, besides private work rooms for the staff. The top floor under the roof will be well lighted by skylights and will give ample working space for the main laboratory, the herbarium, and wood collections, and some special research rooms.

The corridors on the library and top floors have been made amply wide to give room for cases of specimens. They serve, therefore, the double purpose of corridor and museum. A freight elevator in the southeast corner accessible from the roadway will make it possible to lift heavy objects to every floor.

THE WASHINGTON CONFERENCE ON PUBLIC HEALTH

THERE was held this week under the auspices of the United States Public Health Service in Washington a conference of deans of schools of public health and medical schools, presidents of universities with which these schools are connected, a selected number of professors of public health subjects and men actively engaged in public health work, on "The Future of Public Health in the United States and the Education of Sanitarians."

After considering the present status of the public health movement and present facilities for the education of health officers and other sanitarians, the conference considered various newer aspects of public health and their importance in the training of sanitarians; the various kinds of sanitarians which will be needed for the future; the recruiting and training of more and better sanitarians; and the various problems connected with the training of sanitarians for the future and the further education of those who are now employed in public health work.

Among those expected to take part in the conference were Presidents James R. Angell, Livingston Farrand, Frank J. Goodnow, Ray Lyman Wilbur; Deans Hugh Cabot, William Darrach, David L. Edsall; Professors Allen W. Freeman, E. O. Jordan, Roger Perkins, Mazyck P. Ravenel, Milton J. Rosenau, George C. Whipple, Jesse F. Williams, C.-E. A. Winslow; Drs. Lewellys F. Barker, Walter H. Brown, John A. Ferrell, Lee K. Frankel, Otto P. Geier, Frederick R. Green, Vernon Kellogg, John H. Stokes, Victor C. Vaughan, George E. Vincent, William A. White, Hubert Work, also Drs. S. J. Crumbine, Hugh S. Cumming, Eugene R. Kelley, L. L. Lumsden, A. T. McCormack, A. M. Stimson and Allan J. McLaughlin, of the United States Public Health Service and the various state boards of health.

The announcement of the meeting says:

The rapid development of the public health movement in the United States, the shortage of trained public health officers and the present inadequate facilities for their education has brought about a situation which, in its opinion, merits a thorough consideration not only by leaders in the public health movement but by university presidents and others who are now participating in the education of youth. Numerous surveys have called attention to the need for more and better trained health officers. On the other hand, there has never been so much interest among people generally in public health as there is at the present time. Could there be made available a larger number of trained public health officers, it would be possible within a comparatively short period of years to immeasurably increase the health, efficiency and happiness of the American people. From these considerations it appears that the problem of the education of health officers is a matter perhaps more important in its many implications than any other now before physicians and educators.

SCIENTIFIC NOTES AND NEWS

The spring meeting of the American Chemical Society will be held with the Alabama Section at Birmingham from April 3 to 7. Dr. Edgar F. Smith will preside. Among the special addresses are the following: "The pioneer's field in petroleum research," by Van H. Manning; "Informational needs in science and technology," by Charles L. Reese, and "Recent developments of the chemistry of rubber," by W. C. Geer.

On February 24 Vilhjalmur Stefansson delivered a lecture before the National Geographic Society. On that occasion the society made the announcement that its Research Council had awarded him the Grant Squires prize "in recognition of the unique interest and importance of his book, 'The Friendly Arctic,' the outstanding geographic publication of 1921."

The King of Italy has conferred upon Col. Lawrence Martin, of Washington, D. C., formerly professor of geography at the University of Wisconsin, the rank of Officer of his Order of the Crown of Italy for services during the war.

At a celebration which took place at the Sorbonne on January 22 Professor Henry Le Chatelier was presented with a gold medal in commemoration of his fifty years' work of scientific and technical research.

We learn from *Nature* that the first award of the Meldola medal has been made by the council of the British Institute of Chemistry, with the concurrence of Dr. Percy E. Spielmann, representing the Maccabæans, to Dr. Christopher Kelk Ingold.

Mr. A. S. Kennard has been elected president of the Malacological Society of London. The vice-presidents are Mr. J. R. le B. Tomlin, Professor A. E. Boycott, Mr. G. K. Gude and Mr. C. Oldham.

Dr. Francis Weld Peabody, assistant professor of medicine at the Harvard Medical School and physician of the Peter Bent Brigham Hospital, has been appointed director of the Thorndike Memorial Laboratory, which is being erected on the grounds of the Boston City Hospital. The laboratory will be completed in less than a year and will be devoted mainly to research work.

Professor Theodor Svedberg, who holds the chair of physical chemistry at the University of Upsala, has accepted the invitation extended to him by the University of Wisconsin to deliver a course of lectures at the University during 1923.

P. J. Wester, for seven years horticulturist, and the last four years agricultural adviser to the Bureau of Agriculture, Philippine Islands, has applied for retirement from the government service under the Osmeña Act, and is returning to the United States.

H. A. Doerner has been assigned to rare-metal work at the Reno experiment station of the U. S. Bureau of Mines. Mr. Doerner was former connected with the Denver office of the bureau. J. A. Cullen has been assigned to cement experiment work at the Columbus Station.

L. G. Lennert, assistant sanitary engineer, United States Public Health Service, has been granted leave of absence to serve on the International Health Board during 1922. He will have headquarters in Sacramento, Calif.

Ivar Herlitz, fellow of the American Scandinavian Foundation, formerly with the Southern Sierras Power Company, Riverside, Calif., is studying high-voltage transmission problems under a research scholarship from the Swedish Academy of Engineering Science.

GEORGE T. SOUTHGATE, formerly research engineer with the American Cyanamid Company at Brewster, Fla., has accepted a position in the Bureau of Soils, United States Department of Agriculture, Washington, D. C.

DR. CHARLES WILLIAM DABNEY, who retired from the presidency of the University of Cincinnati a year ago, has established an office in Houston, Texas, where he and his associates are prepared to report on mineral, oil and other properties.

DR. RAYMOND PEARL gave an illustrated lecture on "The growth of population" before the War College in Washington on March 6.

DR. JOHN A. WIDTSOE, formerly president of the Utah Agricultural College and later of the University of Utah, is delivering a series of lectures at the Brigham Young University on "The making of science."

PRESIDENT WALTER DILL SCOTT, of Northwestern University, formerly professor of psychology, will give the convocation address at the one hundred twenty-fourth convocation of the University of Chicago on March 21. His subject will be "Handling men."

RECENTLY, under the auspices of the department of physics of the School of Mines and Metallurgy, Rolla, Missouri, Professor S. R. Williams, of Oberlin College, spoke to the students of the department of physics on "The principle of Bernoulli and some of its applications"; to the Science Club on "Magnetic-mechanical analysis of ferromagnetic substances," and at chapel on "The spirit of scholarship."

DR. OTTO KLOTZ, director of the Dominion Observatory, delivered an address before the Brooklyn Institute of Arts and Sciences on "Astronomy in Canada" on February 28.

PROFESSOR H. E. ARMSTRONG, who has consented to deliver the first Messel Memorial Lecture at the forthcoming annual meeting of the Society of Chemical Industry, has chosen as the subject of his discourse, "Rhapsodies culled from the Thionic Epos, including a discussion of the conditions determinative of chemical interchange."

DR. MAJOR GREENWOOD, Milroy lecturer befor the Royal College of Physicians of London, had for the subject of his lectures on March 9, 14 and 16, "The influence of industrial employment on general health." The Goulstonian lectures to be given by Dr. Anthony Feiling, on March 21, 23 and 28, will deal with the interpretation of symptoms in disease of the central nervous system. Dr. Hector Mackenzie's Lumleian lectures on diseases of the thyroid gland will be delivered on March 30 and April 4 and 6.

WILLIAM JAMES COMSTOCK, for many years instructor of organic chemistry at the Sheffield Scientific School of Yale University, died on January 24, at the age of sixty-two years.

GEORGE LYMAN CANNON, for thirty-four years instructor in biology and geology in the Denver high schools, author of contributions to geology and natural history, died on February 15, at the age of sixty-two years.

THE death is announced at the age of forty-two years of Professor Erich Ebler, professor of inorganic and analytical chemistry in the newly founded University of Frankfort-on-the-Main.

AN appropriation of $34,978,033, to meet expenses of the Department of Agriculture during the coming year is recommended in a bill reported on March 6 by the House Appropriations Committee. The total is $3,710,026 less than the amount appropriated for the current fiscal year and $1,554,683 less than budget estimates.

THE defeat of the Ellis evolution bill by the Kentucky House of Representatives by a majority of one vote on March 10 finally disposed of the question at this session of the legislature. The Rash bill in the Senate recently was recommitted and the rules committee refused to allow it to be reported. The Ellis bill would have forbidden the teaching in the University of Kentucky, the normal schools and the public schools of "Darwinism, atheism, agnostics or evolution as it pertains to the origin of man." It was the first of three similar bills introduced this season, two in the House and one in the Senate. The other bills can not be passed, as the legislature was expected to adjourn on March 15.

ANNOUNCEMENT is made from the University of Chicago that Dr. H. A. Lorentz, professor of physics in the University of Leiden, will lecture at the Ryerson Physical Laboratory on March 17 and 18 on "The constitution of matter," on April 3 on "The theory of spectral lines" and on April 4 on "The Theory of relativity." It is also announced that the following graduate courses in theoretical physics will be given during the coming summer quarter at the University of Chicago: "The electrical properties of gases," by Professor H. A. Wilson, of Rice Institute, Texas; "Thermodynamics, radiation and the Quantum Theory," by Professor W. F. G. Swann, of the University of Minnesota, and "Relativity and the Electron Theory," by Assistant Professor Leigh Page, of Yale University. Associate Professor A. C. Lunn, of the University of Chicago, will give courses on "Vector analysis" and "Satistics and probability."

As has already been noted in SCIENCE, Professor Solon I. Bailey of the Harvard Observatory, accompanied by Miss Annie J. Cannon, sailed from New York on February 28 for Peru to take charge of the Harvard Southern Astronomical Station at Arequipa. The *Harvard Alumni Bulletin* says: The work of the Arequipa station, which has been somewhat reduced in scope in recent years, is expected to take on a new importance with the return of Professor Bailey, who was instrumental in its establishment over thirty years ago and served for a long time as its director. He plans to spend the next two years in Peru. In addition to supervising the routine affairs of the station he will continue his studies of the globular star-clusters. Miss Cannon, whose achievements in the investigation of stellar spectra recently won for her an honorary degree from Groningen University in Holland, will remain at Arequipa for several months, and will be occupied largely in photographing the faint stars in the Southern Milky Way in order to classify their spectra."

THE second series of free public lectures on medical subjects and public health, given under the auspices of the Division of University Extension of Washington University by the faculty of the School of Medicine, concluded on March 12. These lectures have been given on Sunday afternoons to an audience averaging two hundred, and have received considerable newspaper publicity. The subjects for the year have been as follows: "Smallpox and vaccination," Dr. George Dock, professor of medicine; "Food and vitamines," Dr. Philip A. Shaffer, professor of biological chemistry; "Syphilis and its results," Dr. Martin F. Engman, clinical professor of dermatology; "The value of a university hospital to the community," Dr. Ernest Sachs, professor of clinical neurological surgery; "Overweight and health," Dr. William H. Olmsted, associate in clinical medicine; "Anthropology in medicine," Dr. Robert J. Terry, professor of anatomy; "Mental hygiene and education," Dr. Sidney I. Schwab, professor of clinical neurology; "What has surgery accomplished?" Dr. Evarts A. Graham, professor of surgery; "Home treatment of minor injuries," Dr. Barney Brooks, associate in clinical surgery.

THE British Medical Research Council has appointed the following committee to report upon the promotion of researches into the biological action of light with the view of obtaining increased knowledge of the effects of sunlight and other forms of light upon the human body in health or disease: Professor W. M. Bayliss (chairman), Mr. J. E. Barnard, Dr. H. H. Dale, Capt. S. R. Douglas, Sir Henry Gauvain, Dr. Leonard Hill and Dr. J. H. Sequeira. Dr. Edgar Schuster is secretary of the committee. The council recently announced that its total resources have been reduced and that it must omit the prosecution of researches which would have indubitable scientific value toward the advancement of preventive or curative medicine. The Medical Research Council, in cooperation with the Ministry of Health, the Board of Health for Scotland and the Ministry of Health for Ireland, was formed for the investigation of tuberculosis, nutritional diseases, food poisoning and dental decay, and the treatment of veneral disease, or rheumatism and allied diseases, and of mental disorders.

UNIVERSITY AND EDUCATIONAL NOTES

It is announced that Vassar College plans to erect two new buildings, a $150,000 physics laboratory and a $100,000 alumnæ building.

It is announced from Brussels that a legacy of $100,000 goes to Louvain University, Belgium, for the erection of a special building for cancer research.

Dr. Harlow Shapley, who was appointed director of the Harvard College Observatory last fall, has been elected to the Paine professorship of practical astronomy, which has been vacant since the death of Professor Edward C. Pickering, in 1919.

Dr. Charles W. Flint will be installed as chancellor of Syracuse University on June 15.

Professor Francis Hartman has recently been elected dean of the Day Technical School of Cooper Union, New York City. This appointment is in recognition of his long service at that institution as head of the department of physics and electrical engineering.

Dr. Ralph A. Waldron, formerly instructor in Pennsylvania State College and the University of Pennsylvania, has been elected professor of biology in Thiel College, Greenville, Pa.

E. W. Markle, who has been connected with the educational and recreational work of the United States army as principal and senior instructor of the electrical department, vocational schools, Camp Funston, Kansas, has been appointed assistant professor of electrical engineering at the Agricultural and Mechanical College of Texas.

DISCUSSION AND CORRESPONDENCE

HAVE THE STREAMS OF LONG ISLAND BEEN DEFLECTED BY THE EARTH'S ROTATION?

During the summer of 1920 Mr. Henry Hicks, of Westbury, Long Island, pointed out to me the very interesting difference between the east and west banks of one of the short streams flowing across the almost flat southern slope of the island. Looking west across the almost imperceptibly sloping eastern bank of the stream-way one sees the western bank rising quite steeply and very much resembling a railroad embankment in height and steepness.

This peculiar situation has long been accepted rather generally by geologists and physiographers[1] as due to the westerly deflection of streams by the earth's rotation. However, when one considers the weakness in flow of these streams, their very slight fall, and the fact that they are mostly less than ten miles long, serious doubts arise.[2] To one who, like the writer, has studied the cumulative effects of wind and vegetation upon wind-borne materials, it appears very probable that the deflective effect is very slight as compared with the resultant effects of these other agencies.

During glacial times and for some time afterwards there must have been, during dry weather and at times of high winds, a considerable movement of loose residual sands and glacial materials over the flat plain south of the terminal moraine which forms the backbone of Long Island. The general southwesterly winds would deposit their main load on the lee-side of any north-south trending bank and this deposition would be augmented and the drifting materials held by the denser vegetation of the moister stream margin. Probably tundra prevailed here for a long period during glacial times and, even yet, the region has not been entirely covered by forest, so that the effects of the notoriously strong winds of the South Shore would have been greater in the past than at present. It is suggested that someone make a careful study of a cross-section of one of these steeper west banks to determine the nature of the deposit and whether it may have been built as is here suggested.

O. E. Jennings

Pittsburgh, Pa.

[1] Lewis, Elias, Jr., *Am. Journ. Sci.*, 3rd Ser., 13: 215-216, 1877.

Gilbert G. K., op. cit., 27: 427-432, 1884.

Fuller, Myron L., "The Geology of Long Island," U. S. G. S., Prof. Paper 82: 9, 10 and 50, 1914.

[2] See also in this connection, Geikie, Sir Archibald, *Encycl. Brit.*, 11th edit., 11: 649, 1910.

LEGISLATION TO SUPPRESS TRUTH

To the Editor of Science: When Professor Morgan stated in his "Critique of Evolution" that the old conflict between science and theology over the question of evolution vs. special creation was ended and that it was unlikely it would ever again be revived, he was evidently not informed of a condition prevalent throughout most of our southern and western states. The newspapers report a bill before the Kentucky legislature making the teaching of evolution an offence punishable by a fine of $500 to $1,000. This action is more than a possibility elsewhere, since the Oklahoma State Baptist Association recently passed a resolution condemning evolution, and appointed a committee to eradicate this "heresy" from their schools in this state. The Texas Southern Baptists in a convention at Dallas recently took the same action. A similar movement was inaugurated in December by a "Congress" of the Disciples of Christ, where in discussion bitter hostility was shown and a committee was appointed to investigate all the colleges under the auspices of that body with a view to withholding funds from any which may be found to "teach evolution." In both of these denominations, the religious periodicals are carrying pages of fulminations against evolution ("Darwinism"), often of the most antequated and puerile matter, but calculated to arouse the frenzy of the uninformed who imagine their religious beliefs to be imperilled by this "damnable doctrine"! The secular press in this same region of the country has in several cases carried editorials commending the action in Kentucky and urging like action elsewhere.

This is not a time when the scientific world should regard the situation as a joke, nor merely as a local manifestation. With a "silver-tongued" apostle, the recrudescence of the old conflict bids fair to take on the proportions of a general action. The Moody Biblical Institute of Chicago, it is reported, is sending thousands of Mr. Bryan's addresses through the mails in furtherance of this propaganda. When it is realized that 50 per cent. of our citizenship are known to have the intelligence of mere children the harm that these misguided reformers may do is beyond calculation.

X.

ECOLOGICAL INVESTIGATION ALONG THE RED RIVER

To the Editor of Science: On page 127 of the February 3, 1922 number of Science you published a news item which included extracts from a letter of the Attorney General of the United States justly commendatory of Professor Cowles "for his ecological investigations along the Red River for use in connection with a suit between the states of Oklahoma and Texas in the Supreme Court of the United States."

The reader might gather from this that the suit referred to was strictly a two-sided one between these two states and that the government of the United States (including the attorney general) were a disinterested, unpartisan referee in the matter. Such an impression the attorney general certainly did not mean to convey, for the United States is an intervener in the suit. When the evidence is made available to the scientific public it will have to be read with this in mind.

Carl Hartman

Austin, Texas

ATOMIC NUCLEI

In my address printed in Science on March 3 last, the following corrections should be made:

1. In the last line of page 225, 3×10^{-13} cm. should read 3×10^{-12} cm.

2. In the fifth line, column 1, of page 226, 3×10^{-13} cm. should read 3×10^{-12} cm.

3. In the twenty-seventh line, column 1, page 226, 3×10^{-12} cm. should read 3×10^{-13} cm.

These errors were made in the copy and inadvertently overlooked by me in the proof.

J. C. McLennan

The Physical Laboratory,
University of Toronto,
March 7, 1922

NOTES ON METEOROLOGY AND CLIMATOLOGY

NEW DISCUSSION OF TEMPERATURES IN THE UNITED STATES

Ordinarily, the dullest portion of a scientific paper is that in which tables and charts are described. But a significant exception to this rule is to be found in Professor Robert DeC. Ward's recent discussion of the new temperature charts of the United States.[1] In this paper, Professor Ward has woven about certain fine charts, which are to appear eventually in the section on "Climate" in the *Atlas of American Agriculture* (U. S. Department of Agriculture), a moving story of isotherms so fascinating that one reads to the very end without the least fatigue;—this is noteworthy because it is exceedingly difficult for most authors to avoid the prosaic when dealing with such a subject. But the dynamic qualities of the paper are not more impressive than the skill displayed in drawing from the isothermal complex, the broad and significant climatic features of these extraordinary charts.

From a large number of charts furnished the author through the courtesy of Dr. O. E. Baker, Professor C. F. Marvin, and Mr. J. B. Kincer, twenty have been selected for discussion and are reproduced as lithographs in the *Monthly Weather Review*. The charts include monthly means for each of the twelve months, average winter temperatures, mean annual ranges, lowest mean monthly temperatures recorded in January and July, absolute maxima and minima, and average annual minima. These represent a distinct advance over earlier charts in that topography has been carefully considered. The mountainous west, therefore, on most of the charts, presents a very complex appearance, for there the influence of altitude is most clearly shown. The river valleys, such as those of the Rio Grande and the Colorado, could be readily detected by the trend of the isotherms were the base map lacking; the Appalachian region introduces warping and many local irregularities. The crowding of the isotherms in the Rocky Mountains, however, prevents such broad generalizations as are possible in the East.

[1] Some characteristics of United States temperatures. *Monthly Weather Review*, November, 1921, pp. 595-606. A limited number of reprints of this article will be available shortly, and may be obtained upon application to the Chief of the Weather Bureau, Washington, D. C.

Beginning with a broad, world-view of the trend of isotherms across the continents, the author shows how the great ocean currents crowd the isotherms in latitude on the east coasts and spread them apart on the west coasts. This accounts for the mild climate of the west coast of Europe as compared with the east coast of the United States. In middle and lower latitudes, the east and west coasts of the United States do not differ materially in mean annual temperature, but in northerly latitudes, the mildness of the Pacific Coast asserts itself. In latitude 45° N., for instance, the mean annual temperatures are about 10° F. higher on the west than on the east coast; while San Diego, Calif. and Charleston, S. C., in the same latitude, have approximately the same mean annual temperature.

A striking feature of the mid-winter chart is a southward curving of the isotherms over the northern interior districts, "which emphasizes, among other things, the fact that the western border of the Great Plains and the eastern foothills of the Rocky Mountains are warmer in spite of their greater elevation than the lower-lying country farther east." Prevailing off-shore winds along the Atlantic and Gulf coasts prevent the full effect of the moderating influence of these warm waters to be realized. But, in spite of this, the isotherms bend in general accord with the coast lines. The moderating effects of water are also observed to leeward of the Great Lakes. Along the Pacific coast, on-shore winds cause the isotherms to parallel the coast, thus affording an interesting comparison of the effect of prevailing winds and latitude controls, the Atlantic coast being conspicuously subject to the latter.

The January mean temperature is much higher on the west coast than on the east, increasing, as was the case with the mean annual temperature, in effectiveness with increase of latitude. The coast of Oregon is 20° F. warmer than the corresponding latitude on the Maine coast. The direction of the pilgrimages of seekers for balmy climates, the shifting of transportation from the Great Lakes to railroads upon the close of navigation, the seasonal control of certain industries, are only suggestions of the many economic considerations dependent in a large way upon the geographical distribution of monthly mean temperature.

In mid-summer, however, the south to north gradients of temperature in the east are not so marked as in winter. "So far as the mean temperatures alone are concerned, therefore, a long journey from south to north in search of decidedly cooler summers gives far less change than the corresponding trip from north to south in winter in search of much warmer and balmier climates." Three features of Pacific coast temperatures are interesting: (1) the slight north-south gradient of only 1° F. per 100 miles along the coast; (2) the extremely steep gradient from the cool coast of southern California to the heated interior; and (3) the contrast between heated valleys and cool slopes.

But it is in his discussion of the annual march of the isotherms that Professor Ward waxes especially cinematographic, for one can see the northward and southward march of the isotherms as vividly as if they were projected upon the silver sheet. As the winter advances these isothermal lines appear in northerly latitudes and glide smoothly and continuously equatorward, and later begin their poleward migration, sometimes leaving the earth's surface entirely in higher latitudes, and rising into the free-air. This is the author's conception of the interpretation of such charts, and concerning it, he remarks:

> When this conception is thoroughly in mind, isothermal maps have a new meaning. They are no longer dead and rigid, but are full of movement, suggesting an infinite number of relations between the everchanging temperature and all of human life and activity.

The temperature gradient in January from southern Florida to Laborador is the steepest in the world, when the great distance is considered. This steep gradient, especially unique because there are no transverse mountain ranges to produce it, has great economic significance, as was first pointed out by Woeikof. Labrador is arctic in climate, while Florida in many respects is tropical. This favored the prosperity of the early colonists and remains of the greatest economic significance.

The final portions of the paper deal with many questions of considerable popular interest. Upon what does our judgment of an abnormally cold or warm month depend? Certainly, our senses are not capable of averaging a month's temperatures so that they can conclude that this month or that was abnormally warm or cool. Such opinions, it seems, are based upon extreme "spells" of weather, their severity, and their distribution.

What is the physical cause underlying the sequence of unusually mild or cold seasons? Such abnormalities have been noted since the earliest times and have been studied by Schott, Stockman, and Henry, and more recently by Dr. C. F. Brooks. The first three showed that no permanent change of temperature is taking place. Dr. Brooks has shown that no other than a chance relationship has existed during four fifths of the years from 1812 to the present; the remaining fifth is represented by two series of alternating cold and warm winters attended by similar preliminary seasons. These series begin with 1872-73 and 1917-18, and are of especial interest in connection with their bearing upon generalized long-range forecasting.

What are the highest and lowest temperatures ever observed at various stations in the United States? "Zero has not been recorded on the Atlantic Coast south of Chesapeake Bay, on the immediate Gulf Coast, or in the Valley of California." In the northern Plains -60° F. has been recorded. At Greenland Ranch, in the Death Valley, a temperature of 134° F. was measured. Key West, Fla., is the only regular Weather Bureau station that has never recorded a freezing temperature.

Finally, there is the question of the validity of certain beliefs that there are irregularities in the annual march of temperature which tend to persist. The "January thaw," the "May freeze" and "Indian summer" seem to have no counterpart in the annual march of temperature, according to Professor C. F. Marvin and the New England "Ice Saints" (May 10) seems to be a similar fiction, according to the late Waldo E. Forbes. Where such irregularities appear in the mean of a number of years, they appear to be the result of one or more extreme occurrences.

The well-merited praise that Professor Ward bestows upon the new temperature charts of the *Atlas of American Agriculture* could equally well be turned by others upon his own splendid discussion of them.

C. LeRoy Meisinger

Washington, D. C.

SPECIAL ARTICLES

THE PRODUCTION OF NON-DISJUNCTION BY X-RAYS

In a previous issue of this journal[1] the writer described certain experiments which showed that the X-chromosome could be "eliminated" from the egg of Drosophila by X-rays. In these experiments red-eyed, homozygous, virgin females were X-rayed and crossed with white-eyed males. A total of twenty-four exceptional sons (white-eyed) were produced by the X-rayed females; fourteen out of the nineteen fertile X-rayed females producing exceptions. All excepting one of the twenty-four exceptional sons obtained from the X-rayed females were from eggs laid within six days of the time of X-raying and they could be divided into two groups corresponding to eggs laid during the earlier and later part of this period. Plough[2] has shown that maturation of the eggs in Drosophila melanogaster occupies approximately six days. It therefore seems probable that the X-rays act on the eggs while in one of the maturation divisions.

In the experiments referred to above only exceptional sons were recorded. In primary non-disjunction as investigated by Bridges[3] both exceptional sons and exceptional daughters occur. When, however, the female parent is homozygous for the dominant allelomorph as in the case of the X-ray experiments, the exceptional daughters are indistinguishable externally from their regular sisters.

The experiments to be described were planned to determine whether exceptional daughters were produced as a result of X-rays. Accordingly homozygous white-eyed females were crossed to eosin-eyed miniature-winged males. The regular offspring of such a cross are eosin-eyed, normal-winged daughters and white-eyed normal-winged sons. The exceptions are white-eyed, normal-winged daughters and eosin-eyed, miniature-winged sons. In the experiments, white-eyed, virgin females from stock obtained from Dr. T. H. Morgan and used in the previous X-ray experiments, were mated to eosin-eyed, miniature-winged males from stock obtained from H. H. Plough. The females used both for the controls and for X-raying, were all sisters, being from the first generation of a single pair of white-eyed flies. The virginity of these was secured by isolating pupæ in test tubes. The X-raying[4] was done soon after the flies emerged from the pupa cases and they were immediately mated. The males used in the matings were, in the greater number of the experiments, the offspring of a single pair of eosin-eyed, miniature-winged flies. (This was probably an unnecessary precaution). Seventeen of the control pairs were fertile and one pair or 6 per cent. produced one exceptional son (eosin-eyed and miniature-winged). The total number of offspring produced by the control pairs in the first generation was 1,743 females and 1,726 males and the exceptional fly formed .06 per cent. of the males. Thirteen of the X-rayed females were fertile. Nine of them or 69 per cent. produced exceptions, two daughters (white-eyed and normal-winged like their mothers) and twelve sons (eosin-eyed and miniature-winged[5] like their fathers). The

[1] Science, N. S., Vol. LIV, September 23, 1921.

[2] *Jour. Exp. Zool.*, Vol. 24, No. 2, 1917.

[3] *Genetics*, Vol. 1, p. 1-52, 107-163, 1916.

[4] The X-ray dosage and the technique of these experiments cannot be adequately described in a short note such as the present. They will be described in detail in a more extended paper to appear shortly.

[5] In the case of three of the exceptional sons the wing character was not determined. Two of them were obtained by dissecting late pupal stages and one died before its wings had expanded.

two female exceptions were the daughters of different X-rayed females. The total number of daughters produced by the X-rayed females was 512 and the two exceptions formed .39 per cent. of them. The total number of sons produced by the same X-rayed females was 467 and the twelve exceptions form 2.5 per cent. of them. It should further be noted that four of the thirteen fertile X-rayed females produced less than ten offspring and that each, *i. e.,* 100 per cent of the nine X-rayed females which produced more than ten offspring produced one or more exceptional daughters or sons.

The exceptional son of the control female was mated and found to be sterile. Eight of the twelve exceptional sons of the X-rayed females were mated and proved sterile. The other four exceptional sons of the X-rayed females were either dead when found or died soon afterwards. Bridges[3] and Safir[6] both found that exceptional males arising from primary non-disjunction were sterile. One of the exceptional daughters was fertile, the other sterile.

It is, of course, not certain that both of the exceptional daughters obtained from the X-rayed females were produced as a result of the X-rays. Safir[6], working on primary non-disjunction in white-eyed stock, found two exceptional females and thirteen exceptional males in a total of 21,773 offspring. A consideration of this and the fact that no exceptional daughters were produced by the control females and that the exceptional daughters came from different X-rayed parents makes it seem extremely unlikely that both the exceptional daughters were the result of natural non-disjunction. It is interesting to note that the unequal ratio of exceptional males to exceptional females, six to one, found in the offspring of the X-rayed females, is approximately the same as that found for natural non-disjunction in white-eyed females by Safir.

Bridges in his work on non-disjunction[3] has clearly demonstrated that the exceptional males arising from primary non-disjunction come from eggs which are without an X chromosome and are fertilized by an X chromosome bearing sperm. Such males have the chromosome formula XO. The exceptional females caused by primary non-disjunction, he shows to be due to the fertilization of an egg having two X-chromosomes by a Y chromosome bearing sperm. Such females have the chromosome formula XXY. This evidence seems to justify the assumption that the exceptional flies produced as a result of the action of X-rays have the chromosome formulas found by Bridges to occur as the result of natural primary non-disjunction; and the conclusion that an effect of X-rays when applied to eggs during maturation is to cause non-disjunction. This makes it probable that the X-rays have a direct effect on the germ cell, causing an increase in the tendency, already seen in the occurrence of natural non-disjunction, for the two X chromosomes to fail to separate in the maturation of the egg. The question as to whether this effect is due to a modification of the physical properties of the X chromosomes or of the protoplasm surrounding them will not be discussed here.

When primary exceptional females are crossed to males like their fathers they produce further exceptions. As shown by Bridges[3] secondary exceptional females occur when the two X chromosomes are included in the mature egg and exceptional males when the two X chromosomes pass into a polar body and leave only the Y chromosome in the mature egg. When the egg containing two X chromosomes is fertilized by a sperm containing a Y chromosome the resulting female lives and is like its exceptional mother. When the egg containing only the Y chromosome is fertilized by a sperm containing an X chromosome the resulting male lives and is like its father. The two exceptional daughters of the X-rayed females were mated to eosin-eyed miniature-winged males. The daughter which proved to be sterile was found on dissection to have only one undeveloped ovary. The other which was fertile produced 174 regular daughters, 198 regular sons, 1 exceptional daughter, and 5 exceptional sons. The

6 *Genetics,* Vol. 5, No. 5, 1920.

exceptional daughter (the F_2 from the X-rayed female) was fertile in a second mating with an eosin-eyed miniature-winged male (the first mating was sterile) and produced one exceptional daughter (white-eyed and normal-winged). Of the five exceptional males (F_2 from the X-rayed female) two were proved to be fertile. The exceptional female (F_3 from the X-rayed female) proved fertile when mated with an eosin-eyed miniature-winged male and produced one exceptional daughter (F_4 of the X-rayed female). Since only one of the two exceptional females was fertile more data is required before it can be assumed that the exceptional females formed as a result of X-rays applied to the egg are fertile and produce further exceptions.

The experiments described confirm my earlier findings that X-rays may be made to affect the germ cells and show further that the effect produced on the first generation, so far as at present investigated, is identical with primary non-disjunction.

The writer wishes to express his indebtedness to the Research Laboratory of the General Electric Company for their continued interest in this work, to Dr. T. H. Morgan and Dr. C. B. Bridges for helpful criticism and suggestions and to Mr. O. J. Irish for technical assistance.

JAMES W. MAVOR

UNION COLLEGE,
SCHENECTADY, N. Y.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

REPORT OF THE SECRETARY-TREASURER OF THE PACIFIC DIVISION FOR THE CALENDAR YEAR ENDING DECEMBER 31, 1921

January 1, 1921—Cash balance		$ 847.30
Receipts:		
Received from the permanent secretary's office	$1,639.00	
Affiliated societies	125.00	
Dues and fees	520.00	
Finance committee, Berkeley meeting	98.21	
		$2,382.21
		$3,229.51
Expenditures:		
Dues remitted to permanent secretary's office	$ 293.00	
Supplies	6.58	
Salary 1921	825.00	
Salary 1920	75.00	
Office assistance	300.00	
Postage and express	41.00	
Telephone and telegraph	20.45	
Expense general	5.00	
Membership campaign	81.60	
Finance committee, Berkeley meeting	5.34	
Ukiah Observatory donation	50.00	
		$1,702.97
January 1, 1922—Cash balance		$1,526.54

BALANCE SHEET, DECEMBER 31, 1921

Assets

Equipment	$ 235.73
Cash on hand	1,526.54
	$1,762.27

Liabilities

Permanent secretary's office	$1,426.54
Investment	235.73
Sundry creditors	100.00
	$1,762.27

SUMMARY OF ANNUAL DISBURSEMENTS FOR THE YEAR 1921

Supplies	$ 6.58	
Salary	900.00	
Office assistance	300.00	
Postage and express	41.00	
Telephone and telegraph	20.45	
Expense general	5.00	
Membership campaign	81.60	
Ukiah Observatory donation	50.00	
		$1,404.63
These disbursements have been made from funds derived as follows:		
Finance committee, Berkeley meeting	$ 92.87	
Affiliated societies (assessments)	125.00	
Initiation fees	230.00	
Receipts from the permanent secretary's office	956.76	
		$1,404.63

COMPARATIVE STATEMENT OF RECEIPTS AND DISBURSEMENTS FOR THE YEARS 1920 AND 1921

	1920	1921
Received from the permanent secretary's office:		
Balance on account 1919	$ 750.00	
Account 1920 and 1921	1,014.00	
Account 1921-1922		$1,639.00
Received from affiliated societies	115.00	125.00
Received from new members, dues	109.00	290.00
Received from new members, initiation fees	163.00	230.00

Received from finance committee, Berkeley		92.87
Annual disbursements	1,687.42	1,404.63
New members enrolled	37	55
Total enrollment at end of year	1,000	990

W. W. SARGEANT,
Secretary-Treasurer

THE AMERICAN ASTRONOMICAL SOCIETY

THE twenty-seventh meeting of the society was held at the Sproul Observatory, Swarthmore College, Swarthmore, Pennsylvania, from December 29 to 31, 1921. This was the second time that the society had met at Swarthmore in five years, and the meeting was well attended, about sixty members and guests being present.

Social events included a reception by President and Mrs. Aydelotte, and a special program was arranged for the second evening, when the society was privileged to listen to an address by Dr. William Romaine Newbold, professor of philosophy in the University of Pennsylvania, on the subject "Evidence contained in the Voynich Manuscript that Roger Bacon possessed a Telescope." There was also an exhibit of views of the life and surroundings at some of the large observatories. Sessions for papers were held on three days.

The schedule of meetings of the society, in the near future, was announced as follows: September, 1922, Yerkes Observatory; December, 1922, Cambridge and Boston; September, 1923, Mt. Wilson Observatory; December, 1923, Vassar College.

The program of papers was as follows:

Spectroscopic notes on some variable stars: WALTER S. ADAMS and A. H. JOY.

Partial explanation, by wave-lengths, of the K-term in the B types: SEBASTIAN ALBRECHT.

Possible periodicity in mean sun-spottedness: DINSMORE ALTER.

Demonstration apparatus for descriptive astronomy class: DINSMORE ALTER.

On absolute magnitudes: BENJAMIN BOSS.

The moon's motion; a postscript: ERNEST W. BROWN.

Median parallax; a statistical method: KEIVIN BURNS.

Résumé of results bearing on the absolute magnitudes of the stars: HEBER D. CURTIS.

Changes in the spectrographic elements of Y Sagittarii: JOHN C. DUNCAN.

On the daily variation in clock corrections: W. S. EICHELBERGER and H. R. MORGAN.

A new orbit of Neptune's satellite: W. S. EICHELBERGER and ARTHUR NEWTON.

Stellar parallaxes determined at Dearborn Observatory: PHILIP FOX.

A test of two methods of measuring parallax plates: JENNIE V. FRANCE.

The use of the stereo-comparator in determining proper motions: CAROLINE E. FURNESS.

Daylight observations with a transit circle: J. C. HAMMOND.

Daily variation in clock corrections and rates: J. C. HAMMOND.

Boulengé and Aberdeen chronographs: HENRY B. HEDRICK.

Kepler's problem for the higher planetary eccentricities: HERBERT A. HOWE.

The latitude of Ukiah and the motion of the pole: WALTER D. LAMBERT.

Preliminary discussion of the correction to the constant of nutation from day and night observations in declination of α Lyræ: ELEANOR A. LAMSON and GEO. A. HILL.

The discovery of faint nebular structure around R Aquarii: C. O. LAMPLAND.

The masses of binary stars: JOHN A. MILLER and JOHN H. PITTMAN.

Comparison of McCormick trigonometric parallaxes with spectroscopic: S. A. MITCHELL.

The position of Neptune's equator: ARTHUR NEWTON.

The orbit of comet 1788 II: MARGARETTA PALMER.

On the orbital eccentricity of binary stars of very long period: HENRY NORRIS RUSSELL.

Barium and lithium in the sun: HENRY NORRIS RUSSELL and K. T. COMPTON.

Four eclipsing variables observed by Hoffmeister: BANCROFT WALKER SITTERLY.

Increased ionization over solar faculæ: CHARLES E. ST. JOHN.

The spectrum of Venus; no oxygen or water vapor lines present: CHARLES E. ST. JOHN and SETH B. NICHOLSON.

A comparison of star positions derived with the doublet with the P. G. C.: FRANK SCHLESINGER.

Report of stellar investigations: HARLOW SHAPLEY.

Differential refraction on astronomical photographs: FREDERICK SLOCUM.

Notes on variable stars: JOEL STEBBINS.

The proper-motions of 154 red stars: RALPH E. WILSON.

JOEL STEBBINS,
Secretary

URBANA, ILLINOIS.

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A NATIONAL POLICY FOR AGRICULTURAL RESEARCH[1]

THERE should be a well-defined national policy in reference to agricultural research because such research relates to questions of fundamental national importance and the value of such research to the whole nation has been proved; furthermore, agricultural problems affecting the national welfare are becoming more and more numerous and complex and research must be enlarged to enable us to cope with them.

The policy should be to provide ample support for the investigation of problems relating to the decrease of cost of producing farm products and their more efficient distribution and marketing, the improvement of their quality, the conservation of soil fertility and the betterment of rural life.

The policy also should be to encourage cooperation of all public agencies engaged in agricultural research, and to provide for proper supervision,—enough of each to produce the highest possible efficiency and not so much as to hamper efficiency.

Sound arguments in plenty can be given to support these statements.

THE IMPORTANCE OF AGRICULTURE AS A FUNDAMENTAL INDUSTRY

About forty per cent. of the population of our country is engaged in agriculture. There are nearly six and one-half million (6,448,366) farms, including nearly one billion (955,676,545) acres. Each farm is an independent unit, and the character of the homes on these farms has a profound influence on the character of our nation.

The value of farm lands is estimated to be over sixty-six billion dollars ($66,334,309,556).

[1] Read at the President's Conference on the Agricultural Situation, Washington, D. C., January 26, 1922.

The value of implements and machinery is estimated to exceed three and one-half billion dollars ($3,598,317,021). The estimated value of live stock is nearly eight billion dollars ($7,996,362,496). The total of these great investments is about seventy-eight billion dollars ($77,925,989,073).

The value of the annual production of our farms far exceeds that of any other industry. It is equivalent to the value of all manufactures over the costs of raw materials. The value of farm products exported from the United States has averaged over two billion dollars ($2,062,000,000) per year the past ten years and constituted an average of 44.4 per cent. of all domestic exports.

In brief, it is sufficient to say that agriculture is our largest industry; it furnishes practically all of our food, the material for all of our clothes, the raw material for the larger part of the manufacturing industries of the nation, about one-half of the gross earnings of the railroads of the country, a consumptive market for nearly one-half of all the manufactured products sold on our markets and, lastly, agriculture furnishes a constant stream of rugged people who quickly find positions of service in the great centers of population.

THE PRESENT ORGANIZATION FOR RESEARCH

Research has been applied to all phases of human activities but research in agriculture has been relatively late in development. It came with a growing concern for the future of agriculture,—an appreciation that as long as man lives agriculture must be a permanent industry and as population increases agriculture must be increasingly efficient.

The policy of encouraging agricultural research started in the states. Agricultural experiment stations were established in Connecticut and California as early as 1875, in North Carolina in 1877, and in fifteen other states prior to 1887 when the Hatch Act became effective. In 1906 the Adams law was passed. Those two laws are formal acknowledgement by Congress that agricultural research is an important national question. Under each of these laws every state receives $15,000 annually for agricultural research, making $1,440,000 from the Federal treasury. State appropriations for the same purpose amount to about three million dollars annually. Research work in the states stimulated similar work in the Federal Department of Agriculture which is now by far the largest single organization conducting agricultural research. This department gives attention principally to problems of national or regional character, and engages in cooperative research work with the State experiment stations to a large extent. It would be impracticable for the Federal department to care for all the problems pressing for solution and wisely that is not attempted. The states are in intimate contact with their own problems and so far as funds permit give these problems prompt and usually sufficient attention.

THE RESULTS OF AGRICULTURAL RESEARCH

The benefits of agricultural research are so well known that it is hardly necessary to mention them. For example: A farmer produced pork at a cost of forty-four cents per pound until he made use of information gained from research and then he reduced his cost to four cents per pound. Through instruction based upon research and widely disseminated to the farmers, one state has shown how to reduce losses from the Hessian fly to the extent of twenty million bushels of wheat in four years,—and all this at only a nominal expense. Research has made it possible to continue growing important crops in sections of the country where some pest or disease was turning the farmers' efforts to naught. About ten years ago the United States Senate showed that scientific research in the Department of Agriculture, costing about five million dollars annually, had resulted in saving about five hundred million dollars annually.

Books could be filled with interesting stories such as how the cause of wheat rust was discovered and a remedy applied and how Texas cattle fever was placed under control and is being surely eradicated and many other similar exploits. Add to all this the development of improvements of animals and plants and of agricultural methods generally.

Research is the foundation of our whole

system of agricultural education in colleges and schools, through the Extension Service, and through agricultural journals and books. It also is the basis for regulatory laws and their enforcement.

It would be impossible to tell what would be the situation in this country if agricultural research had not been maintained. We know some of the most important improved varieties of plants and some of the better strains of animals would be missing. Some diseases of animals and food plants would be rampant. Great areas of soil now producing crops would be barren, and the production from still larger areas would be lowered. Farmers would be paying more for their supplies and some highly effective marketing methods would not be known.

MORE RESEARCH IS NEEDED

It is unfortunate that the research agencies of the country are unable to keep pace with the demands being made upon them. The experience of the past, the present situation, and a view into the future emphasizes the necessity of enlarging the system. A sound and efficient agriculture calls for more research. The development of some phases of agriculture, representing millions of dollars to farmers and to other citizens, awaits the enlargement of research activities. As the country becomes older and its population increases and quicker transportation is developed, new problems constantly appear. Some persons who are not informed think we are doing quite well at the present time and agricultural research might be kept on its present basis or even it might take a vacation for a few years. But the germs and the fungi now on their way to favorable locations throughout the country will not pause on their journey, and plant food will continue to be depleted when crops continue to be taken from the soil.

Research problems might be divided into two great groups. The first would include the new difficulties that are constantly arising and must be overcome to keep agriculture in its present position, such as a new insect pest. The second would include such questions as the improvement of existing methods which means a better agriculture. Originally the second group of questions constituted most of the research work performed. More and more questions in the first group have been coming to the front in recent years until now they demand a very large part of the research resources.

New methods for reducing cost of production, the better distribution of farm products, and better methods of marketing are sorely needed at this time. This is in the interest of the average citizen who buys all his supplies, because such methods will help to reduce the cost of living. This is in the interest also of farmers because better methods will increase the profits of farming. Both benefits are worthwhile. But a chief reason for decreasing the cost of farm production is the importance of holding our position in the markets of the world. We ought to get a better hold upon those markets especially in so far as certain manufactured farm products are concerned. If we wish to sell to Great Britain at a profit we must be able to make a lower price than others can make. We used to export about one hundred forty million pounds of cheese annually, but before the Great War these exports had fallen to two or three million pounds. We like to say that we are not exporting cheese because our larger population is consuming it all. But why did not our cheese production increase with our population? The chief reason was that Canada could do better than we could do in making a favorable price on cheese in the English markets. The outcome of such competition depends largely upon the results of our research for superior and less expensive methods.

Our natural resources plus our skill plus our shipping ability are in competition with the natural resources of other countries plus their skill plus their shipping ability plus their cheaper labor which involves lower living standards. If we are to win from them we must depend chiefly upon our superior knowledge. Some other countries have as good natural resources as ours. Sometimes they are even better because of virgin lands. Other countries have as favorable transportation. Most countries have cheaper labor. We must overcome their advantages by our knowledge which must be developed through research.

When we find an economy in feeding or some method of reducing cost per bushel or when we invent an improved harvester or perfect a silo, or when we find more direct and efficient methods of marketing, we are able to reduce our selling price and thus strengthen our hold on foreign markets. When we allow a mysterious disease or inefficient methods to increase the price we must ask whether we are losing our hold on foreign markets.

We must not forget that in other countries strenuous efforts also are being made to devise better methods through research in order to take the foreign markets away from us and even to invade our home markets. Thus far we have developed only a background of information regarding the great economic questions. We have hardly crossed the threshold in research concerning the adaptation of production to requirements and other such great economic problems.

Other vitally important subjects waiting to be studied as they deserve include the reforestation on farms and the betterment of rural life. There are many questions relating to the comfort and happiness of people who live in the country that are becoming constantly more acute. These include the whole sphere of the work of farm women. The failure to solve these questions is resulting in some of the best of type of farmers moving from the country to the city. Much needs to be done to show such people how to make country life as satisfactory as city life.

One other of many very important problems in need of research may be mentioned,—the conservation of soil fertility. This is the most important of our natural resources. It is easily removed but not easily replaced. We gather crops very much as we harvest lumber. Most people know how we have accomplished such an enormous production of lumber during the past few decades. We simply went into the forests which had required hundreds of years to grow and we took the trees that were wanted and even gave scant consideration to the welfare of other trees which might have become useful in later years. We have not considered how succeeding generations will get their lumber. We have proceeded on the basis that we might as well take it all. We point to our lumber kings as examples of great business ability. What will be said of them fifty years from now when the people of that day want lumber and find that the accumulated growth of centuries over large areas has been destroyed by our generation and even without much effort to start new trees for use in the future? Our cereal production has been carried along on about the same lines. If present practices continue this nation will awaken some day to the fact that we are more like arid Egypt or Babylon than the wonderful, fertile country that our historians tell us was discovered by Columbus.

Furthermore, we are allowing many square miles of good farm land each year to be washed away by our streams. This erosion supplemented by surface wash amounts to hundreds of millions of tons annually. These losses represent stupendous values which doubtless could be largely reduced through further research.

No one can tell what wonderful improvements in agriculture may be revealed in the future. We easily think of possible further advances along the lines we know about but these may be made secondary by other advances that we can not now even think of. Some persons believe that beneficial changes are yet to come in agriculture which are no less profound than the changes in transportation caused by the flying machine or in communication caused by the wireless telephone. Those two improvements are epoch making but were hardly within our range of thinking a generation ago.

I will not be so rash as to suggest that a tin Lizzie ever will give milk, but I will predict that some day power for the farm which now constitutes a chief item of expense will be obtained cheaply from the winds that blow over the farm. And with this cheap power I predict that some day we will produce the best of building materials, at lowest cost, from almost any soil. It may be aluminum.

I will predict also that if our plant and animal experts are given reasonable support they will find, in good time, new and good foods now unknown, and if our economists and other experts are given reasonable support they will show how our cities may be assured of an abundant supply of farm products at all times and at cost reductions that will exceed previous cost reductions that have been so welcome to both farmer and consumer.

DEVELOPMENT OF A POLICY

We should no longer delay the development of a more comprehensive national policy for agricultural research. It should provide for liberal federal and state financial support. The best recent testimony comes from the Congressional Joint Commission of Agricultural Inquiry (Congressional Record, December 14, 1921, page 421). Members of this Commission after a long and thorough study report as follows:

"Agriculture is subject to special hazards resulting from the weather and climatic conditions, animal and plant diseases and insect pests. These hazards reduce farming to a gigantic gamble. But methods of production can be adapted to the end of reducing losses from climatic and weather conditions to the minimum. Plant and animal diseases and insect pests can, to a certain degree, be controlled. But the means and the method of reducing or controlling these hazards can not be worked out on the farm by the individual farmer. The investment even of the largest is not sufficient to permit the maintenance of the organization necessary for the study and formulation of these means and methods. A program of agricultural development therefore must include provisions for an expanded and coordinated program of practical scientific investigation, through State and National departments of agriculture and through agricultural colleges and universities, directed toward reducing the hazards of climatic and weather conditions and of plant and animal diseases and insect pests."

One strong reason for using public funds to support agricultural research is that the knowledge to be derived should be made available to every farmer throughout the country who wants it. It should never happen in this country that knowledge relating to agricultural production shall be limited in its application to private interests because it was developed at the expense of those interests. It may not be improper in other lines of business for individuals or concerns to have a monopoly on knowledge and thus enable them to develop a business monopoly. But this should never be possible in agriculture. A cornerstone of our national strength is the independent farm families who are able to maintain themselves on an independent basis because every farmer is entitled to know all of the secrets of his business that anyone knows.

APPRECIATION OF AGRICULTURAL RESEARCH

(1) What should be insured first in a national policy? Agricultural research needs first of all the appreciation and good will of the public. Until this is given the research will be heavily handicapped.

Secretary of Agriculture Wallace declares that research is the basic work of his department and it is research that little by little is crystallized into agricultural progress. The public should get this idea. The Congress and legislatures should have it. An intelligent appreciation of agricultural research, especially among leaders and public men, a genuine respect for it, an understanding of its importance and its requirements, are the primary essentials in developing an effective national policy. Such an appreciation exists today but in a very restricted sense. Belief in the importance of research is too much of an abstract character, an acknowledgement that it is useful in a general way, an acceptance of the fact that it is desirable, but without real sympathy for it or understanding of its requirements. Thus the public fails to demand it in order that the nation's interests may benefit. One thoughtful student gives as one of the reasons for advocating national support for agricultural research the fact that national appreciation needs the stimulus of direct interest which comes with the discussion of the subject in the halls of Congress and the making of an appropriation. There are, however, other and better arguments.

An intelligent appreciation of agricultural research is not evidenced in any large way by the recent action of Congress, let us say a very few members of Congress, by which the publication of two periodicals in the interest of agricultural research was suddenly ordered discontinued along with a lot of other publications of questionable value, most of which had developed during or soon after the war period. There is encouragement in the fact that some leading members of Congress were not informed as to what was occurring but now realize that a serious mistake has been made and are ready to help correct it.

ESSENTIALS FOR RESEARCH

Well trained men and ample funds are the essentials for research. It should be a national policy to train and encourage in every way possible the right kind of men and women and to supply funds to meet their reasonable needs in research work in the interest of agriculture.

(2) Efforts should be made always to encourage young men and women who have ability and inclination of the right kind, to prepare themselves for research work. Special scholarships and fellowships should be provided by the agricultural educational institutions to enable such persons to complete their fundamental training and later assistantships should be provided to bring them into helpful contact with older and well trained investigators and due credit should be allowed for their own efforts. As they advance in ability and in getting worthwhile results their compensation should be reasonably increased. Care should be taken to make this compensation as attractive as is provided for persons of corresponding ability and service in allied lines of work. Failure in this respect in recent years has resulted in heavy losses from the ranks of research workers in the Department of Agriculture and in State experiment stations. During a period of about six years, including the war, there was a change of nearly eighty per cent. in the scientific personnel engaged in agricultural research throughout the country. Many of the younger men went into war service, but the greater losses to agricultural research came from the resignation of older men who took other more renumerative positions. The overturn has been exceedingly large since the war. On this account, and without reflection upon those who have continued in research work or who have recently gone into that work, it must be admitted that research to-day, instead of being the strongest link in the chain made up of research, college education, and extension work, is the weakest link. Research is the least able of the three to meet the demands it should care for.

Funds for the support of agricultural research as now available represent such a small percentage of the interests concerned that they are almost negligible by comparison. They represent a much smaller per cent. of value of output than is so expended by many a manufacturing plant in the interest of its output.

(3) A principal requirement as to funds is assurance of permanent income. Without such assurance strong men can not be induced to prepare themselves adequately for research nor can they be retained in this work. Too often it has been necessary to stop important experimental work because of failure to continue appropriations. No one can tell what losses have been suffered because important projects after being conducted for an extended period of time had to be discontinued with the failure of appropriations before the final results had been secured.

(4) As agricultural research relates in such large measure to national problems, and the work done in one state is of value in many states and as agriculture is such a large factor in all business, it is right that national funds should be used in promoting agricultural research in the different states. A precedent has been furnished, and a national policy for agricultural research should provide for enlarging these national appropriations by small increments for a few years until they have reached amounts commensurate with present demands, as specified in the Purnell Bill, which would provide fifteen thousand dollars annually additional to each state for experiment station work and an additional ten thousand each year until the amount is eighty-five thousand dollars. These appropriations would be equivalent at the start to less than one cent per capita per year and would finally increase to about

four cents per capita. This measure, or other similar relief, should be enacted as soon as possible. It is preferable from the standpoint of efficiency to make the appropriation with the fewest possible conditions, as was done in the Hatch and Adams Acts, rather than to continue the requirement for offset funds, as provided in the Smith-Lever and Smith-Hughes Acts. As compared with the Federal government it seems that the states now are carrying their full share.

In considering appropriations for agricultural research it is well to remember that when our taxes are increased for this purpose our involuntary taxes, or those which are levied by powers beyond our control, are decreased many times more than the voluntary taxes are increased.

COOPERATION AND SUPERVISION

(5) A national policy fostering agricultural research should provide for more definite and constructive cooperation by research agencies than now obtains.

(6) It must provide also for certain supervision to assure the proper use of public funds, and this is expected and welcomed. A reasonable amount of cooperation and supervision is stimulating. An excess is deadening.

(7) A more definite agreement on the fields to be occupied by the Department of Agriculture on the one hand and by the State experiment stations on the other hand, with better coordination of work and a larger provision for joint effort, should form a part of the policy for further developing agricultural research. Such a definition of function and joint effort would guard against undesirable duplication and would result in better directed efforts. Details should be worked out by representatives of the Secretary of Agriculture and the agricultural colleges and when properly approved should form a fundamental law. Once each year this joint agreement should be considered by duly chosen representatives for the purpose of making it more perfect. Among other things, it should provide for the wise selection of projects for investigation and for inviting experiment stations in different states or the Federal Department of Agriculture to give attention to different phases of a project requiring investigation at different places. All projects should be briefly but clearly described and recorded in the Department of Agriculture at Washington and all interested persons should be informed as to the kinds of work in progress. From time to time, at least once a year, the progress of each project should be officially reported and checked. When a project is undertaken, work on it should continue to a reasonable extent until it is finished or formally set aside, and care should be taken not to provide for starting new projects for any laboratory or station when it has too many projects unfinished.

(8) While a national policy for agricultural research should not enter the details of local administration, it should encourage the types of organization which would be most efficient.

SHALL WE HAVE AMPLE AGRICULTURAL RESEARCH?

An effort has been made to suggest a picture of our country as it would be without properly supported agricultural research, and again with such research. If this work is properly developed, agriculture will continue on a permanent and profitable basis in the face of ever increasing obstacles. And this nation with a strong agriculture will continue to furnish its own great commodities which come from the farms and will profit further from large sales of the surplus in other countries. The time is ripe for stimulating a national policy for agricultural research which will contribute to this great end.

Raymond A. Pearson
Iowa State College of Agriculture and Mechanic Arts

THE 1921 EXPEDITION OF THE CALIFORNIA ACADEMY OF SCIENCES TO THE GULF OF CALIFORNIA

In the spring of 1921 the California Academy of Sciences sent a well-equipped scientific expedition to the Gulf of California. The purpose of the expedition was primarily to make as thorough study as possible of the fauna and flora of the islands in the Gulf and of certain important localities on the adjacent mainland of Sonora and Baja California, and to make collections of research and museum materials in the various departments of zoology, botany and geology.

While several scientific expeditions have in the past visited the peninsula of Lower California, little attention has been given to the islands in the Gulf, of which the Coast Survey charts name about 30; in addition to these there are several rocks or small islets unnamed or not shown. Only five of these islands have more or less permanent inhabitants. Tiburon, the largest, is the home, for a portion of each year of the Seri or Koonkat Indians who visit it for hunting and fishing. San Marcos, Ceralbo, Carmen and San José are the locations of various industrial plants of some little importance; practically all islands of any considerable size are visited now and then by prospectors of various sorts. Some of the islands have become known because of the presence of salt beds, others because of guano deposits of considerable value; and these last with still others are the breeding grounds of vast numbers of sea birds. Visits of scientific men to these islands have been few and brief. Enough was known, however, to justify the belief that a careful exploration would yield collections and knowledge that would prove of great popular interest as well as scientific value.

The scientific staff of the expedition consisted of the following: Joseph R. Slevin, herpetologist, in charge; Edward P. Van Duzee, entomologist; Dr. Fred Baker, conchologist, paleontologist and physician; Ivan M. Johnston, botanist; Virgil W. Owen, ornithologist and mammalogist; and Joseph C. Chamberlin, general assistant. In addition to the Academy representatives, the expedition was fortunate in having two collaborators from the Mexican government, Señor Francisco Contreras, director and conchologist, and Señor Carlos Lopez, chief taxidermist of the Museo Nacional de Mexico.

The Academy chartered the gasoline schooner *Silver Gate*, 64 feet 6 inches over-all, 15 feet beam, 9 feet draft when loaded, 22 tons net, cruising radius 2,000 miles, and capable of making 8 knots per hour. The vessel was in command of Captain John Ross whose intimate acquaintance with the Gulf and its islands was of very great help to the expedition.

The issuance of the permits for exportation from the United States of the firearms and the alcohol necessary for the collecting and preservation of specimens was most exasperatingly delayed at Washington, and it was not until Honorable Julius Kahn and the Secretary of State were appealed to that action was gotten. Mr. Kahn secured the waiving of certain formalities and the necessary permits were issued. The Mexican government very promptly granted authority to the Academy to bring into Mexico the necessary equipment and to carry on the desired investigations in Mexican territory.

The various members of the party joined the *Silver Gate* at Guaymas, from which place the expedition set sail April 16.

The total number of days spent in the field was 87, and the number of miles cruised was 1811. Thirty-seven different islands were visited, some of them more than once. In addition to these, 14 stations were made on the coast of Lower California, and five on the coast of Sonora. Altogether, 96 collecting stations were occupied.

The Gulf of California is celebrated for its sudden and violent gales, but the itinerary of the *Silver Gate* was arranged with this in mind; with the results that no severe gales were encountered, no time was lost on account of adverse weather conditions, and the work was carried out essentially as originally planned.

The scientific results of the expedition are very satisfactory. Unusually large collections were made in most of the groups.

In entomology, more than 13,000 specimens were secured, a remarkable result when the arid, volcanic character of the country is considered and the further fact that the collecting was done at the close of the dry season when insects are fewer than at any other time. The collection of spiders, pseudoscorpions and myriopods secured by Mr. Chamberlin is particularly complete and valuable.

Perhaps the most remarkable collection of all is that of reptiles and amphibians secured by Mr. Slevin, totaling more than 3,000 specimens. Every species previously known from the islands is represented by one or more specimens, and several species new to science were secured.

Very large and complete collections of the botany of the islands were secured by Mr. Johnston. In addition to a large number of dried specimens secured for the Academy's rapidly growing herbarium, a considerable number of living cactuses were sent direct to Dr. J. N. Rose at the United States National Museum, who with Dr. Britton, is monographing that group.

Owing to the unfortunate illness of Mr. Owen, during much of the cruise the collections of birds and mammals are small; however, good series of eggs of several species of birds were secured, particularly of Heermann's gull, and elegant and royal terns.

Dr. Baker secured a very extensive collection of mollusks particularly of shallow-water species. As the vessel was not equipped for dredging in deep water, not much was done in that line. Valuable collections of fossils were obtained at several places where fossils had not been previously known to exist. Dr. Baker also rendered invaluable service in his capacity as physician to the expedition. Through his constant attention to the drinking water supply, the food, and all other matters pertaining to health conditions on the ship, no serious illness due to local conditions appeared at any time.

A record of water temperatures was kept throughout the cruise and samples of water were taken, all of which have been turned over to the Scripps Institution for Biological Research for use in its oceanographic studies.

Small collections of marine algæ, fresh-water fishes, and marine invertebrates were made.

All of the collections have now arrived at the Academy's Museum in San Francisco. Specialists are already at work upon them and the results of their studies will appear in due time in the Proceedings of the California Academy of Sciences.

Mr. Slevin as chief of party performed his duties with excellent judgment and rare tact. All members of the staff showed a fine spirit of cooperation and a degree of enthusiasm and industry highly commendable. Collaborators Contreras and Lopez proved most agreeable and helpful members of the party and contributed materially to the success of the expedition. Through their relations with local officials of the Mexican government they were able to render very great assistance in many ways. Captain Ross was an ideal commanding officer who appreciated the aims and purposes of the expedition, and was always ready to do anything possible that would contribute to its success.

The uniform courtesy shown by local government officials was very gratifying and was highly appreciated by all members of the expedition, as it is by the Academy.

Special mention should be made of courtesies extended by the United States officials with whom the members of the party came in contact, particularly Mr. J. A. McPherson, United States Vice-Consul at Guaymas and Mr. Francis J. Dyer, United States Consul at Nogales, Sonora.

On the whole, the expedition is regarded by the Academy as having been a very successful one, the results of which when published will add much to the knowledge of the natural history of the region.

G. DALLAS HANNA
CALIFORNIA ACADEMY OF SCIENCES

APPEAL OF THE AMERICAN CHEMICAL SOCIETY

A SMALL group of chemists, gathered together in 1876, founded the American Chemical Society. For several years the society was localized in its nature. Its journals were of little scientific importance, and its membership grew slowly. At least twenty-five years passed before it gained strength. Its growth really started when it eliminated classes of membership, became a democratic organization, and interested chemists throughout the country. As its membership began to increase, its one journal, the *Journal of the American Chemical*

Society, took on character and standing. Members came in rapidly so that in 1907 the society had accumulated a slight surplus and felt it could branch out in the publication of a second journal, *Chemical Abstracts,* for which there was a decided need. With the publication of *Chemical Abstracts* chemists realized that the American Chemical Society was to be the central organization for chemistry in America and was interested solely in the advancement of American chemistry and the welfare of American chemists. With increasing numbers its income grew and in 1909 it was able to satisfy another crying need by publication of the *Journal of Industrial and Engineering Chemistry.* The increasing activities of the society so pleased the chemists of America that new members continued to join the society, and the society grew. With numbers its income further increased, and it was able to spend more money on its varied activities and improve the quality and size of its journals. More money was spent on its general meetings and more money was returned to its local sections for activity throughout the country.

With the war came added duties. Its president and council placed the society at the disposal of the government and through its efforts over 4,000 chemists were enrolled, as such, in uniform for chemical work during the war. At the same time practically all of its membership, in uniform and out, was engaged directly or indirectly in war work.

Up to this time the literature of the American Chemical Society had had for its main object the enlightenment of chemists. During the war it became apparent that it was extremely important that correct chemical information be also furnished to the public through the daily press and the *News Service* was organized. A year later in order to foster the growth of chemical literature in English the American Chemical Society established its series of *Chemical Monographs,* both scientific and technological, and assigned a paid editor to each. Again the society induced the Research Council, with the society's support, to enter upon the compilation and publication of *Critical Tables of Chemical and Physical Constants.* In 1917 the society published, at a cost of approximately $40,000, a *Decennial Index to Chemical Abstracts* and in 1920 entered upon the publication of an annual formula index to *Chemical Abstracts.*

The inception and continuation of each of these activities was made possible only by the increased number of chemists supporting the American Chemical Society and its resultant increase in income. Each was inexpensive in its infancy but with growth increased in cost. This growth is made apparent by the following table:

	1907	1921
Membership	3,400	15,000
Jour. Amer. Chem. Society, Cost	$ 6,752.18	$ 48,000.00
Chemical Abstracts, Cost	12,668.05	100,000.00
Jour. Indus. and Eng. Chem., Cost (1909)	7,478.70	82,000.00
A. C. S. News Service, Cost (1919)	2,069.88	13,000.00
Chemical Monographs, Cost		2,150.00
Local Sections, Cost	2,323.63	9,792.69
Total society expenditures, Cost	27,248.89	325,000.00

The society's success has been due to its democratic organization; to the fact that every member has an equal voice in its affairs; to its form of government; to its sixty local sections, patterned after our national government, each electing representatives to the governing body; to the easy removal and constant rotation of its officers and representatives; to the high character of its publications; but chiefly to the fact that through numbers it has been able to accomplish results and return to its membership much more for each dollar individually expended than can be shown by any other technical society in any country in the world. According to the treasurer's report published in 1921 the expenditure per member for 1920 was as follows:

Journal	$ 3.23
Abstracts	5.84
Industrial Journal	4.84
News Service	.57
Local Sections	.55
Secretary's Office	1.43
Treasurer's Office	.22
President's Office	.02
General Meetings	.12
Monographs	.15
Miscellaneous	.07
Total	$17.04

The total expenditure of several hundred thousand dollars was made possible simply by the size of the membership. The success of the society was due first to the character of its work and second to the fact that it has more technical men, representing one profession, gathered together and working together for the development of their profession than any other society in the world.

All members will appreciate the necessity of a high quality of work but will not appreciate without explanation the need of large numbers working as a unit. This is, however, easily shown. With numbers the society can increase its output chiefly for the reason that every additional member helps diminish the overhead per individual. The journals must be published, and it costs just as much for editorial office and composition whether the publication is distributed to one or twenty thousand individuals. It is only because the members of the American Chemical Society take all three journals that it is possible to publish them at all, for the cost of "putting on the press" is by far the larger part of the cost of publication. Each additional copy is printed at a comparatively small additional cost. Accordingly, every additional member adds just so much to the surplus which the society has to spend. The return which the American Chemical Society gives to its members is the envy of other organizations throughout the world and is constantly referred to as a model of efficiency.

This data is sent to you to impress you with your individual responsibility if you wish the work of the American Chemical Society to continue and its influence for the development and continuation of chemical science and chemical industry to increase. It is the duty of every member to stand by and do his part not simply by the continued payment of his annual portion and by personal activity in the affairs of the society itself, but he should especially endeavor to impress the 10,000 individuals still in America who should be, but who are not, supporting its work. If this additional 10,000 would join with the 15,000 we now have, the activities of the American Chemical Society could be more than doubled. Few of the 10,000 realize the fact that they are carrying no part of the burden and are shirking their duty to the profession. By not associating themselves with the movement, they are not only enjoying the results of the labors of others, but also, are actually retarding the progress of the profession through which they are supposed to gain their livelihood. There is not a chemist in America that cannot afford to support the work of the American Chemical Society. In fact, there is not a chemist in America that would not gain financially in dollars and cents if he, as an individual, attended regularly the meetings of his local section and the general meetings of the society in order to rub shoulders with his fellows; to keep in touch with his profession and to rid himself of the effect of professional solitude from which too many of our American chemists suffer to-day. He would gain much inspiration; he would learn himself and transmit knowledge to others; he would increase in aptitude and in spirit; and from continued professional contact with other chemists he would acquire a viewpoint toward life which would be sure to return to him much more than the amount expended.

Until 1921, the curve of membership, the curve of expenditure, and the curve of profitable chemical output within the American Chemical Society went steadily upward. In 1921 the severest depression in chemistry took place that has ever befallen our country. The membership has, accordingly, somewhat declined, although by far the majority of the members have stood by, some at real personal sacrifice. The decrease in membership, in spite of conditions, has been only between 6 and 7 per cent. This decline in numbers has, however, immediately made itself felt in the society's ability to turn out productive work. As a result, the directors at their recent meeting were forced, much against their will and in face of an increased demand for space, to reduce the pages of each one of our three journals by 10 per cent., to decrease the activities of the *News Service* by a still larger percentage, and to discontinue the publication of the formula index of *Chemical Abstracts*. If the membership falls off further with the continued industrial depression, other activities of the society will also have to be retrenched. It, therefore, behooves every member of the society, if he wishes for a recovery of chemical activity in our country, not only to himself continue to support the work of the society through the period of depression, which is sure to be temporary, but also to see that every other reputable person in America interested in chemistry comes into the society to give it new life, new vigor and increased resources.

SCIENTIFIC EVENTS

AN INSTITUTE OF HYGIENE IN LONDON[1]

It has been known for some time that the Rockefeller Foundation has been seriously considering the recommendation for the establishment of an Institute of Hygiene, contained in the report of the post-graduate medical committee published last May (the Athlone committee). The recommendation was that an Institute of State Medicine should be established in London with well equipped laboratories and an efficient staff. It was further recommended that the institute should also provide instruction in other directions, including courses in forensic medicine, toxicology and industrial medicine.

These recommendations were considered by an expert committee, with the minister of health as chairman. In view of the difficulty at present of financing the scheme, the whole case was put before the Rockefeller Foundation as one in which they might think it well to coöperate in the general interest of progress in public health.

The minister of health has announced that the Rockefeller Foundation have offered to provide a sum of two million dollars towards the cost of building and equipping an Institute or School of Hygiene in London, on the understanding that the British Government accept the responsibility of providing for the staffing and maintenance of the school when it is established. This generous offer has been accepted by the minister of health on behalf of the government.

Hygiene, like other departments of medicine, knows no boundaries. In that sense this fine gift is made for the benefit of international medicine, but this country is grateful to the Rockefeller Foundation that it should have been selected. The Athlone committee estimated that the cost of maintaining an Institute of State Medicine would be about £10,000 a year. The scale on which the Rockefeller gift will make it possible to establish the Institute of Hygiene (it amounts at the present rate of exchange to over £400,000) will call for a larger expenditure for staff and maintenance; we have heard it estimated at £25,000 a year. Those familiar with the Athlone report will remember that it proposed to associate the institute with the University of London. This recommendation, it would appear, is not to be carried out, and the annual expenditure will therefore not come out of moneys at the disposal of the university grants committee, but will be found by a special vote of Parliament. The intention is, we believe, that the Institute of Hygiene shall be administered by a mixed committee, representing the various bodies interested, for it is to be remembered that London already possesses certain important elements of an institute of hygiene.

[1] From the *British Medical Journal*.

COOPERATION BETWEEN THE GOVERNMENT AND INDUSTRY IN STANDARDIZATION

At the request of the Honorable Herbert C. Hoover, secretary of commerce, the American Engineering Standards Committee has designated Mr. A. A. Stevenson, the retiring chairman of the committee, as a special representative to work with the department in the coöperation between its division of simplified practice and the American Engineering Standards Committee.

The division of simplified practice is a coordinating unit of the Department of Commerce assisting in those reductions of excessive variety and other simplifications which many industries are undertaking in order to decrease the cost of production and distribution of manufactured articles. The work of the division was organized in the latter part of 1921 and is now actively under way.

The American Engineering Standards Committee, which serves as a national clearing house for a broad field of engineering and industrial standardization, has offered Secretary Hoover the use of its machinery in carrying out the detailed work on technical projects initiated in the simplification program of the Department of Commerce. The committee hopes to be of great value to Mr. Hoover in this simplification program of the department. It was as a result of this hope that the designation of Mr. Stevenson as a representative came about.

The American Engineering Standards Committee has been actively at work somewhat over two years, during which time it has brought about a large measure of industry-wide cooperation. In this work more than a hundred national organizations are participating through representatives officially designated by them. The formulation of the standard for each specific project is in the hands of a working committee made up of representatives officially designated by the various bodies concerned. Eighteen standards have received formal approval as nationally recognized standards, and work on more than sixty other projects is in various stages of development. The committee is maintained jointly by twenty-nine national organizations, including five departments of the federal government, nine national engineering societies, and fifteen national industrial associations.

There are now similar national industrial standardizing bodies in thirteen foreign countries, all but one of which were formed during or since the war. Of these the British and the German work is the most extensive, but active and important work is going forward in other countries.

COMPETITIVE EXHIBITION OF PHOTOGRAPHS OF MAMMALS AT THE AMERICAN MUSEUM OF NATURAL HISTORY

THE American Museum of Natural History plans to hold a competitive exhibition of photographs of mammals at the time of the annual meeting of the American Society of Mammalogists. These photographs will be exhibited in the halls of the museum and all entries must be made on or before May 10. These photographs will be on exhibition to the general public for one month. Prizes will be offered for the best photographs, and the conditions of entry are as set forth below:

1. Only such photographs will be accepted for exhibition as are deemed suitable by the committee.

2. Photographs will be exhibited and judged under two categories: *first,* photographs of mammals in the wild state; *second,* photographs of mammals in captivity. Photographs of domestic mammas are not desired.

3. The American Society of Mammalogists will be asked to select the judges who will award the prizes.

4. Photographs may be of any size, but they should be affixed to cardboard or paper mat, preferably gray. No photograph should be sent unmounted. Contestants may submit any number of photographs.

5. The installation of the exhibition will be done by the museum, and all entries will be returned, postpaid, if desired by the exhibitor. The museum, however, would be pleased to accept for its files any photographs of especial interest. While the museum will exercise every possible care of the material exhibited, it does not assume any responsibility for loss or damage.

6. Cash prizes will be awarded as follows: for the best photographs of mammals in the wild state: First prize, $100; second prize, $60; third prize, $40; for the best photographs of mammals in capitivity: First prize, $50; second prize, $30; third prize, $20. A certificate of honorable mention will be awarded to not more than five additional exhibitors in each category.

Committee on exhibition: H. E. Anthony, Herbert Lang, Robert C. Murphy, G. Clyde Fisher.

ANNUAL MEETINGS OF THE AMERICAN GEOPHYSICAL UNION AND ITS SECTIONS

THE American Geophysical Union and its several sections met, March 6-8, at the offices of the National Research Council, Washington, D. C., to hear reports of committees, to consider the agenda for the meetings in Rome, May, 1922, of the International Geodetic and

Geophysical Union, and to elect officers. The meetings were well attended and several of the sections reported gratifying progress in their respective fields.

The delegates selected to represent the Union and its sections at the Rome meetings are:

Geodesy: Wm. Bowie, United States Coast and Geodetic Survey, Washington, D. C.

Seismology: Harry Fielding Reid, Johns Hopkins University, Baltimore, Md.

Meteorology: H. H. Kimball, United States Weather Bureau, Washington, D. C.

Terrestrial Magnetism and Atmospheric Electricity: L. A. Bauer, Carnegie Institution, Washington, D. C.

Physical Oceanography: G. W. Littlehales, Hydrographic Office, Washington, D. C.

Volcanology: H. S. Washington, Geophysical Laboratory, Washington, D. C.

The officers, as of July 1, 1922, are:

The Union: L. A. Bauer, *chairman;* A. L. Day, *vice-chairman;* Wm. Bowie, *secretary.*

Geodesy: John F. Hayford, *chairman;* R. L. Faris, *vice-chairman;* N. L. Bowen, *secretary.*

Seismology: W. J. Humphreys, *chairman;* J. B. Woodworth, *vice-chairman;* D. L. Hazard, *secretary.*

Meteorology: E. H. Bowie, *chairman;* R. DeC. Ward, *vice-chairman;* A. J. Henry, *secretary.*

Terrestrial Magnetism and Atmospheric Electricity: W. F. G. Swann, *chairman;* L. A. Bauer, *vice-chairman;* J. A. Fleming, *secretary.*

Physical Oceanography: J. P. Ault, *chairman;* G. W. Littlehales, *vice-chairman;* W. E. Parker, *secretary.*

Volcanology: L. H. Adams, *chairman;* T. A. Jaggar, *vice-chairman;* R. B. Sosman, *secretary.*

Geophysical Chemistry: H. S. Washington, *chairman;* Whitman Cross, *vice-chairman;* R. B. Sosman, *secretary.*

W. J. Humphreys,
Secretary for the Union

LECTURES ON LIGHT AND THE CONSTITUTION OF MATTER AT THE UNIVERSITY OF WISCONSIN

Professor H. A. Lorentz, of Leiden, Holland, is delivering a series of four lectures on the general subject of Light and the Constitution of Matter at the University of Wisconsin from March 20 to 27. Following the lectures, on March 30, 31, and April 1, a colloquium, on the "Fundamental concepts of electro-dynamics and of the electron theory," will be held in his honor. As shown in the following program, the papers presented will summarize the present status in various fields with especial reference to the unsolved problems and the relation between theory and experiment. Dr. Lorentz will respond to each, and general discussion will be invited. The university extends a cordial invitations to attend both the lectures and the colloquium to all persons interested.

Program:

Thursday, March 30

The experimental basis for the laws of electrodynamic action: W. F. G. Swann, University of Minnesota.

Astrophysical evidence concerning radiant energy: Harlow Shapley, Harvard Observatory.

Deduction of the laws of electro-dynamics from the relativity principle: Leigh Page, Yale University.

Analytical formulation of electro-magnetic theory through the field concept: Max Mason, University of Wisconsin.

Friday, March 31

The rotating earth as a reference system for light propagation: L. Silberstein, Research Laboratory, Eastman Kodak Company.

Application of statistical mechanics to electron theory: A. C. Lunn, University of Chicago.

Scattering of light and resonance radiation in relation to optical theories: R. W. Wood, Johns Hopkins University.

Thermal radiation,—a discussion of recent experimental results: C. E. Mendenhall, University of Wisconsin.

Saturday, April 1

Electron theory of metals, volume phenomena: P. W. Bridgman, Harvard University.

Electron theory of metals, surface phenomena: K. T. Compton, Princeton University.

SCIENTIFIC NOTES AND NEWS

Dr. Frank Schlesinger, director of the Yale Observatory, has been elected chairman of the American delegation to the meeting of the International Astronomical Union that opens at Rome on May 2. Other members of the delegation are Messrs. Aitken, Curtis, Lee, Miller, Russell, St. John, Seares and Shapley.

Dr. H. Foster Bain, director of the Bureau of Mines, was elected president of the Joseph A. Holmes Safety Association at its annual meeting at Washington, D. C., last week. Dr. Charles D. Walcott, secretary of the Smithsonian Institution, was named first vice-president, and Mr. Samuel Gompers, president of the American Federation of Labor, second vice-president. Mr. George S. Rice, chief mining engineer of the bureau, and Mr. James Lord, of the mining department of the American Federation of Labor, were elected directors.

WILLIAM M. CORSE, general manager of the Monel Metal Corporation, will take active charge of the division of research extension of The National Research Council on April 1, succeeding Dr. H. E. Howe, now editor of *The Journal of Industrial and Engineering Chemistry.*

O. M. BUTLER has resigned his position as assistant director of The Forest Products Laboratory, in order to accept the position of director of technical activities of the American Forestry Association.

THE nominating committee of the Harvard Alumni Association has selected Dr. William Sidney Thayer, Baltimore, former president of the Association of American Physicians, and Dr. Herbert Charles Moffitt, San Francisco, professor of medicine, University of California, as candidates for the Harvard board of overseers.

MRS. ANNA BOTSFORD COMSTOCK, who retired in September from a professorship of entomology at Cornell University, has been nominated for election as alumni trustee.

THE University of London labor party has adopted as its parliamentary candidate, Dr. W. H. R. Rivers, F. R. S., praelector in natural science, St. John's College, Cambridge. Mr. Sidney Webb, the candidate at the last election, who is standing for another constituency, proposed the adoption of Dr. Rivers, and among those who spoke in his support was Sir Arthur Newsholme, who described Dr. Rivers as the most advanced and original anthropologist in England.

PROFESSOR F. G. HOPKINS and Dr. W. H. R. Rivers have been elected members of the Athenæum Club for "distinguished eminence in science."

DR. WOLFGANG KÖHLER has been appointed director of the Berlin Psychological Laboratory, to fill the vacancy caused by the retirement of Professor Stumpf.

PROFESSOR W. W. WATTS, F. R. S., has been appointed representative of the University of London at the International Geographical Congress to be held in Brussels next August.

DR. A. W. PORTER, D. Sc., F. R. S., has been appointed a member of the council of the British Photographic Research Association.

FRANK R. ELDRED, for many years chief chemist and director of the scientific division of Eli Lilly and Company, and Frederick C. Atkinson, chemical director of the American Hominy Company, have organized the firm of Eldred and Atkinson, consulting chemists and engineers, with offices in New York City.

DR. CHARLES A. CULVER, formerly in charge of the physics department of Beloit College, Wisconsin, was recently elected president of the Radio Research Club of Canada.

THE Board of Regents of the University of Minnesota have granted Professor F. L. Washburn, of the division of entomology and zoology, a six months' sabbatical furlough to collect insects in certain islands of Polynesia. Expenses of the trip are not paid by the university, but are provided for through private funds and interest in the work on the part of a group of business and professional men in Minneapolis. Mr. Washburn will make collections on Tahiti, Murea, probably the Marquesans and possibly in the Cook group. The collection will be the property of the university.

DR. FRANCIS W. PEABODY, assistant professor of medicine at Harvard University, who was recently appointed director of the Thorndike Memorial Institute, who has been acting in an advisory capacity and holding clinics for the department of medicine of the Peking Union Medical College during the first trimester, has left for home. On his way back, he will visit the medical schools of the Shantung Christian University at Tsi-nen-fu and of the Yale-in-China mission at Changsha.

Dr. William Bowie gave recently two lectures to the students of Lehigh University; one was on the subject of "isostasy" for the geological students, and the other "the work of the Coast and Geodetic Survey" before the students' civil engineering society.

Professor G. Elliot Smith recently delivered the Montgomery lecture before the Royal College of Surgeons of Ireland on the "Influence of Vision in the Development of Man's Intellectual Powers." Professor Smith also lectured to the Royal Zoological Society of Ireland on "Our Rude Ancestors."

On March 2, Professor H. M. Lefroy delivered the first of two lectures at the Royal Institution on (I) "The Menace of the Insect Pest" and (II) "The Balance of Life in Relation to Insect Pest Control." On March 4, Sir Ernest Rutherford began a course of six lectures on "Radio activity."

At the meeting of the Royal Society, held on March 9, the Bakerian lecture was delivered by Professor T. R. Merton and Mr. S. Barratt. The lecture was entitled "The Spectrum of Hydrogen."

The British Institution of Electrical Engineers began the celebration of its jubilee on February 21, when at its house on the Victoria Embankment Professor J. A. Fleming gave a lecture on "Michael Faraday and the Foundations of Electrical Engineering." Many of Faraday's original experiments were repeated, and on the lecture table were some of the original apparatus he employed, lent by the Royal Institution, where all his work was done. The Science Museum at South Kensington also lent models and examples of early electrical machines.

Dr. Charles W. Waidner, chief physicist of the Bureau of Standards, known for his studies of temperatures and heat measurements, died at his home in Washington on March 11.

Boynton Wells McFarland, assistant professor of chemistry at Yale University, died at his home in New Haven on Monday, March 13, after a brief illness.

Dr. Fritz Hennings, professor of railway construction at the Zürich Technical High School, died on February 2, at the age of eighty-three years.

Professor C. B. Atwell writes: "It is our sad duty to announce the death, on March 4, of Associate Professor William Logan Woodburn, who for twelve years has been our colleague in the department of botany at Northwestern University. Born near Bloomington, Indiana, in 1882, he prepared for college in the near-by high school, completed the course for A. B. at the University of Indiana in 1908, was elected to the honorary societies of Phi Beta Kappa and Sigma Xi, acquired the master's degree by graduate work in 1909, and the doctorate of philosophy in 1912 at the same institution. During his twelve years at Northwestern University, he proved himself to be a conscientious, enthusiastic, and inspiring teacher, and a loyal, unselfish and sympathetic colleague. As an investigator he carried to successful completion and publication several valuable research problems in cytology, largely along the line of spermatogenesis in liverworts and mosses."

A correspondent writes: "The death of Thomas Edward Clark, who in his early days was much interested in science, occurred at Los Angeles, California, on November 27, 1921, where he had resided for many years. Dr. Clark was born in Tyringham, Massachusetts, a small hamlet in the Berkshire Hills, on September 29, 1828. He received the degree of A. B. from New York University in 1849, B. S. from Harvard in 1854, Ph. D. from Göttingen in 1857. In 1859 he held the chair of chemistry at Williams College. He received the degree of M. D. from the College of Physicians and Surgeons in New York in 1866, and practised medicine for a few years in New York City. Following his retirement from the practise of medicine, he spent several years in Europe, largely in France and Italy. Upon his return he purchased a ranch in Kansas where he resided for a few years, from which he retired to a life of leisure at Los Angeles, California. He was a fellow of the American Academy of Arts and Sciences, Boston, and of the Academy of Natural Science, Philadelphia. Dr. Clark descended from a stock noted for its production of naturalists, among them we find such names as Jackson, Orton, Kingsley. He was a brother of Henry James Clark, who was formerly associated with Agassiz at Harvard, and distinguished for his work on the invertebrata, etc. Their father, Henry Porter Clark, married Abigail Jackson Orton. He was a Swedenborgian minister but retired early in life. He was a lifelong friend of the Rev. Henry James, father of Henry and William James, who was likewise a Swedenborgian."

THE International Union of Pure and Applied Chemistry will hold a meeting in Lyons, France, from June 27 to 30.

THE American Pharmaceutical Association has available a sum amounting to $360 which will be expended after October 1 for the encouragement of research. Investigators desiring financial aid in their work should communicate before June 1 with Professor H. V. Army, Chairman A. Ph. A. Research Committee, 115 West 68th Street, New York, giving their past record and outlining the particular line of work for which the grant is desired.

THE United States Civil Service Commission announces an examination for ordnance engineer, qualified in optics. A vacancy at Frankfort Arsenal, Philadelphia, Pa., at $4,000 a year, is to be filled. The work will consist of the supervision of the design and manufacture of optical systems for military instruments, as well as investigating optical problems relating to such instruments. Competitors will not be required to report for examination at any place, but will be rated on physical ability 10 points, and on education and experience 90 points.

IN order to promote original research relative to the fungicidal and insecticidal properties of sulphur and the effects of sunlight, temperature and moisture on its action, the Crop Protection Institute expects to offer two fellowships yielding an income of $2,500 each. Training in chemistry and plant physiology is a prerequisite, and candidates should have demonstrated ability to undertake research efforts of a high type. Applications, accompanied by reprints of scientific articles and letters of recommendation, should be made immediately to the Crop Protection Institute, National Research Council, Washington, D. C. A statement explaining the purposes and scope of the projects and selection of research laboratory may be obtained on application.

UNDER stress of the economic conditions that the war has placed on Austria, the well known Zoologisch-Botanische Gesellschaft finds it necessary to part with some of its scientific collections as a means of maintaining its existence. A recent letter from Dr. Hans Neumayer, the general secretary of the society, to Professor Wm. Trelease, of the University of Illinois, asks that American botanists be informed of that fact that a collection of about 12,000 mosses, comprising over 1,000 species and collected by Schimper, de Notaris and other men famed in this branch of botany, is offered for sale. Detailed information may be obtained from the secretary of the Gesellschaft, at Vienna, and offers for its purchase may be addressed to him.

The first volume of a series of translations and reprints to be known as *Psychology Classics* is in press and will appear shortly. The series is to be edited by Professor Knight Dunlap, and published by the Williams and Wilkins Company in Baltimore. The first volume contains a translation, by Miss Istar A. Haupt, of Lange's monograph on *The Emotions,* with reprintings of William James's article, "What is an Emotion?", for *Mind* and his chapter on "The Emotions" from the *Principles of Psychology.* In order to facilitate the preparation of further translations and reprints, the royalties from these volumes will be matched by an equal amount by the Williams and Wilkins Company, the fund so constituted to be deposited with the treasurer of the Johns Hopkins University, and will be applied solely to the defraying of clerical and other necessary expenses of such preparation. The editor requests suggestions concerning future volumes, and cooperation in their production.

UNIVERSITY AND EDUCATIONAL NOTES

Among appropriations announced by the General Education Board are: Northwestern University, toward $2,000,000, $600,000; Boston University, Boston, Mass., toward $1,500,000, $400,000; Illinois Wesleyan University, toward $400,000, $135,000; New York University, $500,000, toward $1,500,000; for the discharge of its outstanding obligations, $500,000.

Dr. Frederick L. Hoffman has accepted the position of dean of what will probably be known as the "Graduate School of Applied Business Science, of the Babson Institute, at Wellesley Hills, Mass. Dr. Hoffman will continue his connection with the Prudential Life Insurance Company as consulting statistician, and will hereafter divide his time as may best meet the needs of his new work. In his new position he is expected to develop the business education for officers and managers of industrial undertakings, including insurance. The plans under way include an entire group of new buildings, and a museum of industrial products and processes. Dr. Hoffman will make his future home at Wellesley Hills.

Dr. Simeon Burt Wolbach has been appointed Shattuck professor of pathologic anatomy in the Harvard Medical School, to fill the vacancy caused by the retirement of Dr. William T. Councilman.

Leigh Page, Ph.D., assistant professor of physics in Yale University, has been promoted to be professor of mathematical sciences beginning with the academic year 1922-23, with assignment to the Sheffield Scientific School.

The chair of mining at Sheffield University, vacant by the death of Professor F. E. Armstrong, has been filled by the appointment of Mr. Douglas Hay.

Dr. Henri Claude has been appointed professor of mental diseases in the Paris Faculty of Medicine in succession to the late Dr. Ernest Dupré.

DISCUSSION AND CORRESPONDENCE

THE VOTE ON THE EVOLUTION BILL IN THE KENTUCKY STATE LEGISLATURE

On March 9, the lower house of the Kentucky legislature, contrary to what was expected, took the anti-evolution bill (the one carrying a heavy fine and jail sentence for a violation of its provisions) out of the hands of the committee and put it to vote. Not since the memorable election of William A. Bradley to the Senate in 1908 has there been in the legislature such intense interest in the result of a ballot. As names were called the majority for and against see-sawed with narrow margins, and there was much scurrying hither and thither by the advocates and opponents of the bill for the purpose of finding and dragging in their respective absentees for the vote. It was like a neck and neck horse race, and Kentuckians do dearly love a horse race. The final ballot resulted in 41 votes for the measure and 42 against.

An analysis of the vote above recorded shows that with the legislative district taken as a unit and computing the percentage of illiteracy on the basis of the male population, twenty-one years old and upward, in each, the advocates of the bill represented an illiteracy of 13.5 per cent., and the opponents of the bill an illiteracy of 10.7 per cent. The illiteracy of the state as a whole computed on the same basis is 11.3 per cent.

In view of the closeness of the vote on this measure and what an analysis of it reveals as to the forces which were backing its passage, the proposal that the content of teaching in the state universities shall be dictated by legislative enactment, as advocated by Mr. Bryan, is fraught with interesting possibilities.

As interesting incidents connected with the final attempt to pass this anti-evolution measure, are the following:

Two persons, not members of the assembly, were permitted to address the house on the measure, President McVey of the university against it and Rev. Noel Gaines, of Frankfort, in favor of it. The latter exhibited standard text-books on zoology, and grew quite excited as he quoted evolutionary statements from them.

A representative, whose vote against the bill made it a tie, called up his pastor by long distance telephone, while the balloting was yet in progress, and asked for advice as to how to cast his final vote.

The representative from Breathitt County, one of the counties of the mountain section, where anti-evolution sentiment is strong, surprised everybody by voting against the bill; indeed it was he who cast the deciding ballot. This county is known as "Bloody Breathitt," because of its distinctive lead in homicides growing out of private feuds. This member can scarcely be said to represent the sentiment on evolution in this county, which has an illiteracy of 21.6 per cent. It is doubtless more correctly represented by the editor of the *Jackson News* of that county, who recently said, "The professors at the state university may believe they are descended from apes and baboons, but let it be known that the good people of Breathitt are pure Anglo-Saxon."

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ROTERTIA

IN the mind of the student the word "moment" is unalterably connected with the idea of a very short space of time. Such an expression as "moment of force" is, therefore, on the face of it, meaningless. It is useless for the teacher to point out that "moment" also means importance, and that the moment of a force is merely its importance or effectiveness in producing rotation. Calling it a "moment of force" makes "a tendency to produce rotation" a difficult physical conception for the student to grasp. This difficulty has been recognized by teachers of physics, who have at last very generally discarded the expression "moment of force," in favor of the shorter, simpler, and clearer term "torque." A torque is a twist. There you have the whole thing in a nut-shell, and the student knows what you are talking about.

Why not keep up the good work by accepting suitable substitutes for "moment of momentum" and "moment of inertia" as well? If "moment of force" is bad, these are worse. Some text-book writers have already seen the wisdom of using "angular momentum" for "moment of momentum." This is a distinct improvement, since "angular momentum" carries its meaning on its face. But so far I have failed to find any serious attempt made to use a substitute for "moment of inertia," although, to my mind, this is the worst offender of the three. The magnitude of a moment of force is calculated by multiplying a force by a distance ($f \times r$); similarly that of a moment of momentum by multiplying a momentum by a distance ($mv \times r$); but the magnitude of a moment of inertia is *not* equivalent to the product of an inertia times a distance ($m \times r$), but times the square of a distance ($m \times r^2$). The use of the word "moment" in all three cases, therefore, misleads the student to expect an analogy which does not exist in the case of moment of inertia, thus making the term particularly inappropriate. My experience has been that the word "rotertia" immediately conveys to a student the physical conception buried in the expression "moment of inertia"; and in such a way that it is not easily forgotten. I therefore seriously urge its adoption. "Rotertia" on the face of it is equivalent to rotational inertia; and, hybrid though its stock may be, what more can we demand of a technical term than unambiguity, clarity, and force?

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NOVEMBER 14, 1921.

THE VALUE OF TILTH IN AGRICULTURE

DR. JEROME ALEXANDER (in SCIENCE, February 10, 1922) criticises a statement made by the present writer (SCIENCE, September 2, 1921) that "the comminution of the surface of the soil, *more or less perfectly stops evaporation and thus conserves the store of soil water.*" This statement is said by Dr. Alexander to be "quite contrary to all engineering and practical experience"—the fact being, according to him, that such breaking of the upper surface "causes or tends to cause *increased* evaporation."

The statement made by the present writer may possibly be contrary to "engineering" experience, but that it is a truism well known to all practical farmers from the days of King Hamurabi to date, can not be gainsaid.

I quote from "Soil Fertility and Permament Agriculture" by Dr. Cyril Hopkins, page 579—"In the semi-arid regions, fallow cultivation is practiced during one season, *the soil being stirred after each rain to prevent evaporation*, and thus store up sufficient moisture in the soil to give the crop a good start" (italics mine).

There is scarcely a more well known practice inculcated by practical farmers, in regions where droughts are feared, than the absolute necessity of keeping the surface covered with finely broken soil, for the specific purpose of conserving the soil water.

In semi-arid regions, this practice is absolutely essential to the farmers' financial life, and most "farm periodicals"[2] harp upon this string in season and out.

L. S. Frierson

Gayle, La.

QUOTATIONS

PROPOSED LEGISLATION AGAINST THE TEACHING OF EVOLUTION

In Kentucky[1]

The Kentucky House of Representatives spent five hours to-day [March 9] in discussing and hearing discussions of the "monkey bill" of Representative G. W. Ellis of Barren County, forbidding the teaching of evolution in public schools and universities. The measure was defeated by a vote of 42 to 41, after a recapitulation of the vote during which members were dragged into the chamber from other parts of the capital.

Dr. F. L. McVey, president of the state university, and the Rev. Dr. E. L. Powell, pastor of the First Christian Church, Louisville, discussed the bill by invitation. The former declared that the legislature is not within its rights in passing such a law as that proposed, and urged the members not to base the inspiration of the Bible on matters not essential, but to heed teachings of the Book. He asserted that the Bible is not an authority on science, legislation, chemistry, or any of one thousand other subjects, but on moral, spiritual and religious matters. Dr. McVey went into the subject of evolution, pointing out that many accept the teachings as not in contradiction to the Bible, and insisted that the university makes no attempt to interfere with the religion of its students. He told of the various religious activities of the university, and warned the House that it would set a dangerous precedent in the passage of the Ellis bill. He recalled fights on scientific theories in the past based on the ground that they are opposing the Bible, and reviewed briefly the manner in which various scientific subjects are taught.

Mr. Ellis brought forward Noel W. Gaines of Frankfort, formerly an army officer, who has been in the limelight several times in his career, most recently when he was involved in the "ground glass" controversy in a Southern camp, to speak for the bill. Mr. Gaines put William Jennings Bryan to shame in his denunciation of those who believe evolution, directing many of his remarks directly at Dr. Powell and Mr. McVey. He talked for nearly an hour and was frequently applauded and cheered, while spectators in the gallery and around the walls of the chamber roared with laughter. One of his "stunts" was a division of the sheep and goats, placing Dr. McVey, Dr. Powell and various zoology text books on the one side and the Bible, the Declaration of Independence and himself on the other. He had the books before him as he ran up and down behind the clerk's desk, scattering them about as he waved his arms in emphatic gestures. Finally he threw one of the text books to the floor and trampled it under foot.

"I am ashamed of this day in the Kentucky legislature," said Representative G. C. Waggoner of Scott County, a minister and veteran legislator, toward the close of the debate.

"This bill smacks of intolerance and the

[1] Abridged from the *Louisville Courier-Journal*.

shadows of the Dark Ages are settling about us." Mr. Waggoner opposed the bill on the ground that in passing it the legislature would exceed its functions as a law-making body and would set a dangerous precedent. "There have been times here to-day when those on both sides of this discussion were about ready to place their opponents on the rack and torture them," continued Mr. Waggoner. "I don't know anything about evolution and from what I've heard I don't believe there are others here who do. We have set up a straw man and have been boxing industriously at him all day."

In his final appeal for the passage of his bill, Mr. Ellis said he had sent his son to the University of Kentucky and that he returned with his faith destroyed and argued religion against his father and mother. The voice of the aged representative was broken with emotion as he told of this experience.

When the roll was called the vote stood 38 to 36 for the bill, which meant its defeat, as 40 votes are required for passage. As Mr. Meyers was about to announce this the proponents demanded that the absentees be called. Then the vote was 40 to 39 for the bill. The opponents demanded a recapitulation. During that they dragged in two more members and the proponents one, making it 41 to 41. Representative Bryce Cundiff, who had declined to vote on the ground that he "was a hard shell Baptist and believed what was would be anyhow," said he would have to discard his religion and vote "No." Then the bill was declared to be defeated by a vote of 41 to 40.

IN SOUTH CAROLINA[1]

The teaching of "the cult known as Darwinism" as "a creed to be followed" is prohibited in all state supported public schools and institutions of higher learning by a proviso attached as a rider to the general appropriation bill by the Senate yesterday morning. The amendment, which was tagged on to the end of the section providing for the appropriation of funds for the public school system, would make it impossible for any public school or higher institution of learning teaching or permitting "Darwinism" to be taught to receive any funds from the state and would prohibit the paying of state funds to any such institution. Senator F. A. Miller of Hartsville is the author of the proviso, which was adopted by the Senate, practically without opposition.

Ultimate fate of the proviso, which took its place as one of the Senate amendments to which the House refused concurrence, will therefore have to be determined by the conference committee to which the appropriation bill was referred. None of the representatives on this committee from either house have announced their stand on the question and since the House has never explicitly expressed itself on the question the House conferees will consider the proviso without any idea as to the House's stand on the matter.

The amendment was passed in the Senate practically without debate or opposition, Senator Miller making the only address either for or against the measure. The proviso follows in full:

> And provided, further, That no moneys appropriated for public education or for the maintenance and support of state supported institutions shall be used or paid to any such school or institution teaching, or permitting to be taught, as a creed to be followed, the cult known as "Darwinism."

The proviso contains no definition of "Darwinism" and is intended, Senator Miller explains, to apply only to Darwinism and therefore not to the theories of evolution of Lamarck, Bergson, Le Dantec, Baldwin, Osborn, and the many others who have since Darwin's day practically thrown "Darwinism," as it was first enunciated, into the discard. The amendment applies, Senator Miller points out, only when "Darwinism"—which is now defined as the theory of natural selection, that is, the survival of the fittest in the struggle for life, was the mechanism by which evolution was accomplished—is taught or permitted to be taught "as a creed to be followed" and not when it is

[1] From the Columbia *State*. The amendment was eliminated from the bill by the conference committee appointed to adjust differences between the bill as passed by the House and by the Senate. It is said that another attempt will probably be made to pass the bill when the legislature meets next year.

merely explained to the pupils as the pagan philosophies are explained.

SCIENTIFIC BOOKS

The Friendly Arctic. V. STEFANSSON. The Story of Five Years in Polar Regions, with a foreword by Gilbert Grosvenor, president of the National Geographic Society, and an introduction by Sir Robert Borden, Prime Minister of Canada. New York (Macmillan) 1921. Pp. xxxi + 784.

IT is the habit of scientific men to say that there is no guide for the well-ordered conduct of the every-day business of living which approaches in validity and all-round usefulness that which is called the scientific method. But while this is strictly orthodox and extremely common preaching, the thoughtful observer of human folkways can not but be impressed with the fact that the correlation between this trite preaching and the actual practice of his friends in the conduct of their own lives, is not of as high an order as it would be expected to be if the preaching were taken at its face value. It is, therefore, an event of great human interest as well as of no mean scientific importance to have forthcoming a well-nigh complete and perfect example of what happens when scientific methods of thought are translated into action, with something approaching 100 per cent. completeness, to the end of living happily, usefully and continuously in a naturally harsh environment. Such an event is afforded in this recent book by Stefansson.

It is from this point of view that, in my opinion, the book has its greatest significance. It contains a wealth of records of achievements in the field of geography in the narrower sense of the word—discoveries and descriptions of new lands, exploration of the bottom of the polar sea by soundings, much exact mapping of coast lines, and the like—which I suppose to be of major importance in those fields of science, but being in no wise a specialist in either geography or polar exploration, I am not qualified to express any expert opinion on these matters. But I have a strong conviction, after carefully reading the book twice, that the importance which the history of science is going to attach to Stefansson's work in the polar regions will rest primarily upon quite another thing than his contributions to geography in the strict and limited sense, significant as I have no doubt these contributions are.

In temperate, sub-tropical and sub-arctic portions of the earth's surface certainly, the zone of freedom in human behavior is, from the viewpoint of evolution, rather wide. Men in such regions are, and must always have been, widely free to develop any sort of habits of life and folkways in general, so far as the eliminative action of the purely physical environment was concerned. For example, it makes no difference in terms of survival value so far as one knows, whether ladies dress in the entertaining and colorful manner of the Rumanian peasant, or in the quite different if not less exciting manner of the Fifth Avenue society woman. But the case is biologically quite different in the polar regions. There the zone of freedom in respect of the mode of conducting life is extremely narrow. The environment imposes strict and narrow limitations on habits and biological folkways generally. One conforms or is eliminated. There is no wider range of choice.

Now presumably the Eskimo's knowledge of how to live happily, comfortably and reasonably long in the Arctic has been very slowly and somewhat painfully wrought into his racial and individual consciousness mainly by the operation of natural selection. Those who did not dress, house themselves, find food, etc., within the limits of the zone of freedom of individual action rigidly set by the environment are no longer either present or represented in the Eskimo population. The consequence is that the Eskimo is now, as Stefansson has demonstrated with a wealth of detail in this and his earlier book, "My Life with the Eskimo," a creature extraordinarily well adapted to his particular environment, and therefore happy in it.

Prior to Stefansson's work the whites who have adventured into the Arctic as explorers, and the list is a nobly impressive one, have uniformly depended upon what is, in its philosophical essence, one and the same scheme to avoid the consequences of the stark evolutionary processes there operative. This scheme has been essentially to provide sufficiently adequate transport facilities, by sea and by land, so that the physiologically obligate elements of the environmental complex, food, heat, shelter and clothing, could be in whole or in part taken from the temperate zone into the Arctic and act as a buffer between the exotic white man and the indigenous environment. In short what the Arctic explorer has always endeavored to do is to project, like a pseudopodium, a piece of the temperate environment into the Arctic environment, and move in and out of the country along the center of the pseudopod.

Stefansson's plan is philosophically quite different. It is based biologically upon the considerations: first, that the physiologically obligate essentials of life must be generally if not universally present in the Arctic, else there could and would be no Eskimos there; and second, given that these essentials are there, a sufficiently acute, penetrating and optimistically sympathetic application of the reasoning faculties of the scientifically trained mind should enable one man to avail himself of them and hence *live,* as well as another. It is quite easy, given a sufficient lack of knowledge of the facts, on the one hand, and of imagination, on the other hand, to prove conclusively by *a priori* logic that this theory of Stefansson's is all wrong. In point of fact a considerable number of the members of his expedition logically excogitated the matter and came to the conclusion that in holding such views 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.

The best possible refutation of a purely logical proof that Stefansson's theory was all wrong was, of course, to carry through, over a long period of time and a wide range of area, travels in the polar regions, living entirely off the country as the native Eskimos do. Precisely this is what Stefansson did for a period of nearly five years, with brilliantly successful results, viewed from any standpoint. "The Friendly Arctic" is the record of how it was done and of what happened. With two or three companions, a few generally poor sledges (because the good ones were either left on the Karluk or retained by the logical but unimaginative southern party), some dogs, a rifle apiece with a modicum of ammunition, a little scientific apparatus for observing, *et prœterea nihil,* Stefansson moved about over the polar ice and lands freely at will, and added richly to the world's knowledge of the regions.

Every one who is interested in the philosophy of evolution, general biology and human psychology, as well as those interested in geography and Arctic exploration, should read this fascinating book. It records an extraordinary intellectual achievement.

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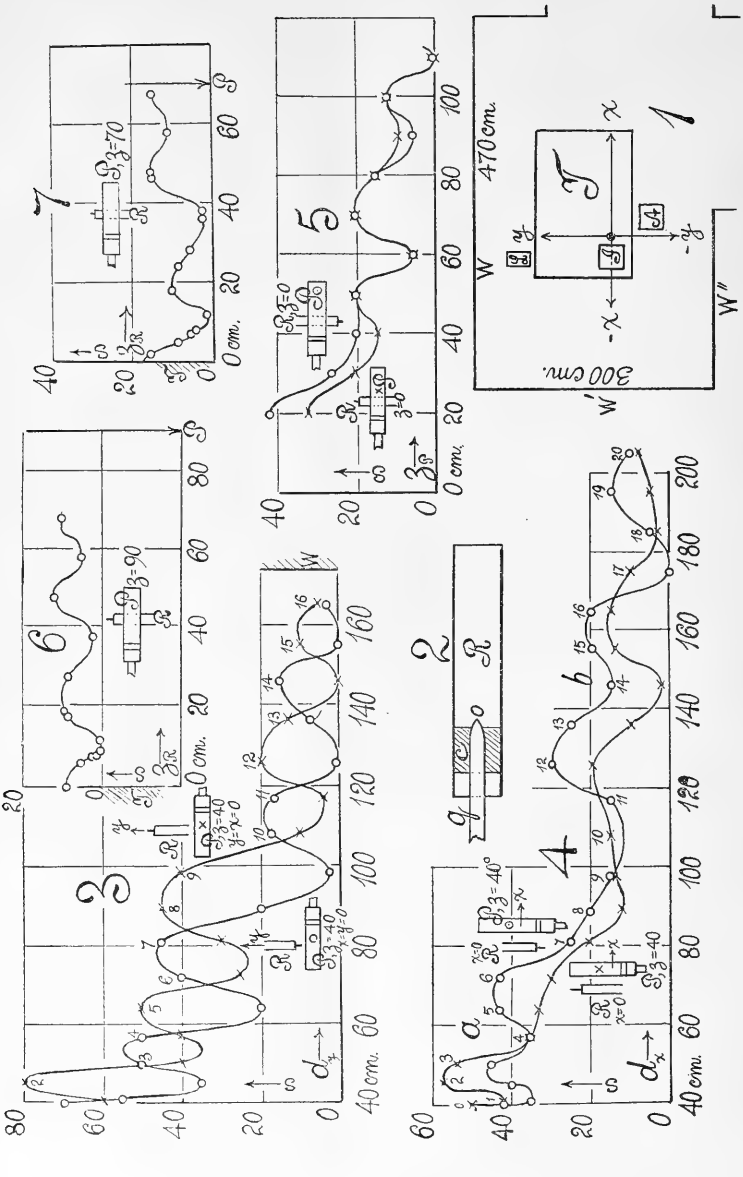
SPECIAL ARTICLES

ACOUSTIC TOPOGRAPHY IN A ROOM[1]

1. *Introductory.*—A plan of the room is given in figure 1, where W, W' denote the unbroken walls, I the interferometer and U-gauge, L the electric lantern, A other apparatus. The coordinates along which the surveys are to be made are x, y, z, y being between walls, x toward the open door and z above the table T. For more refined work, I. L, A, etc., should have been removed to another room; but for my present purposes this is unnecessary.

The pin hole probe described in this journal (Science, May 27, 1921) has since been found useful for the location of nodes in pipes and other vessels, both telephone and windblown. These experiments are omitted as without interest here, except in so far as they indicated the exceptional sensitivity of the probe to nodes. It is relatively quite unresponsive to ventral segments or to wave trains. The pressure variations in question are converted into static pressures through the intervention of the

[1] Advance note, from a Report to the Carnegie Institution of Washington, D. C.


470 cm.
300 cm.

pin hole and measured at a mercury U-gauge, read by displacement interferometry. As the pipes to be employed were to be of all kinds and intensities, it did not seem worth while to reduce the fringe-deflections to pressures. These deflections will therefore be reported as measured on an arbitrary scale s (.1 mm. collimator plate micrometer). The width of a fringe was however on the average about 2 scale parts. Thus the corresponding pressure increments p are readily found from $p = .00015\ s$ millimeters of mercury. The apparatus can be made more sensitive by enlarging these small fringes; but the latter would then usually be thrown out of the field of the telescope and the screw micrometer become necessary to restore them, which is irksome, particularly with fringe U-gauges.

The pin-hole probe at one end of an eighth inch pure rubber tube of any length (2 to 3 meters or more), at the other end of which is the gauge, is at once available for introduction anywhere. It fails however to give an appreciable acoustic record except in the inside sounding pipes. The plan of associating the pin hole probe with a resonator, of either the open or closed type, thus suggests itself.

2. *The closed pin hole resonator.* The outstanding trouble encountered heretofore was ascribed to the organ pipe; *i. e.,* to the continuity of notes lying very close together, but to only one of which the resonator responds effectively. A further difficulty was referable to two ends of the open cylindrical resonator then used, with a pin hole in the middle within; for these ends being 22 cm. apart are liable to lie in regions differing acoustically. The advantage of the tube is the ease with which it may be accurately tuned by mere elongation and hence its sensitiveness. The Helmholtz resonator, probably for this reason, was found much less sensitive. Hence the closed pin hole resonator qR, figure 2, suggests itself, consisting of the cylindrical tube (1.9 cm. diam., effectively 22 cm. long) R, closed by the snugly fitting cork c which carries the pin hole probe qO. The pin hole, O, is at the base of the tube R, the quill tube q being connected, as stated, by a length of gum rubber tubing with the U-gauge. This resonator has but one mouth and thus tests acoustically a single point, as it were, of the region, while the tuning may be effected with nicety by moving the cork c within R, or by elongation at the mouth of R. The pin hole at O must be salient (*i. e.,* carried by the conical end of the quill tube q) and not on a reëntrant or flat end. Moreover, the diameter of the pin hole must bear a certain relation to the size of the resonator R, to be found by trial. The construction of a sensitive pin hole resonator is extremely difficult; out of dozens of trials I netted but one or two adequately sensitive instruments. If of metal foil, it is liable to change in the lapse of time.

3. *Survey between walls;* y *coordinate.* The two series of results (pipe in azimuth 180° at $x = y = 0$, $z = 40$ cm., and resonator in azimuth 90° and 270°, respectively, at $z = x = 0$ and y) are given in figure 3. The abscissas, d_y, are the distances between centers of pipe P and resonator R. The y values of R (on the table) are given in decimeters on the curves. Insets show the orientation. The two curves are pronouncedly harmonic from $y = 0$ to the wall, and they are almost exact inversions of each other, crests in the one taking the place of troughs in the other, throughout. Moreover the crests seem to lie in successive levels; an initial high one ($y = 10$-20 cm.); an intermediate lower one ($y = 30$-80 cm.); a still lower one (100-140 cm.) beyond; etc. It is not feasible to go much beyond 160 cm.; for with the wall at 174 cm. the resonator pitch is beginning to be modified. A curious result is the initial maximum and minimum, the points not being at $y = 0$, but beyond at $y = 20$ cm. The horizontal mean wave lengths Δy to be obtained roughly from these curves are respectively $\Delta y = 34$ cm. and $\Delta y = 35.5$ cm., the range being from 30 to 40 cm. The mean d intervals, Δd_y, are about 30 cm.

The precipitous descent of the graphs between $y = 70$ and 90 in one case and $y = 90$ to 100 in the other, makes less impression on the wave intervals than would have been anticipated and the mean wave length here, $\lambda = 35$ cm., does not differ from the earlier cases of $\lambda = 37$ cm. by more than the observations of a single curve. The graphs, figure 3, were obtained independently, one after the other.

Now in the line PP', normal to the wall W, 40 cm. above the table between pipe P and pipe image P' in W, the nodes should follow each other at a distance of $\lambda/2 = 24$ cm. apart; but as the distribution above and below is hyperbolic, the nodes at the level of the table must be further apart. Unfortunately, the equation is cumbersome. Without attempting to use it here, we easily surmise that the increased distance so obtained is inadequate; *i. e.*, not as large as the 35 cm. intervals found in the experiments, in place of $\lambda/2 = 24$ cm. estimated to increase to 27 cm. or 29 cm. One should expect 7 or 8 nodes in place of the 5 or 6 recognized. Thus it seems not unlikely that a frequency of a near order is contributed by the room itself, particularly as the reflected waves returning from 2 meters are too weak to compete effectively with the outgoing wave trains. Furthermore, there is another wall in the direction of negative y (at $y = -130$) and one at $x = -190$ cm. Although apparatus lies in the path here, they introduce further complication.

There remains the reflection from the table, so that the pipe and its image 40 cm. below, make the plane of the table a region of reenforcement; or, with regard to the loss of $\lambda/2$ at the surface, a locus of nodes, though the term node would be strictly applicable only for the case of normal incidence near the line pipe-image. The next nodal locus is hyperbolic and therefore higher than 25 cm. above the table, out of reach of the resonator which lies on it. Thus it is finally necessary to compound the phase reversed direct ray here in question, with the corresponding phase reversed reflections from the walls, to get the disturbance at any point of the table. This succeeds experimentally, as I will point out presently, for walls close at hand (within a meter or two); but for walls as distant as those of the room, the reflection wall effect is too small to account for variations as marked as those of figure 3. It is possible that a wide high wall, like W, may act obliquely by diffraction; but to speak on this subject, further inquiry will be needed. As a general fact, however, it is noticeable that a survey in y, between walls, here produces a much more marked harmonic distribution of acoustic pressure along that axis, than a similar survey along x toward the open door (§4).

The striking opposition of phase which figure 3 presents for an inversion of the resonator is more easily intelligible. As the length of the resonator is approximately $\lambda/4$, the rotation of 180° about its center will pass the mouth from a node to a loop of the stationary wave train, or between corresponding 90° phase differences. Now the pin hole probe, as above stated, is sensitive to nodes (compressions) only and scarcely responds to wave trains (or to the similar harmonic motion at the loops). The pin hole resonator might be thought to have the opposed quality, being stimulated by wave trains (or loops) and not by nodal phenomena or compressions: but (§ 5) this inference is not correct. We must therefore again anticipate nodes at the maxima of the graph and loops at the minima, when the pin hole resonator is used.

It follows from this that if half of the length of the resonator be added to the y coordinate of one of the graphs, figure 3, and half the length be deducted from the other, *i. e.*, if the *mouth* of the closed resonator be taken to define the coordinate y, the two curves of figure 3 should coincide at their mean position in y. Hence if the resonator is rotated on an axis passing through its mouth, the data obtained should be constant at all angles. Experiments were specially made to corroborate this inference.

4. *Survey (in* x) *toward the open door.* The example of this survey, which I will here communicate, was made somewhat differently from the preceding, by locating the resonator at the origin ($x = y = z = 0$) in two azimuths, 90° and 270°, successively. The pipe, kept horizontal, parallel to y and 40 cm. above the table, was now moved along the axis x. The abscissas, d_x, still refer to the distance between the centers of the pipe and resonator, while the coordinates x are marked in decimeters on the curves. The graph then shows the effect at the origin, of an f″ pipe sounding at different points along x, and the pressure distribution are here throughout quite different from

the y distribution between walls. The case for R 90° is now a compound harmonic which seems to dip into stationary wave trains at a and b. The other curve is quite similar in general character, only less pronounced. Horizontal wave lengths exceeding 35 cm. may again be detected at the double inflections.

5. *Survey in the vertical direction* (z). This was carried out by allowing the resonator to rest horizontally on the table, in a direction normal to the f″ pipe, the latter being raised successively in steps of 10 cm., keeping it in the same azimuth of 0°.

The graphs (figure 5) for two positions of the resonator are essentially identical, indicating stationary waves produced by reflection from the table. The z distance between crests and troughs, however, now varies between 24 and 25 cm. and thus corresponds very closely to the semiwave length, 24 cm., of the f″ pipe. In all cases the pipe must be raised some distance (40 cm.) before the periodic distributions begin.

The behaviour here in evidence is very much like Melde's experiment, though it is now made with a string of air (as it were) between the actuating organ pipe as one attachment and the table as the other. The only adjustment possible is thus the length of the string. Since the resonator lies on the table, certainly to be regarded as a nodal surface, we would be inclined to look for the maximum of wave production, when the direct and return wave train coincide in phase at the mouth of the pipe. This will take place at intervals of $\lambda/2$, or $\Delta z = 24$ cm. apart, conformably with the graphs. It would seem, however, that the maxima (in view of the loss of $\lambda/2$ at the table) should lie at $z = 5\lambda/4$, $7\lambda/4$, etc., whereas in the graphs they lie at $2\lambda/2$, $3\lambda/2$, etc. The latter demand a node at the mouth of the f″ pipe.

As the table is certainly a nodal surface, we here encounter the result of special sensitiveness to nodes on the part of the mouth of the pin hole resonator. The case is tested in figure 6, where the pipe, P, in azimuth 0° is $z = 90$ cm. above the table and the resonator vertically below the pipe is raised from the table at $z = 0$. The evidence given by the curve is very satisfactory, the wave lengths of the graph being 24 to 25 cm., or semi wave lengths of the f″ pipe. There is complete absence of deflection at 10 to 12 cm. above the table; *i. e.*, at $\lambda/4$ for the pipe, so that the ventral segment is inactive. As the pipe at $z = 90$ cm. is approached by the resonator, the deflections naturally increase, but they do so very slowly. Obviously the present disposition with a raised pipe and with the resonator between pipe and table is conclusive; but because of the important evidence obtained I repeated it for an f″ pipe at $z = 70$ cm. (nearly $3\lambda/2$). The results in figure 7 are of the same kind as to wave length, inactivity for a resonator 12 cm. ($\lambda/4$) above the table, the marked effectiveness (maximum) of the distant node at the table ($z = 0$) and a maximum near the pipe ($z = 68$ cm.). Troughs and crests lie at positions which are multiples of $z = 12$ cm.

The above results for normal reflection may be summarized as follows: Both the organ pipe and the pin hole resonator are stimulated in proportion as their mouths lie in a nodal region or surface; they remain relatively uninfluenced by a ventral segment. Consequently an even number of half wave lengths lie between pipe and resonator when the response is a maximum. Although the mouths of the respective pipes are necessarily ventral segments, the anomalous features of these results disappear when it is remembered that the nodes are alternately dense and rare.

6. *Reflection from plates.* Using a plane about 1x.5 square meters in area, displaced along x and normal to it, in steps of 10 cm. from the origin successively, the effect of reflection (as I shall show elsewhere) came out beautifully. It was possible, by compounding the direct and reflected rays in each case, to interpret the harmonics and compute the wave length of the pipe accurately. At the distance of the wall (174 cm.), however, the reflection effect had dwindled to 10 to 15 scale parts. Diminution of the reflection effect also occurred when the plane was placed oblique to x, but not as abruptly as the law of reflection would predict. Furthermore the distribution of height in the successive maxima in the different reflection curves was quite as remote from

mere diminution with distance as is the case in figure 3. My impression is that if displacement of an air particle oblique to the table be resolved into tangential, and normal components, it is in the phase changes of the former (owing to a tangential slip, possibly with vibration) that a clue to an explanation may be looked for.

Location of the ray of maximum amplitude. Further experiments showed that if the pipe is successively lifted above the table, the corresponding unique or highest maximum continually moves away from the origin into greater x. So far as I have gone this position (*i. e.,* the position of the resonator on the table) is reached when the corrected (asymptotic) ray from pipe to resonator makes an angle of incidence of about 51° with the normal to the table. The same rule holds for the other corresponding maxima and minima. In a raised pipe the unique maxima will thus be found at 50 to 100 cm. outward from the origin, below the pipe. The location of interferences by the method of the preceding paragraph affords no clue. In any case it is astonishing that a diagram such as figure 3 or 4, should represent an actual distribution of acoustic pressures, certainly of nodal intensity on the table, whenever the organ pipe is sounding. In fact, in the present research which I have now been pushing for some time, whatever one predicts fails and what one does not expect comes out serenely. It will therefore be prudent to conclude with Newton, that there are fits of easy reflection.

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PROVIDENCE, R. I.

MEETINGS OF THE GENETICS SECTIONS

IN accordance with provisions made by the American Society of Zoologists and the Botanical Society of America, a joint program in genetics was arranged and held in connection with the recent meetings of these societies at Toronto. This program occupied all of Wednesday, December 28, and the forenoon of Friday, December 30. A. F. Blakeslee was elected to preside at the sessions and L. J. Cole to act as secretary. The complete list of the papers presented will appear in connection with the reports of the respective societies.

A committee, composed of L. J. Cole, R. A. Emerson, H. S. Jennings, A. F. Shull and G. N. Collins, was appointed to formulate a plan of organization for the Genetics Sections of the two societies. The committee reported the following articles of organization:

Resolved, That the Genetics Sections of the American Society of Zoologists and the Botanical Society of America organize for the purpose of securing a closer coordination of genetic interests.

The membership shall consist of those members of the two societies who shall indicate their desire to be affiliated with the Genetics Sections.

The following officers shall be elected at each annual meeting and shall take office at the close of the meeting:

1. A chairman to be chosen alternately from the Zoological Section and from the Botanical Section.

2. A secretary, who may be chosen from either section.

3. A society representative, who shall be chosen from the section other than that from which the secretary is chosen.

These officers shall constitute the executive committee of the Genetics Sections.

In addition to his usual duties the secretary shall, in consultation with other members of the executive committee and with the secretaries of the societies, arrange for the program of the meetings.

The secretary and society representative shall act as the representatives of the Genetics Sections to their respective societies.

At the annual meeting the chairman shall, in advance of the business meeting, appoint a nominating committee of three to nominate officers for the following year.

These articles were adopted as proposed.

A nominating committee, composed of R. A. Emerson, G. H. Shull and Charles Zeleny, announced the following nominees for officers for the ensuing year:

Chairman: H. S. Jennings.
Secretary: L. J. Cole.
Society Representative: B. M. Davis.

These were duly elected.

The secretary reported on the condition of the American Genetics Association and the needs of the *Journal of Heredity* and stated that efforts would be made to hold a conference of the executive committee of the Genetics Sections with the council of the American Genetics Association to see what steps can be taken for their mutual benefit.

L. J. COLE,
Secretary.

SCIENCE

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DEDICATION OF THE NORMAN BRIDGE LABORATORY OF PHYSICS OF THE CALIFORNIA INSTITUTE OF TECHNOLOGY

PRESENTATION BY NORMAN BRIDGE

THIS is one of a series of pleasant occasions that have attended the growth and metamorphosis of this school for nearly a third of a century.

Each one has marked some accession of value in its progress from a small affair with varied aims and moderate ambitions, to a concentration of effort on the most ambitious plans for the selection and excellence of the few. Sometimes the acquisition has been a material one, as of buildings, grounds and tools; sometimes it has been spiritual and intellectual. To-day we welcome both forms.

The changes in the institution have come through a process of elimination of the casual and easy—designed for the many; and of the engrafting upon it of the more difficult, the more costly—and ultimately the more potent, for the few who can measure up to its requirements.

And the most telling addition of all has been the deliberate movement toward systematic research—otherwise the search for additions to the knowledge of the world.

We are gathered here to take note of the latest material addition to the equipment, as well as the latest spiritual and intellectual accession. This laboratory is undoubtedly a long step toward an ideal outfit for teaching, and for the research that is in the greatest demand at this time. But no man can guess what new facilities will be needed within a few years, for novel lines of research not now even thought of.

The growth of knowledge comes step by step; sometimes the steps are short, frequent, and strictly progressive; at other times they are long, infrequent, and so radical that one step may require the recasting of a whole science. A hundred such instances stare us in the face, each one having sent a lot of the old apparatus of research to the scrap-heap. Such may some day be the fate of half the apparatus of this laboratory. If and when it comes it must be welcomed; if it will mean the achievement of vital economies for mankind—the exchange will be profitable, and the trade will be a good one. And you will then probably buy new and better apparatus, and go on with your research, but with new angles and for newly discovered purposes.

It was to be expected that such an expansion and elaboration in exacting education would occur here, on this hill—and with some such an institution as this. For, eons ago Providence, by the forces of the stars, made it certain that some day there would be here a great community of people, capable of such achievements as this movement represents, *provided* the land could be blessed with a stable and enduring government. Ages ago it was foredained to happen; it was bound to come, and come here—but with the indispensable peace-protecting and industry-protecting government.

Millions of years ago—yesterday morning it was, by the calendar of geologic time—the nearby mountains were lifted up by the buckling forces from below; and the off-shore currents of the more distant sea were then ordained to flow southward, and to flow *cold*. Then it was that the good luck of the low latitude and the right width of the low littoral, made it as sure as fate that here would be a wholesome climate, highly conducive to work and achievement, and that superior people would one day come hither in great numbers—given always a protecting government.

The influence of the mountains and the ocean—the shape and height of the mountains and the currents of air and sea; the width of the plain between, and the fortunate latitude, have made an ideal atmosphere on one lofty spot on the mountain for astronomical study—which study in our time has been realized in astounding fashion. In that day those forces also created here a multitude of engineering problems that are good for instruction, and for a challenge to research by some far-off generation of men. We stand to-day in the mid-period of that generation; and it would be a shame for us to fail.

Providence seems to have guided the human hands that have developed this institution as it is to-day. Really, it was a late discovery of a few people that nature had provided here the best conditions to make it the logical spot for a movement of this kind.

The first inspiration came to Amos Throop, a rugged, great soul with a far-reaching vision, who had been enticed here by the natural advantages for health and comfort. He knew how great these advantages are, and he knew that before many decades there would come about in this Southland the rapid growth of cities and the beehive of activity that we now see all about us. He saw that this community needed and deserved the best advantages of education and power. No such advantages had been provided for Pasadena. He had an ideal of a school to equip men to *do* things as well as to think and remember. His life had been keyed to practical in contradistinction to scholastic achievements. So he founded a Polytechnic Institute, and gave it all the money he had. By the measures of today the gift was not large, but it was greater than Mr. Carnegie or Mr. Rockefeller ever gave—for it was all he had. And he did what many givers of money forget to do; he gave himself with his gifts.

From that laudable beginning, this school of high college grade has grown. Now it summons from afar, and ofttimes invents, tools for its art unheard of before; and it calls from the ends of the earth the ablest experts into its faculty. Moreover, men famous in science come here to pursue further research with its facilities, under the inspiration of its work, and in the midst of its many advantages.

With all this development, the Institute has never departed from the original ideas of Mr. Throop ("Father Throop," as he was lovingly called) that it must in the highest degree possible give an education that shall fit men to *do* things in this rushing world of useful achievements—and a new civilization.

The new laboratory is the latest step in this practical direction, but by no means the last step. It is being equipped with all the practical things its designers could think necessary—but no human mind can foresee what new machinery may be needed on tomorrow—or some other morrow. In this particular the end is not yet; and the equipment will never be finished. It will always be growing and changing.

Another inspiration came out of a search for a good place for a Carnegie Observatory for the study of the sun and other stars. Should it be located here or across the sea; or across the equator? It must be put in the best place—for millions of money were sure to be spent upon it. The incomparable director of that work soon demonstrated the natural advantages of Mt. Wilson for the observatory. More than that, as this region bristles with scientific problems and interrogation points, he saw that here was the place of election for a great scientific school of the future. It not only belonged here, but it would be a wholesome neighbor to the Observatory. Then it was that Dr. Hale consented to become a trustee of this corporation, on the condition that the Board should fix a standard for the school, a little higher than that of any other then in existence. The Board, under the enthusiastic leadership of the then President, Dr. Scherer, promptly accepted the challenge; and it has, I believe, kept its promise, and maintained the condition.

But the plans for this higher emprise could not have been carried out, but for the vision, faith and unfalteringness of the Chairman of the Board, Mr. Fleming. His wisdom has, if possible, exceeded his determination; he has asked from others large gifts and got them; and, like the true soldier he is, he has led the way by making larger gifts himself. To use a colloquialism, he has been for years the very "angel" of the Institute. He does more good things, and talks less about them, than anybody else—and I nominate him as the most useful citizen in this community.

The evolution of a great laboratory is an absorbing subject—absorbing both in interest and money. Two years ago a laboratory of the physical sciences became a vital need of the Institute, if it were to go on in its progress without halting. It required a large expenditure of money. Some folks at our house, who had watched the growth of this movement from its beginning—and helped through its first two decades and more—had for long expected to do something more substantial toward its perfection than they had done before. Of course they knew of this urgent need and opportunity. But they were unable to see how they could provide even a small laboratory without losing so much time that opportunities and treasures of the first order were likely to be lost before the building could be completed. And the need was for a *great* laboratory, not a small one. Then a new light dawned, a hint from a genius, and the laboratory began to take form as a reality.

The program of this occasion says that the presentation of the laboratory is to be made by the donor. It ought to have said *donors*. For myself and Mrs. Bridge, some personal facts should be stated here; and one of them is that I appear here rather under false pretences. We could not have rapidly provided this magnificent and elaborate structure without the influence and connivance of that remarkable man already named, the wise and unselfish Chairman of the Board of Trustees. So, constructively he is in very essence one of the donors. Without his wisdom and faith, this building could not have been provided in time to function early, and early to embrace the greatest opportunity the institution has ever had. And as I am speaking in the presence of—as well as at, the head of the governing council of the Institute, who is also the Director of the Laboratory, I will, at the moment, spare his embarrassment by merely hinting at what that opportunity was. This community and the educational world are fast finding out what it was; and if God and the fates spare his life, they shall in good time realize it completely.

For myself, I beg to make a personal explanation and a confession—wherein may appear the evidence of the amazing vacillation of man. I had long protested that my name should not be given to any endowment of anything that I might ever make; I protested against the use of it on this laboratory building; and the arguments of members of the Board and other friends, including the Director of the Laboratory himself, failed to move me in this particular—until I found that the vital member of my own household, who had for half a lifetime helped toward this opportunity, was in league with these people—then I surrendered. And I am ready now to confess to one comfort in seeing my name chiseled over the chief portal: it ought to tend toward discouraging the public from longer trying to impose on my name a final *S* and a middle initial!

As to the material contributions toward the building, they are made with utter gladness, with the knowledge that here shall develop a great center of education and resarch that will give the start and found the careers of many of the scholars and super-engineers of the future —and make life easier and more joyful, as well as more worth living, to vast numbers of people —for the men who are graduated here will carry the torch to others, and they to still others, on through an endless succession. Certainly no gift of mine already made, or that shall hereafter be made here, can possibly be a measure of my faith in this institution, and I have not for years had any official connection with it. My faith in it is greater than if I had a hand in its management.

Finally now, and in behalf of the donors and all the friends who have encouraged this consummation—those who have hoped and prayed for it; those who have planned and designed it and watched its growth; and those who have devised and furnished the sinews of construction that have made its walls arise into being—in behalf of all these and in their name, I commend and present this Laboratory of Physics—the last and best word in a modern workshop of nature's philosophy, to this corporation, and to you, Dr. Millikan, its Director—to you, Sir, who embody in your person the new spiritual and intellectual gift that comes with the Laboratory. And you are the hope and sure promise of the future!

ADDRESS OF ACCEPTANCE OF THE NORMAN BRIDGE LABORATORY OF PHYSICS

In accepting in the name of American physics this beautiful and well-appointed laboratory, I wish first to express on behalf of my colleagues and myself the appreciation and gratitude which we feel because of the opportunity which you, Mr. Fleming, and you, Dr. Bridge, have jointly opened up to us, not only of devoting ourselves to the intensive pursuit of the science which we love, but also of assisting in the solution of the fascinating and vitally important problems which the extraordinary developments in physics during the past two decades have pushed to the forefront of the world's needs to-day.

In the second place, I wish to accept this gift on behalf of the California Institute of Technology, with which I now have the honor to be connected, and to express its gratitude for the opportunity which is thus afforded it of taking another long stride forward toward the realization of the ideal which the far-visioned men who constitute the Board of Trustees have had from the beginning—an ideal not very common in American educational institutions, an ideal not of large growth in numbers, nor of the extension of the field of study over a large range of subjects, but rather the ideal of doing work of superlative quality in the chosen and relatively limited field of the Institute's activities—*the cultivation of the mathematical and physical sciences and their applications.*

In the third place, I wish to accept this gift on behalf of all those who, like myself, believe that the private educational institution still has a very vital role to play in the development of American civilization. I am no opponent of state education. From the common school up it represents one of America's most important contributions to modern life, and that contribution should be greater in the future than it has been in the past. But state-education is not all that is needed in this country. It can do something but not everything. Indeed, one of the most dangerous tendencies which confronts America to-day is the apparently growing tendency of her people to get into the habit of calling upon the state to meet all their wants. The genius of the Anglo-Saxon race has in the past lain in the development of individual initiative, and if we lose that we shall lose our most priceless heritage. Even in the field of education the greatest and most distinctive contributions which our race has made thus far have been made through private institutions like Oxford, Harvard, and Chicago—institutions which are supported by men whom it has been our glory to develop in numbers found nowhere else in the world—*men who have treated their wealth and their talents as public trusts and have voluntarily devoted them to public ends.* I, for one, believe that some, at least, of our most important future contributions are going to come because we continue to develop such men and to preserve such ideals.

In the fourth place, I wish to accept this gift on behalf of American education, to which this institution hopes to contribute by its example an important element. We have succeeded in this country marvelously well in quantity or mass-education, as we have in quantity production. We have not as yet succeeded as well as have a number of other countries in quality education. We have not produced one-half as many—I think I may say one-fifth as many outstanding scientific and technical men in proportion to our population as have Holland, England, Germany, or France. The English honor system, to take but one example, has selected and trained the exceptional man in England and Canada as nothing in this country has thus far done, and after all the progress of civilization is determined by the very few men of vision and capacity which each age develops. There is then not only a place, but there is tremendous need in the United States for some schools which are designed to furnish exceptional opportunities and to give exceptional training to exceptional men. This has been the aim of the trustees of this Institute from the start. This is why the first step taken in the initiation of the work of the Norman Bridge Laboratory has been to provide something rare in America but something which the Institute already has, namely, an unexcelled staff in mathematical physics. Four-fifths of all teaching is the teaching of example. Creative men arise spontaneously in an atmosphere in which creative men exist and in general nowhere else.

But there is a second reason for accepting this gift in behalf of American education. With the gradual disappearance of the classics and the rigid discipline which they furnished, as the basis of our higher educational system, there have been slowly creeping into it during the past two decades certain emasculating influences which need to be counteracted. There is no Elisha upon whom the mantle of the classics can fall except the mathematical and physical sciences. There is no training like that which they furnish for teaching men to apply themselves intensively, to observe carefully and correctly, to treat their data honestly and dispassionately, and to reason objectively from a given set of conditions to their inevitable consequences—in a word to see clearly and to think straight. Indeed, there is nothing else left to constitute the backbone of the training of the coming generation if it is to maintain the virility and the strength of those that have preceded. The Institute hopes to do some pioneer work in demonstrating the values of an education having the mathematical and physical sciences for its backbone. I accept this gift, then, in behalf of American education in the confident belief that the intensive training in the mathematical and physical sciences which will take place within its walls may exert a wholesome, yes, a saving influence upon American education as a whole.

In the fifth place, if I may be so presumptuous, I wish to accept this gift in the name of Southern California, of which I have been a resident for the whole of three months, for I believe that this enterprise here is not a local enterprise. I believe that there is a contribution which it can and will make to the intellectual and cultural development of this whole empire of the south, which with all that it has of stimulating climate, of enterprise, of wealth, and of business capacity, still needs throughout its length and breadth the stability and sanity—in a word the culture—which a center of rigorous, objective, scientific thinking should help to impart to it. Nor is this enterprise one which should influence Southern California alone, for since men of affairs come to this region as to scarcely any other region in the United States, no section is more favored than is this one in its opportunity of contributing its own good things to the progress of the country as a whole.

Finally, I wish to accept this gift in the name of all those who believe, as I do and as the trustees of this institution have from the start believed, that science in itself is not the most important thing in this world, but that the salvation of the world is to be found in the cultivation of science together with the cultivation of a belief in the reality of moral and spiritual values. Science alone may destroy this world instead of saving it, but the trustees of this institution have from the start differentiated it from most technical schools in the altogether exceptional emphasis which has been laid in its curriculum upon cultural and spiritual development. One expression of this ideal is seen in the atmosphere which has been thrown about the campus by the architectural beauty of the buildings which are already found here, a beauty which the architect, Mr. Goodhue, has known how to put in exceptional degree both into the exterior and the interior of the Norman Bridge Laboratory. I accept your magnificent gift, Dr. Bridge, in the hope and the belief that it will be an important factor in the creation at the California Institute of Technology, not only of men with the highest technical skill, but of men of the finest character and of the broadest citizenship.

R. A. Millikan

A JOINT INVESTIGATION OF THE CONSTITUTION OF MATTER AND THE NATURE OF RADIATION

The establishment of the Norman Bridge Laboratory of Physics, if my estimate is correct, is an event of no small significance in the progress of science. Dr. Millikan has explained its bearing on scientific and technical education, and pointed out that research, as conducted in the Bridge Laboratory and the Gates Chemical Laboratory, accompanied by the best instruction in physics, chemistry, and mathematics, must provide the firmest of foundations for the entire superstructure of the California Institute of Technology. It remains for me to speak of a joint investigation of the constitution of matter and the nature of radiation which the organization of the Bridge and Gates Laboratories has rendered possible.

Matter occurs in nature under the widest variety of composition and form. The physicist, who approaches this complex problem by the simplest and most direct route, deals chiefly with the chemical elements, and evolves powerful methods of research which enable him to penetrate to the core of the atom, to visualize the electrons swinging in their orbits, and to remove them one by one for detailed study. The chemist, concerned primarily with the union of atoms into molecules, and the combination of molecules of one or more elements, necessarily attacks matter of greater complexity, extending all the way from the single atom of hydrogen to compounds containing hundreds of linked atoms of many kinds. The astrophysicist, permitted by his powerful telescopes to penetrate to the depths of the universe, observes matter in the state of luminous gaseous elements, associated in the cooler stars with certain chemical compounds. The cosmic crucibles in this vast laboratory of nature exhibit conditions of temperature and pressure often transcending those attainable on earth, and thus present for observation experiments on an immense scale, the interpretation of which has already added much to our knowledge of physics and chemistry. A general study of the constitution of matter should therefore approach the problem simultaneously along the converging lines of physics, chemistry, and astrophysics.

The progress of research, particularly during the last quarter century, has brought us to the present critical juncture, when the possibilities of such a joint investigation are especially favorable. In each of the branches of science involved the methods and instruments of research have advanced to a high degree of per-

[1] Address at the dedication of the Norman Bridge Laboratory.

fection. Discovery has followed discovery, now in one subject, now in another, each throwing new and increasing illumination into the other fields. The application of the spectroscope to astronomy, affording the means of determining the chemical composition, distances, motions, temperatures, pressures, densities, and masses of the stars, has led to many advances of fundamental importance. The rise of physical chemistry, which revealed the role played by electrically charged particles in solutions and established for chemistry a rational underlying theory, opened another new world of thought. The extraordinary discoveries and developments in physics, particularly in the fields of radioactivity, the electrical nature of matter, X-rays and radiation, have brought to light wholly unexpected relationships between the elements which are of the greatest significance, both from the purely scientific and the practical point of view.

We now know that there are just 92 elements in nature, the heaviest of which are spontaneously breaking up into lighter ones. The basic element hydrogen exists throughout the universe, accompanied by other elements in varying proportions and states. A few stable elements can be broken up by artificial means in the laboratory, but no method of combining their constituents has yet been found. In the stars, however, there is strong reason to believe that the heavier elements are actually being built up from lighter ones, under conditions involving phenomena of radiation and absorption of energy as yet unknown on the earth. We should therefore not be limited to any single line of procedure, but should organize our attack in such a way that physics, chemistry, and astrophysics may all play adequate parts.

In the development in Pasadena of a single center for this purpose, the equipment needed for physics is now supplied by the establishment of the Norman Bridge Laboratory, with its powerful instruments and adjuncts, including a high tension laboratory, containing a million volt transformer, provided by the Southern California Edison Company. The Gates Laboratory, with many added facilities, will meet the necessary requirements for chemistry. The Mount Wilson Observatory, with its telescopes on Mount Wilson and its laboratories and instrument shops in Pasadena, provides for astrophysics. Thus the material means are not lacking, while the excellent atmospheric conditions, available sites for physical experiments ranging from sea-level to easily accessible mountain stations up to 12,000 feet, a neighboring Army Balloon School for free air experiments, and ample sources of hydroelectric power meet the needs of the widest research activities.

Most fundamental of all, however, is the research staff, and we are fortunate indeed in the recent accession of Dr. Millikan and Dr. Epstein, and in the privilege of having Professor Lorentz with us during the present winter. Mathematical physics must play a prominent part in our joint efforts, and the cooperation of the leading authorities in this field is essential. The combined corps of investigators of the Institute laboratories and of the Observatory, powerfully supplemented by our eminent Research Associates, is now well qualified to open an effective campaign. Indeed, if time permitted, I could show you how it has already begun.

A detailed report on the proposed joint investigation was presented by the California Institute to the Carnegie Corporation of New York in September. This was referred to President Merriam and the Executive Committee of the Carnegie Institution of Washington, who cordially endorsed the project and agreed to administer any funds for its support that might be granted by the Corporation. At its meeting on November 17 the Carnegie Corporation appropriated thirty thousand dollars per year for five years to the Carnegie Institution of Washington, to be accepted and administered by the Institution for the support of fundamental researches in physics and chemistry to be conducted at the California Institute of Technology. Dr. Millikan and Dr. Noyes have been appointed Research Associates of the Carnegie Institution, and the appropriation will be expended under their direction. Supplementing, as it does so generously, the research funds of the California Institute, this appropriation provides the added means required for the joint investigation in conjunction with the Mount Wilson Observatory, a department of the Carnegie Institution of Washington.

It is hardly necessary to say that this liberal action is most heartily appreciated by the Trustees of the California Institute, who are thus encouraged to continue and to extend their policy of developing fundamental research in science and engineering.

George E. Hale

RESEARCH IN THE NORMAN BRIDGE LABORATORY

It is a great honor to me to have been requested to address you on this memorable occasion and I have many good reasons for being interested in to-day's proceedings. In the first place, I have been so kindly and warmly welcomed by the scientific men of the institute that I feel almost as if I belonged to them and as if I also were going to have a share in the facilities for scientific research that have now been put at their disposal.

In the second place, I have for a long time admired Professor Millikan's important work, and I have now some idea of his great energy and activity, wondering how he can do all he does. I therefore heartily rejoice at this splendid opportunity being offered him to work on his favorite subject. He is going to have a laboratory that is worthy of him as was his wish, with Professor Noyes and his chemists and with the Mount Wilson Observatory close at hand.

But apart from these personal feelings the great development that has been inaugurated here to-day has my warmest sympathy. This would have been the case even if I never had come to this country. I am happy to say so. Indeed, even when separated by oceans, physicists form a kind of fraternity spread all over the world. It is true that the ties that unite them have not at all times been equally strong and that they have to a certain extent been severed in the disastrous period through which the world has passed. But, though we recognize that this could hardly be otherwise, we sincerely hope that in the end the feeling of good comradeship, such as is natural among men who have before them a great and important common task, will again prevail. It can not be too much emphasized that the understanding of Nature's secrets, that the use of knowledge of forces of greater urgency, and that much remains to be done, will join all workers. Certainly each individual worker will do his best to follow his own inclinations and to act according to his special abilities, and it is highly desirable that the research work of each nation bear the mark of its mentality and national aptitudes but by mutual aid and co-operation, one stimulating the other, all can be blended in one great effort.

I am deeply convinced that it must be so and therefore I feel that Dr. Norman Bridge, who is so generously promoting scientific research in this country, deserves the warm thanks, not only of Americans, but of scientific men.

And now when he takes off his evening dress, and has returned to his every-day life, Professor Millikan will set to work in his laboratory. You know what he can do, what marvels he can achieve with a single oil drop, determining, more certainly that ever was done, the electric charge and the manner and the number of the smallest particles of which matter consists. This afternoon we heard from him how he has been able to extend his investigations to ultra-violet invisible rays of the very smallest wave lengths. He is planning to send up high in the atmosphere instruments which, when safely returned to the earth, will tell about radiations which exist at great altitudes and of which he wants to trace the origin, either of the earth or the heavens. And when the high tension laboratory is ready, he and his fellow workers will bombard matter with electrons moving with a velocity comparable with that of light and they will try to knock to pieces the atoms of our elements and to see what becomes of them.

In all this they will work with Professor Noyes of the Gates Chemical Laboratory and with the astronomers of Mount Wilson. If some effect can not be found on the earth they will look for it in the sun and if there is some new and not wholly understood phenomenon in solar physics, it will be reproduced and investigated in the Norman Bridge Laboratory.

Mr. Chairman, it is a great pleasure to me to express the best and most hearty wishes for the good success of the work that has now been set on foot.

H. A. LORENTZ

BIOTIC AREAS AND ECOLOGIC HABITATS AS UNITS FOR THE STATEMENT OF ANIMAL AND PLANT DISTRIBUTION

MORE precision in the statement of animal and plant distribution has become an urgent need. A specimen labeled "California" or "Africa" is obviously of little value in a critical study of distribution. But, though less obviously at fault, a record giving merely a city or county as a locality is still not of the greatest use. A number of distinctly different kinds of life conditions occur within a short distance of most towns, and in the western parts of the United States the life conditions within a single county may range from desert to moist forest and even to perpetual snow. Unless the life conditions under which a species lives are known we can gain little insight into the factors which govern its distribution.

A knowledge of the life conditions under which a species lives can not be obtained from a statement alone of geographical localities, no matter how exactly these may be given. Even a record of the precise acre on which a specimen has been taken means little unless the environmental conditions of the spot also are stated. Exact geographical records are necessary, but mention alone of a locality is not enough, and a complete record must include a statement of the environmental conditions as well as the locality.

Some sort of classification of the environmental conditions must, of course, be adopted if the conditions under which a species lives are to be stated concisely and with precision. Although I do not intend to propose here any new system of classification, either for environments or for biological distribution, I do wish to call attention to some of the units on which a classification must be based.

The units of biogeographical classification which I believe will prove most generally useful are two in number: (1) a unit of geographical extent forming a natural life area (faunal or floral area), and (2) the habitat or ecologic community. The statement of the faunal or floral areas and the habitats or communities in which a species is found, together with records of geographical localities, should give very accurately both the geographical distribution and the conditions under which the species exists.

Biogeographers have long made use of floral and faunal areas for the classification of distribution, and the importance of this unit of distribution is generally conceded. Some ecologists employ practically the same concept under such designations as "climatic formation" and "climax formation." The best term available to include the concept of both floral and faunal areas seems to be biotic area. A *biotic area,* then, may be defined as a geographic district, characterized by an assemblage of species and of ecological characteristics differing from those found in adjacent areas. A biotic area will usually, though not always, be also a climatic area, and will often be a distinct physiographic area as well.

The animal species found in a biotic area constitute a *fauna;* the plant species found in the same area constitute a *flora;* and the combined animal and plant species of the area may be termed a *biota.*

It has been generally presumed that the units of classification for ecological distribution and the units of biogeographical classification belong to different categories and can not be used together. However, I see no reason why the unit of ecological classification, the ecologic community, may not, for the exact statement of distribution, be combined with the unit of geographical distribution, the biota as above defined. In fact, I firmly believe, after considerable experience in the use of this combination in the field, that it forms an excellent method of stating distribution.

By this method each biotic area is considered to be made up of a number of *ecologic habitats,* the animals and plants of each habitat forming an *ecologic community.* The community then, may be considered as a subdivision of a biota, with the same geographical limits. Some communities will extend over two or more adjacent biotic areas, and they may receive the same name in the various areas in which they occur. But no community is likely to be exactly the same in two biotic areas, for between the various areas there are definite general differences in the fauna and flora, and usually also in climate and physiography.

The terms ecologic habitat and ecologic community are here used to designate ecologic divisions of any rank. Field workers dealing with different systematic groups of animals and plants will probably find it convenient to use different grades of ecologic units, depending partly on the size and mobility of the organisms considered. The ecologic communities recognized for ants will probably be smaller in average area covered, and lesser in ecologic rank, than mammal communities will be.

The rank of ecologic community which will probably be most generally useful in field work is the association, using this term in the sense of any relatively stable community whether climax or not. For finer distinctions the association may be divided into communities of lower rank, such as strata, societies, and the like. However, if the habitats and communities are carefully described, the field worker need not worry about the rank of the ecologic divisions. The important thing is to record the field observations in such a way that the environmental relations of the species considered are clear.

The discrimination of biotas and ecologic communities is not easy. We must recognize at once that there are few sharp divisions in nature, and that the lines we draw must in many cases be arbitrary ones. Communities or biotas which are very distinct where typically developed, at their edges frequently shade off gradually into adjacent divisions. But often taxonomic groups, such as subspecies, pass gradually into other taxonomic forms without sharp boundaries. The classification of biotas and ecologic communities is no more difficult, and not essentially different in kind, from the classification of animal and plant species and larger taxonomic groups.

"Probably the best criterion for characterizing faunal (biotic) areas is the dominance of particular habitats. It is evident that in passing from one area to another a situation will be met where the dominant habitat of one area will equal in extent the dominant habitat of the other area. It is at this point that the line separating the two must be drawn."[1]

In the western parts of the United States, where the topography is often much broken and where the climatic districts frequently are sharply limited, it is often possible to mark the boundary between adjacent biotic areas with considerable precision. But in regions of slight topographic and climatic diversity, such as is the case over much of the eastern United States, the limits of the biotic areas are often not clearly defined. Indeed, in some cases, it might be impossible to determine within several hundred miles the position of the boundaries between adjacent areas. The biotic area, however, is still a useful concept, even though the position of the boundaries of some areas can not be stated exactly. To attempt an exact definition of the boundaries of adjacent areas between which there is a wide belt of overlapping is certain to result in confusion rather than in precision.

The distinguishing characters of animal habitats are frequently based on the vegetation, though sometimes on the physical characters such as the occurrence of rocks or water. There is a close correlation between the distribution of animal species and of types of vegetation, and even in places where the vegetation is not the dominant factor in the environment it often can be depended upon to give an index of the physical factors which affect the distribution of animals as well as plants.

However, it is not yet certain that the smaller animal communities correspond exactly in distribution to the smaller plant communities. The mollusks and insects and other invertebrates often seem to be restricted in distribu-

[1] Dice, 1916, *Univ. Calif. Publ. Zool.* 16: p. 299.

tion by other factors than the plants are, and it may be that the smaller divisions of ecologic communities will be different in animals and plants; and perhaps these smaller communities will differ even in different groups of animals. It will be well, therefore, for field workers not to depend too rigidly on the plants or on any other one factor in describing distribution.

Indeed, it may sometimes happen that even the faunal and floral areas, or the principal ecologic associations, for the various groups of organisms will differ. It certainly will not be best to force unruly facts of distribution to conform to any rigid system of description.

On the other hand, a classification of habitats and biotic areas will be of the greatest use when it is applicable, so far as possible, to all groups of animals and plants. For this reason the ecologic communities recognized for all organisms should correspond as nearly as possible without obscuring the facts.

To form a universal classification will require the establishment of more divisions than would a classification for one group of organisms alone. For mammals, for instance, the grouping of all the fresh-water environments of a faunal area into one nominal habitat, the aquatic, would probably suffice; but if fresh-water fishes, invertebrates, and plants are to be considered, a number of habitats in the water must be recognized. Even when mammals alone are considered it can do no harm to describe more than one aquatic habitat, and it is of great advantage to have a classification of wide application.

One of the great advantages of using ecologic habitats and biotic areas for the statement of distribution is that these units are not founded on the assumption that any one particular factor of the environment is most important in the limitation of distribution. Units of distributional classification based on a bias for some one particular factor, such as temperature, as being most important in the control of distribution can not have the confidence of persons who consider the basis of classification unsound, or at least unproved. But the facts of distribution can be described by the use of biotas and ecologic communities without an assumption that any one factor is all important. However, if one factor is actually the most important one in the control of distribution over any area, this relation is not obscured by the employment of the units of description suggested.

It is my opinion that we are not as yet sufficiently informed as to the exact distribution of any group of animals or plants to render possible anything more than a preliminary classification of distribution in any part of the world. I would emphasize, therefore, the need for the precise statement of distribution in terms of units which are capable of combination into a number of possible systems of classification, rather than to describe distribution in terms of large and relatively unstable biogeographical regions, life-zones, or ecologic formations.

With a knowledge of the biotas and ecologic communities of the world it will be an easy matter to compare floras and faunas of different geographic regions; or the communities of similar habitats of different biotic areas may be compared as desired. Zoogeographers and phytogeographers may, if they wish, combine biotic areas to form provinces, regions, or life-zones; and communities may be combined at pleasure by the ecologists to make formations or other large divisions.

The time has come in the study of the factors limiting distribution when little more progress can be made by statistical methods, the attempt to correlate the distribution of climate or other barriers to distribution and of groups of animals and plants in the mass. Rather we must critically determine the factors concerned in the distribution of individual species. To do this will require carefully controlled experiments in the laboratory, correlated with long continued measurement and observation of the physical and biological factors of the natural environments.

Before laboratory experiments can be efficiently carried out, however, we must know the exact distribution in nature of the species of animals and plants and their environments. This is the greatest need of biogeography at the present time: to describe biotic areas and habitats and to determine the precise habitat distribution of each species. This work can be performed without any expensive equipment; good judgment and hard work in the field are the main requirements.

There is pressing need that the work of describing the biotic areas and habitats of the world should be speedily done. Through the influence of man's industrial activities the natural conditions of the world are rapidly passing, and in our more settled districts it is now difficult or impossible to find even small areas of the original habitats. It is important to determine quickly the habitat preferences of the native plants and animals, for these can surely be determined only in natural habitats. With the changes due to the presence of man numerous species have been introduced, others have greatly changed their abundance, and the whole balance of nature has been upset. It behooves us to record all we can of natural habitats and habitat preferences before it is too late.

L. R. DICE

MUSEUM OF ZOOLOGY,
UNIVERSITY OF MICHIGAN

THE MOST NORTHERLY RECORD OF THE CAPTURE IN ATLANTIC WATERS OF THE UNITED STATES OF THE GIANT RAY, MANTA BIROSTRIS

LIKE many other ichthyologists I have long known that Manta drifts north with the Gulf Stream as far as Cape Lookout, North Carolina, where it is sometimes found in the Bight of the Cape or playing over the shoals which extend some 15 or 20 miles out to sea. Furthermore, I have presumed that it occasionally drifted further north, but until my attention was called to the matter recently I did not know that any scientific records of its occurrence north of that point had ever been made. However, as a matter of fact the earliest record of the occurrence of this gigantic ray in our waters is found in Lawson's voyage to North Carolina (1709)[1]. Lawson describes the "divil-fish" as shaped like a "scate," of great size, and having a very large pair of horns on its head. He notes its occurrence in the inlets of the great sandy bars separating the ocean from the sounds.

The next notice is found in Marc Catesby's "Account of Carolina and the Bahama Islands," an appendix to Vol. 2 of his "Natural History of Carolina, Florida, and the Bahama Islands, etc." 2 vols. London, 1743. Speaking of "*Diabolus marinus,* the devil-fish," which he says is a great ray having two horns on its head, he describes how one came afoul of the cable of "a sloop of 80 tons," in the harbor of Charleston, South Carolina, and dragged it about the harbor.

The first scientific record of the capture of the fish, with a careful description and excellent figures dates in the year 1824. In August, 1822, there was captured near the mouth of the Delaware Bay a specimen which was brought to Philadelphia and secured for the Academy of Natural Sciences. It was figured and described by LeSueur[2] in 1824. It was 15 or 16 feet wide, and 7 feet, 9 or 10 inches long without the tail (which LeSueur says was slightly over 8 feet long) and had a mouth 2½ feet wide. He described it under the name *Cephalopterus,* head-winged.

It seems to have been a matter of general knowledge at that time among the fishermen of Capes May and Henlopen that this gigantic ray occurred in the ocean off that region. At any rate, it is recorded that late in August, 1823, a crew of fishermen set out to capture one of the fishes, and that on September 9 they brought a specimen to New York. Here it was measured and described by Dr. S. L. Mitchill who published his account in the same year with LeSueur, 1824.[3] It was a record

[1] Lawson, John, "A new voyage to Carolina; containing the . . . natural history of that country, etc." London, 1709.

[2] Le Sueur, Description of several species of the genus Raia, of North America, *Journal Academy Natural Sciences,* Philadelphia, 1824, Vol. 4, pp. 115-121, 4 figs.

[3] Mitchill, S. L., Description of a new and gigantic species of the genus *Cephalopterus* of Dumeril, *Annals Lyceum Natural History,* New York, 1824, Vol. 6, pp. 23-29, 2 figs.

specimen, measuring 16 feet from tip to tip of pectorals, 10 feet, 9 inches from tip of head to root of tail, 17 feet, 3 inches over all (from tip of extended cephalic fins to tip of tail), and the widest part of the mouth cavity measured 3 feet, 9 inches along the curve. Mitchill calls this ray, *Cephalopterus vampyrus,* the oceanic vampire.

The next record was made by Mr. Henry W. Fowler[4], Curator of Fishes of the Academy of Natural Sciences of Philadelphia, in 1903. This specimen was taken in a pound net located about one mile out at sea off Stone Harbor, New Jersey, on September 1, 1903. Mr. Fowler saw only the parts brought to him and hence could give no measurements.

Until this writing, this has constituted our most northerly record in the United States of the capture of Manta. However, during the last week in August of this year, a crew of swordfish fishermen were cruising off Block Island when the man in the "pulpit" saw some great flat animal swimming under him. He quickly threw his harpoon into it and after a fight which lasted over three hours, the great ray succumbed and was towed into Block Island. Fortunately there was at Block Island at this time an expert photographer, Mrs. Florence E. Foster of this city, who was engaged in making moving picture films of swordfish fishing. She took a number of excellent pictures of this specimen of Manta, particularly of its gigantic mouth. One of these shows a sucking fish clinging to the inside of the upper jaw. Mrs. Foster has very kindly presented to the department of ichthyology of the American Museum a set of these photographs which are unique of their kind.

This fish is said to have been 14 feet wide between tip of the pectorals, and 7 feet long from head to base of tail, and to have weighed on the scales 1,686 pounds. It is the only specimen known to me that has been actually weighed, and it is significant that the weight runs far less than the "estimates" usually made of from 2 to 5 tons. The record width is said to be about 25 feet and the weight 10,000 pounds, but this has not been verified.

Another point of interest may be noted. The newspaper accounts say that there was a large spine or "sting" on the tail. Mrs. Foster did not see this but saw a wound on the tail near the base where a spine was said to have been torn off. There is much controversy among ichthyologists as to whether Manta is spined or spineless. The late Theodore Gill, the dean of American ichthyologists, once expressed to the writer his doubt as to whether Manta has a spine, and Jordan and Evermann in their "Fishes of North and Middle America" doubtfully give it a spine. However, LeSueur definitely says that both his (female) specimen and her fœtus had spines, and his figure shows the spine. Mitchill found no spine, but noted "a hump or knob, about the size of a hen's egg, at the root of the tail behind the dorsal fin." In this hump Holmes[5] found and figured a bone which seems to be either a rudimentary or a degenerate spine. This is an interesting matter and one deserving of further study.

It now remains only to call attention to the two localities where these giants abound and in which they have been taken in large numbers. The first and longest known is the harbor of Beaufort, South Carolina, made famous by William Elliott's classic work, "Carolina sports, by land and water; including incidents of devil-fishing, etc.", the first edition of which is dated Charleston (S. C.), 1846; the second, New York, 1850; the third, New York, 1859; and an English reprint of this, London, 1867. No more delightful book of its kind has ever been published.

The other locality is Captiva Inlet on the southwest coast of Florida where Dr. Russell J. Coles[6] operated extensively in 1909, 1914

[4] Fowler, H. W., The occurrence of three interesting fishes on the New Jersey coast, SCIENCE, 1903, N. S. Vol. 17, pp. 595-596.

[5] Holmes, F. S., Contributions to the natural history of the American devil-fish, etc., *Proceedings Elliott Society of Natural History,* 1856, Vol. 1: 39-46, 3 figs.

[6] Coles, Russell J., My fight with the devilfish. *American Museum Journal,* 1916, Vol. 16, pp. 217-227, 7 figs.—Natural history notes on the devilfish, *Manta birostris* (Walbaum) and *Mobula olfersi* (Müller), *Bulletin American Museum Natural History,* 1916, Vol. 35, pp. 649-657, 5 figs.

and 1915. During this last year Dr. Coles took a female specimen 18 feet wide, cut it up into segments of which he made plaster casts, and sent material and casts to the American Museum. From these Mr. J. C. Bell of our department of preparation made the life-sized cast which is one of the chief prizes of our Fish Hall.

The most complete account of the natural history of Manta is contained in an article by Dr. Theodore Gill, "The story of the devil-fish." *Smithsonian Miscellaneous Collections*, 1908, vol. 52, pp. 155-180. 15 figs.

E. W. GUDGER

AMERICAN MUSEUM OF NATURAL HISTORY

JOHN CASPER BRANNER

JOHN CASPER BRANNER, geologist and President Emeritus of Stanford University, was born in New Market, East Tennessee, July 4, 1850, and died in Palo Alto, California, on March 1, 1922. He entered Cornell University in 1870, soon after its organization, graduating in 1874 as Bachelor of Science, subsequently receiving the degree of Ph. D. from Indiana University and that of LL. D. from the University of California. In 1883 he married Susan D. Kennedy of Oneida, New York, and left three children: John K., architect, George C., geologist-philosopher, and Elsie, Mrs. Frederick Hall Fowler.

His advanced work at Cornell was under a great teacher of Geology, Charles Frederick Hartt, who (during vacations) acted as Imperial Geologist of Brazil. Thus with Orville A. Derby, Richard Rathbun, Herbert H. Smith, and other student assistants, Branner went to Brazil where, upon the death of Hartt in 1875, he became director of the Imperial Geological Commission. Afterward, Brazil having become a republic, he entered the service of the Sao Cyriaco Mining Company at Minas Geraes as engineer and interpreter. Later he again went to Brazil and to Argentina as special botanist for Thomas A. Edison in search of wood fitted for certain electrical uses, and still later represented the United States Department of Agriculture in the former country. Returning to America in 1883, he served as topographical geologist of the Survey of Pennsylvania, a position resigned to accept that of professor of geology in the University of Indiana, where his college friend, the present writer, had just been appointed President. In 1891, he entered the faculty of the newly founded Stanford University as professor of geology, later becoming vice-president of the institution. In 1913 when the title of Chancellor was created for me that I might be free for public service, he was elected President of the University, and held that office up to his retirement as Emeritus in 1917.

Branner directed three scientific expeditions to Brazil: one under the patronage of Alexander Agassiz in 1899, one in 1907 supported by Richard A. F. Penrose, a former assistant professor at Stanford, and a third in 1911 for the Brazilian government. This last made a geological and biological study of the coast north and south of the mouth of the Amazon river, the especial purpose being to determine the effect of the great volume of fresh water brought into the ocean by the Amazon upon the marine life of the ocean.

His publications include a volume on the Geology of Brazil, with a large number of special papers, and a grammar of the Portuguese language. His other memoirs on Geology and Physical Geography are very numerous; his "Bibliography of Clays and Arts" is an important contribution to that subject.

Branner was a fellow of the Geological Society of America, a member of the Geological Society of London, of the Société Géologique de France, the National Academy of Sciences, the American Philosophical Society. He was also a member and for a time president of the American Seismological Society, and associate editor of the *Journal of Geology*. Iu 1906 he was appointed to the California Earthquake Commission, and in 1915 served the United States government on the commission to investigate the land slides on the Panama Canal.

In 1911 the Hayden Medal was conferred upon him by the Academy of Natural Science of Philadelphia "in recognition of the value of contributions to geological science, and of the benefits derived from his able and conscientious discharge of the official trusts confided to him."

In 1912 he published "How and Why Stories," a delightful collection of tales told by negroes in Tennessee, bearing on the episodes of creation—"how the snake lost his legs," and the like—quite worthy of place besides the Georgia tales of "Uncle Remus."

In person Branner was robust and vigorous, six feet in height and well proportioned, a man of attractive personality and excellent address. In college he was noted for his dry humor, unfailing readiness, and good nature. As a teacher he was singularly successful in training men to thorough and accurate dealing with problems of geology and mining, gaining the personal love and confidence of his students. Among his disciples are many of high standing in the profession—Herbert Hoover, Robert V. Anderson, Frank M. Anderson, Ralph Arnold, George H. Ashley, Carl H. Beal, Willis S. Blatchley, W. J. Crook, H. W. Durrell, Noah F. Drake, Frank L. Hess, Theodore L. Hoover, J. M. Hyde, D. S. Kimball, E. M. Kindle, Newton B. Knox, Henry Landes, Deane P. Mitchell, James H. Means, John F. Newsom, Frederick W. Nobs, Edward H. Nutter, W. A. Pritchard, A. H. Purdue, Milnor Roberts, Hugh Rose, Claude Siebenthal, E. K. Soper, Herbert S. Stark, Stephen Taber, Frederick P. Vickery, Gerald A. Waring, H. E. Williams, Hayes Young, and many others well known in science or mining. The "Branner Club" of Los Angeles is composed of his students in geology.

I must add a personal word. My acquaintance with Branner covers fifty-two years, the first two as fellow-student and fraternity brother in Delta Upsilon, the next thirty as fellow-teacher and co-worker in science in Indiana and in California, three more as my successor and colleague in administration of the educational work to which I gave the best twenty-five years of my life, and, finally, five years of retirement from active responsibility to the congenial work of writing out of the fullness of experience. In all these years he lived up to his motto, "I can get along without the respect of my neighbors, but not without the respect of *Number One*." And in maintaining self-respect, he won the regard of his neighbors of whatever degree. A righteous life helps to strengthen all who come in contact with it. "There is always room for a man of force and he makes room for many."

David Starr Jordan

SCIENTIFIC EVENTS

WORLD PRODUCTION OF COAL IN 1921

The world's production of coal in 1921 dropped back to the level of 1909. From reports so far received, the United States Geological Survey estimates the total output at approximately 1,100,000,000 metric tons. This figure is subject to material revision.

In comparison with the feverish year 1920, the year just closed shows a decrease of more than 200,000,000 tons. The chief factors in the decrease were the British miners' strike which lasted from April to June, and—more important—a world-wide industrial depression. Prices collapsed early in the year, and the seaborne coal trade of the world fell off sharply. The consequent reduction in the volume of business offered to the shipping of the world has been an important element in the decline in ocean freight rates.

Of the major coal-producing nations, France and Germany were the only ones to show an increase. Progress in restoring the ruined mines of France is indicated by the steady increase in output of the past three years. In 1919, 22,000,000 tons were produced; in 1920, 25,000,000; in 1921, 29,000,000. A further increase of 12,000,000 tons, however, would be necessary to bring French production up to the level of 1913. German production of bituminous coal is also still far below the pre-war level although an increase was effected in 1921 as against 1920. German production of lignite in 1921 reached the highest point ever attained. The estimated output of 120,000,000 tons is an increase of 35,000,000 tons over the last year before the war.

The proportion contributed by the United States was 40.9 per cent., a larger share than in the years before the European war, but the smallest in any year since 1916.

The following table, prepared by W. I.

PRELIMINARY ESTIMATE OF THE WORLD'S COAL PRODUCTION IN CALENDAR YEARS 1919, 1920 AND 1921
(In metric tons of 2,204.622 lbs.)

COUNTRY	1919	1920	1921
Australia	10,736,321	13,176,426	[1]
Belgium	18,342,950	22,388,770	21,807,160
British India	22,991,217	17,356,889	[1]
Canada	12,411,328	15,088,175	13,300,000
China	23,000,000	19,500,000	[1]
Czechoslovakia	26,946,813	31,086,479	[1]
France	22,341,000	25,300,000	29,000,000
Germany—Coal	116,500,000[2]	140,757,433[2]	145,400,000[2]
Lignite	93,800,000	111,634,000	120,000,000
Japan	31,461,386	29,245,384	[1]
Union of South Africa	9,313,232	11,181,846	9,400,000[3]
United Kingdom	233,467,478	233,216,071	166,992,000
United States	502,534,410	586,000,000	448,600,000
Other countries	46,553,865	49,068,527	[1]
Totals	1,170,400,000	1,305,000,000	1,100,000,000

[1] Estimate included in total. [2] Includes Saar and Upper Silesia. [3] Estimated from 11 months' production.

Whiteside, of the Section of Foreign Mineral Reserves, presents the information received by the Geological Survey up to February 15, 1922. The tonnage of the countries not yet heard from ordinarily amounts to 12 or 15 per cent. of the total. Receipt of data for these missing countries, estimates for which are included in the total, may raise or lower the final figure by some millions of tons. The unit used is the metric ton of 2,205 pounds, the approximate equivalent of the long or gross ton. It is not, however, exactly the same, and the translation from net or gross tons to metric tons gives many of the figures an unfamiliar look. A more complete report on world production in 1921 will be issued by the Geological Survey about April 1.

THE MOUNT EVEREST EXPEDITION

WE learn from the London *Times* that the preparations for this year's Mount Everest expedition are now complete. The nine members who have left England for India are:

Brigadier-General the Honorable C. G. Bruce, C.B., chief of the expedition.

Lieutenant-Colonel E. L. Strutt, C.B.E., D.S.O., second in command.

Mr. G. L. Mallory, who led the climbing party in 1921.

Mr. George Finch, of the Imperial College of Science.

Major E. F. Norton, D.S.O., R.F.A.

Mr. T. Howard Somervell, F.R.C.S., of University College Hospital.

Dr. A. M. Wakefield, of Megantic, Quebec Province.

Dr. T. G. Longstaff, surgeon and naturalist.

Captain J. B. L. Noel, M.G.C., photographic officer.

The party will be joined in India, the *Geographical Journal* published by the Royal Geographical Society states, by Captain Geoffrey Bruce, Fifth Gurkhas, and by Captain C. J. Morris, Third Q.A.O. Gurkhas. The twelfth place was to have been filled by an artist, but to the great disappointment of the committee it was not possible to find one among those whose methods seemed appropriate, who could undertake the journey. Of the eleven members of the expedition named above six are soldiers—three of the Gurkhas, one of the Royal Scots, one Royal Field Artillery, and one Machine Gun Corps, formerly of the East Yorkshire Regiment.

Three members of the party are of Cambridge University—Mr. Mallory, of Magdalene, Mr. Somervell, of Caius, and Dr. Wakefield, of Trinity; two are of Oxford University—Colonel Strutt and Dr. Longstaff, both of Christ Church; three are surgeons; two are naturalists, several are expert photographers, one at least is a painter, and all are distinguished mountaineers. It is, in fact, a very strong party, of which much is expected.

The climbing equipment includes an oxygen apparatus specially devised for the occasion. The photographic outfit is very complete, including three cinematograph cameras, of which one is equipped with a battery of lenses up to 20-inch focal length; two panoramic cameras, of which one rotates through the complete circle; four cameras for glass plate, including one $7\frac{1}{2}$-inch by 5-inch, all fitted with telephoto lenses; one stereoscopic camera, and five Kodaks, besides a variety of private cameras belonging to different members of the party. The dark-room equipment includes all that is required for developing cinematograph films in the field.

General Bruce, with his two assistants, Captain Geoffrey Bruce and Captain Morris, are at Darjeeling making preparations for the start of the expedition at the end of the month. They will be especially concerned with the two most important matters, first, the organization of the special corps of Himalayan coolies enlisted from Nepal and the borders of Sikkin and Tibet, and, secondly, with transport arrangements, which require careful and methodical planning, for the expedition is larger this year than last, and is more fully equipped.

Telegrams will be dispatched from the expedition describing its progress, and will be published in *The Times.* A book containing a full account of last year's reconnaissance, with a new map and illustrations, is now going through the press, and will be published by Edward Arnold by the end of next month or the beginning of May. The *Geographical Journal* will contain monthly notices of the progress and results of this year's attempt to reach the summit.

THE AMERICAN CHEMICAL SOCIETY

The American Chemical Society, which will meet in Birmingham, Ala., from April 3 to 7, expects an attendance of from 700 to 1,000 chemists. It was planned to leave Washington, D. C., on March 30. March 31 will be spent at Kingsport, Tenn., where the Clinchfield Portland Cement Plant and several large extract plants and tanneries are located, together with numerous other chemical industries. April 1 will be spent at Chattanooga, Tenn., and April 2 will be spent at Muscle Shoals, Ala., the site of the large government cyanamid plant and the Wilson power dam. The special train will arrive in Birmingham on April 3.

The following divisions of the society will meet and discuss technical and scientific problems and developments: Agricultural and Food Chemistry, Biological Chemistry, Dye Chemistry, Industrial Engineering Chemistry, Organic Chemistry, Chemistry of Medicinal Products, Physical and Inorganic Chemistry, Rubber Chemistry, Water, Sewage and Sanitation Chemistry, Sugar Chemistry, Cellulose Chemistry, Petroleum Chemistry, Chemical Education and History of Chemistry.

Dr. Edgar F. Smith, president of the American Chemical Society, will turn over to the society dies for the Priestley Medal together with funds which have been donated for the purpose of presenting every two years a medal for the most distinguished service to the science and industry of chemistry, and will make the address of welcome.

Dr. Van H. Manning, former chief of the Bureau of Mines, will present a paper on "The pioneer's field in petroleum research." Dr. Charles L. Reese will give a paper on "Informational needs in science and technology," and Dr. W. C. Geer will speak on "Recent developments of the chemistry of rubber."

Meetings of the various divisions will occupy Wednesday April 5, and Thursday, April 6, concluded with a banquet at the Hotel Tutwiler on Thursday night. Friday, April 7, will be spent in excursions to the steel, by-product, coke and other industries in and around Birmingham. George Gordon Crawford is the honorary chairman and J. F. Carle, of the Southern Testing Laboratories, is chairman of the executive committee in Birmingham in charge of the local arrangements.

Permission to visit the nitrate plant and water power development at Muscle Shoals has been limited by the government officials to American citizens and to those who have no personal connection with or financial interest in the manufacture of cyanamid.

One of the avowed purposes of the meeting is to gather support, by writing congressmen and senators, for the passage of the reclassification bill as reported by the Senate civil service committee, which provides for higher salaries for scientific men employed by the government.

THE JOHN SCOTT MEDAL FUND

The Board of Directors of City Trusts, having charge of the John Scott Medal Fund, has recently awarded the John Scott Medal and Certificate, with premium of $800, to each of the following, for the inventions named:

William Duane, Ph.D., of Boston, Mass., for "his researches in radio-activity and the physics of radium and of X-rays."

Reginald Aubrey Fessenden, of Chestnut Hill, Mass., for "his invention of a reception scheme for continuous wave telegraphy and telephony."

Elwood Haynes, of Kokomo, Indiana, for "his discoveries in connection with stainless steel, stellite, chrome-iron, etc."

Thomas B. Osborne, Ph.D., of New Haven, Conn., for "his researches on the constitution of the vegetable proteins."

John Scott Medal Fund

Extract from power of attorney to carry out certain provisions in the will of John Scott. Dated April 2, 1816:

. . . that the interest and dividends to become receivable . . . be laid out in premiums to be distibuted among ingenious men and women who make useful inventions; but no one of such premiums to exceed twenty dollars, and along with which shall be given a copper medal with this inscription "To the most deserving," conformably to the tenor of the will of the said testator, John Scott, deceased.

Decree of the Court of Common Pleas of Philadelphia:

And now, this nineteenth day of February, A. D. 1919, the report of the master having been duly filed and no exceptions having been taken thereto, it is adjudged and decreed that the same be confirmed, and that the Board of Directors of City Trusts having in charge the trust created under the will of John Scott, deceased, be authorized and directed in the administration of said fund to distribute the income arising from the fund as it stands with its accumulations as of the date of this decree, in premiums to be distributed among ingenious men and women who make useful inventions, but no one of such premiums to exceed eight hundred dollars ($800.00) in value (increased under decree of court, dated November 29, 1921, to $2,000.00); and along with such premium shall be given a copper medal with this inscription, "To the most deserving" conformably to the tenor of the will of the said testator.

It is further ordered and decreed that in the selection of the recipients, the said trustees shall be at liberty to make such rules and regulations for enabling them to make a wise selection of beneficiaries either by the selection of an advisory board or otherwise, as they may deem best. The premiums shall be awarded for useful inventions which shall include any inventions that will be useful to mankind in the advancement of chemical, medical or any other science or in the development of industry in any form; the test being that the invention is, in the judgment of the trustees, definitely accomplished, and that it may add to the comfort, welfare and happiness of mankind.

Resolution adopted by the Board of Directors of City Trusts:

Resolved, That the award of medals under the John Scott Medal Fund be made hereafter upon the recommendation of an advisory board, to consist of five persons, to be appointed by the Board of Directors of City Trusts; three to be nominated by the National Academy of Sciences, one by the University of Pennsylvania, and one by the American Philosophical Society; all of said nominees to be acceptable to the Board of Directors of City Trusts; the recommendations of the Advisory Board to be made on a majority vote.

Personnel of the Advisory Committee:

National Academy of Sciences: H. H. Donaldson, Theobald Smith, W. B. Scott.

University of Pennsylvania: Arthur W. Goodspeed.

American Philosophical Society: Samuel M. Vauclain.

SCIENTIFIC NOTES AND NEWS

Dr. Hans Zinsser, professor of bacteriology in the College of Physicians and Surgeons, Columbia University, formerly in charge of the sanitary inspection, successively in the first and second army corps, American Expeditionary Forces, was awarded the distinguished service medal at Governors Island, on March 17, for his successful operation of a plan of military sanitation and epidemic disease control.

The Fenger Memorial Fund has allotted a grant of $400 for the extension of work now being carried out by Dr. M. G. Seelig on some uses of magnesium in surgery. This work is being conducted in the surgical laboratories of the Washington University School of Medicine.

The British Medical Association has awarded its gold medal to Sir T. Clifford Allbutt, regius professor of physic in the University of Cambridge, for his distinguished services to the profession and the association, and in commemoration of his five years' presidency of the association in the time of the war.

The Founder's Medal of the Royal Geographic Society has been awarded to Colonel Howard Bury, the leader of last year's Everest expedition, as a token of appreciation for what the society considers the most noticeable geographic achievement in the last twelve months. The presentation was made by Sir Francis Younghusband, president of the society.

The Society of Sigma Xi of the University of Iowa has elected to membership Dr. L. Wallace Dean, dean of the college of medicine; Dr. Samuel T. Orton, head of the psychopathic hospital; Lorle I. Stecher of the Iowa Child Welfare Research Station; Clarence W. Hewlett and Edward O. Hulburt, assistant professors of physics. Walter S. Hendrixson, professor of chemistry at Grinnell College, and William Harmon Norton, professor of geology at Cornell College, are initiates from other institutions.

Dr. Victor F. Hess, technical director of the United States Radium Corporation, has been appointed consulting physicist of the United States Bureau of Mines.

William H. Rhodes, Jr., who has been senior highway engineer, U. S. Bureau of Public Roads, has accepted the position of maintenance engineer with the Louisiana Highway Commission.

Dr. W. J. Humphreys writes that on page 312 of Science for March 24, it is stated through an error that got into the rough minutes that N. L. Bowen will be the new secretary of the Geodetic Section of the American Geophysical Union. Wm. Bowie, the present secretary of the section, will continue to hold that office.

Dr. F. F. Russell and Dr. Richard M. Pearce have arrived in South America to promote the work of the Rockefeller Foundation.

John R. Freeman, Jr., returned recently to the Bureau of Standards from a seven months' trip to Europe, where he visited, for the Bureau of Standards, the principal metallurgical laboratories of France, Germany and England. While in England he worked for about two months in the metallurgical department of the National Physical Laboratories under Dr. Walter Rosenhain.

Dr. Raymond Pearl, professor of biometry and vital statistics at the Johns Hopkins School of Hygiene and Public Health, will deliver the ninth Harvey Society lecture at the New York Academy of Medicine, on Saturday evening, April 8. His subject will be "The interrelations of the biometric and experimental methods of acquiring knowledge, with special reference to the problems of the duration of life." The lecture on March 25 was given by Dr. W. J. V. Osterhout, professor of botany in Harvard University, on "The mechanism of injury, recovery and death."

Professor Edward S. Morse, curator of the Peabody Academy of Science, gave a lecture at the Buckingham School, Cambridge, on March 25, on "Some experiences of a collector."

Professor Edward Kasner, of Columbia University, spoke on "Dimensionality in Einstein's cosmological theories," at Princeton University on March 14.

Dr. F. W. Aston, F.R.S., of Cambridge University, addressed the Physical Colloquium of the Western Electric Company in New York on March 13 on the subject, "Isotopes."

Dr. Thomas Lewis, of London, will deliver the seventh Mellon lecture before the Society of Experimental Biology of the School of Medicine of the University of Pittsburgh, on "Clinical electrocardiography," on May 8.

The Guthrie lecture of the Physical Society was given on March 24 at the Imperial College of Science, by Professor N. Bohr, who took as his subject, "The effect of electric and magnetic fields on spectral lines."

Sir Ernest Rutherford will deliver a lecture on the "Evolution of the Elements" before the Royal Institution on April 7. Recent lectures before the institution include one by Thomas R. Merton on the "Problems in the variability of spectra," and one by A. P. Laurie on "The pigments and mediums of the old Masters."

The John M. Dodson lecture of the Rush Medical College, established by the alumni in 1919 in recognition of Dr. Dodson's service to the college, was delivered on March 17 by Dr. Ray Lyman Wilbur, president of Stanford University, whose subject was: "Medicine: a look ahead."

As a memorial to Alfred Noble in recognition of his distinguished achievements in the field of engineering, a bronze tablet, the gift of the American Institute of Consulting Engineers, was unveiled on March 15 in the Engineering Societies Building, New York. Charles W. Leavitt, consulting engineer, made the address of presentation and J. Davies, consulting engineer, accepted the memorial in behalf of the United Engineering Society.

It is proposed to appoint a committee for the purpose of collecting the necessary funds with which to erect a monument to Professor Chauveau, who died in January, 1917. M. Chauveau was formerly president of the Paris Academy of Sciences, the Academy of Medicine, the Society of Biology and the French Association for the Advancement of Science.

The balance of the Rayleigh Memorial Fund has been given to the library of the Cavendish Laboratory. The library is to be called the Rayleigh Library. Six hundred pounds is to be separately invested in the Rayleigh Library endowment fund for experimental physics, and the income accruing is to be paid to the Cavendish professor for the purposes of the library.

The *Journal* of the American Medical Association states that the tenth anniversary of the death of Lister brings within view the completion of a scheme to honor his memory. Soon after his death the question of a memorial was taken up, but the war prevented its being carried out. A representative committee was appointed, and collected $60,000, which was subscribed from all over the world. Out of this has been established the International Lister Fund for the Advancement of Surgery. A sum of $2,500, with a bronze medal, will be awarded every three years, irrespective of nationality, in recognition of distinguished contributions to surgery, the recipient being required to give an address in London under the auspices of the Royal College of Surgeons. Sir Thomas Brock, the sculptor, has executed a memorial tablet to Lister, which was unveiled in Westminster Abbey in 1915. He is at present engaged in designing a bronze bust to be mounted on a pedestal in Portland Place, near Lister's last home. The bust and pedestal will stand about 21 feet high.

The death is reported at Charleston, S. C., of Captain William C. Hodgkins of the Boston field station of the United States Coast and Geodetic Survey, at the age of sixty-eight years.

Philip Argall, mining engineer, an authority on metallurgy, died in Denver, on March 19, at the age of sixty-eight years.

The annual meeting of the American Oil Chemists' Society will be held at the Grunewald Hotel, New Orleans, on May 8 and 9. A large attendance is anticipated and arrangements are being made for entertainment, as well as the usual program of business.

Establishment of fellowships in medicine to increase the supply of qualified teachers and investigators, is announced by the National Research Council. The fellowships, supported by appropriations of the Rockefeller Foundation and the General Education Board, will be open to Americans or Canadians of either sex holding or qualified to hold degrees of doctor of medicine or doctor of philosophy from approved universities. The appropriations are $100,000 a year for five years. Successful candidates, to be known as Fellows in Medicine of the National Research Council, will be at liberty to choose the institutions or universities in which they will work. The fellowships in medicine are similar to the fellowships in physics and chemistry established under the same auspices.

THE triennial competition for the prize known as the George Montefiore Foundation, which was won last year by Dr. J. B. Whitehead of the Johns Hopkins University, is again announced by the Association des Ingénieurs Electriciens sortis de l'Institut Electrotechnique Montefiore, of which L. Calmeau, rue Saint-Gilles, 51, Liège, Belgium, is general secretary. This prize, amounting to 21,000 francs, is awarded for the best original work in French or English, upon the scientific advance of electricity and its technical applications. Though known as the competition of 1920, the next award will be made in 1923, and works may be submitted up to April 30 of next year.

THE annual conversazione of the British Institution of Electrical Engineers will be held at the Natural History Museum, London, on June 29.

THE British Iron and Steel Institute will hold its annual meeting on May 4 and 5 at the house of the Institution of Civil Engineers, Great George Street, S. W. 1, London.

THE twentieth International Congress of Americanists is to meet definitely at Rio de Janeiro on August 20-30, 1922, under the Presidency of Dr. Lauro Muller.

THE second meeting of the informal group known as the "Boston Psychologists" was held at Wellesley College on Saturday, March 18. At the afternoon session questions of laboratory policy and the place of mental tests in systematic psychology were discussed. The dinner was followed by a toast to Professor Sanford, of Clark University, in recognition of his return to an active part in psychology. The subject for special discussion at the evening session was the status of the practicing and consulting psychologist. Twenty-five psychologists from many of the New England colleges and universities attended the meetings. The first gathering of the group took place at Harvard University last November. The invitation to hold the next meeting at Clark University next fall was accepted.

THE Council of the Optical Society of America has decided to hold an optical instrument exhibit during the annual meeting of the society at the Bureau of Standards, Washington, D. C., the latter part of October next. The director of the bureau has offered the necessary space for this exhibit. To enable the exhibit committee to plan the space adequately and assign it equitably, it requests those interested to submit the following information: (1) What instruments are offered for exhibition? (2) How much floor space would be necessary? (3) What additional facilities other than space will be needed? When this information is at hand the exhibit committee will notify the prospective exhibitors of the amount of space allotted to them. It will also see that the general laboratory facilities necessary are provided. The exhibitors will install their own exhibits and meet the expenses incident thereto.

A SMALL party of scientific men from the University of Iowa will visit islands in the Polynesian group next summer in order to obtain material for the university's laboratories and museums of natural history. Included in the group will be Professor C. C. Nutting, head of the department of zoology; Professor R. B. Wylie, head of the department of botany; Professor A. O. Thomas, geologist; Professor Dayton Stoner, entomologist and ornithologist, and Waldo S. Glock, meteorologist and photographer. In the interest of economy as well as for the sake of securing better specimens for student use, the University of Iowa for many years has maintained the policy of granting leave of absence to its men in search of such material instead of buying from dealers.

UNIVERSITY AND EDUCATIONAL NOTES

A CONTRACT has been let for a new medical building at the University of Alabama, Tuscaloosa, at a cost of $82,000. Construction work will be started immediately.

THE University of Strasbourg has recently made a report in which it is stated that in the university year 1920 there were 1,505 students; in the year 1921 there were 2,415, and at present there are over 2,600, and there is every prospect that the increase will continue. Provision for further development has been made there by 175 professorships in the place of 90 chairs before the war.

CLAUDE BURTON HUTCHISON, professor of plant breeding of Cornell University, has been selected by the regents of the University of California to head the activities of the branch of the College of Agriculture at Davis and to become professor of plant breeding.

DR. D. H. DOLLEY, professor of pathology at the University of Missouri, has been appointed director and professor of pathology in the St. Louis University School of Medicine. Dr. R. L. Thompson has resigned as director but will continue in the department.

DR. H. R. DEAN, professor of pathology and pathological anatomy in the University of Manchester, has been appointed to the university chair of bacteriology at the University of London, tenable at University College Hospital Medical School.

DISCUSSION AND CORRESPONDENCE

SELECTIVE FERTILIZATION AS AN INDICATOR OF GERMINAL DIFFERENCES

IT has been argued from time to time that the qualities which separate species are essentially different in kind from the visible variations which the geneticists are now busily describing in terms of genes. The position of those who take the affirmative side is fairly stated, I believe, in the following quotation from Bateson's recent address before the American Association for the Advancement of Science:

> Analysis [of the hereditary traits of animals and plants] has revealed hosts of transferable characters. Their combinations suffice to supply in abundance series of types which might pass for new species, and certainly would be so classed if they were met with in nature. Yet critically tested we find that they are not distinct species and we have no reason to suppose that any accumulations of characters of the same order would culminate in the production of distinct species. Specific differences therefore must be regarded as probably attaching to the base upon which these transferables are implanted of which we know absolutely nothing at all. Nothing that we have witnessed in the contemporary world can colorably be interpreted as providing the sort of evidence required.[1]

At this time lack of knowledge concerning the primary factors of evolution makes the stand of the agnostic undoubtedly a safe one and the one which may be the most conducive to real progress in the end. At the same time there is some evidence which should be considered in connection with the statements made in the quotation.

It has been shown conclusively in one species that fertilization takes place less readily when the gametes come from unlike forms than when homogeneous unions are made. The discrimination becomes more pronounced as the germinal differences of the uniting individuals are greater.[2] Maize is better material than most plants to show this because of the large number of seeds it produces with one application of pollen, and because the source of the pollen is soon apparent in the characters of the immediately resulting seeds. Mixed pollinations carried out with this organism have shown that the individual's own pollen, when acting in competition with pollen from other individuals of different constitution, is more effective in accomplishing fertilization.

When two different plants of similar type are compared the selective action is small. For example, when two varieties of maize having the same size and form of plant, equal length of growing season, similar seed shape and texture of endosperm and differing only in minor details are tested, the inequality in fertilizing power of the two kinds of pollen is slight although significant. The small difference in genetic make-up of these plants is also shown by the fact that there is very little heterosis exhibited in the increased weight of the crossed seed compared to the self-fertilized seed. But when a small-growing variety having non-starchy endosperm is paired with a larger variety which differs markedly from it in habit of growth, has starchy corneous seeds of very

[1] SCIENCE, 1922, N. S. Vol. 55, pp. 59 and 60.
[2] *Biological Bulletin*, 1920, Vol. 38, pp. 251-289.

different size and shape and possesses important differences in nearly all parts of the plant, the discrimination against the foreign pollen is very pronounced. The result is almost complete non-functioning of the pollen from the dissimilar plants although such pollen when acting alone is capable of normal fertilization. The greater genetic diversity of these two types is also indicated by the fact that the amount of heterosis shown in the increased weight of the crossed seeds is much more than in the previous case of the similar varieties.

There is here exhibited the working of a tendency which acts to set individuals apart. Besides *Zea mays* three other species, representatives of different orders of the two main classes of angiosperms, show the same phenomenon. It is paralleled in the assortative mating of animals from the lowest to the highest. It is not inconceivable that when carried far enough there may be created an impassable physiological barrier separating different groups. As far as can be judged the differences shown by the types used for illustration are the usual qualitative and quantitative characters which we have been thinking of in terms of Mendelian units. Such hereditary characters may not be directly concerned with the selective action but may be merely associated with differences in more fundamental qualities, but whatever these are they are transferable.

Of course this tells us nothing as to how the differences which are correlated with inequality in fertilizing ability arose. But however diverse were the forms which entered into the ancestry of maize they must have been sexually compatible. Individual members of this species which are quite diverse in form and behavior are now showing a marked tendency towards sexual incompatibility. The degree of selectiveness may be no greater now than it was when the species was first founded but the fact that there is a condition of measurable physiological aloofness is reason to suppose that the accumulations of characters of the same order would culminate in different groups being clearly set apart. Given sufficient time specific differences may finally result.

D. F. JONES

CONNECTICUT AGRICULTURAL
EXPERIMENT STATION

GRAVITATIONAL ABSORPTION

THE experiments of Majorana[1] on gravitational absorption having attracted considerable notice, it seems well to direct attention to the large amount of experimental evidence to the contrary.

Russell[2] in a recent article has shown that astronomical and tidal phenomena would limit any gravitative absorption to one-thousandth or less of the amount announced by Majorana.

Eichelberger and Morgan,[3] of the U. S. Naval Observatory, have recently published the results of clock observations from 1903 to 1911, reduced so as to show a difference, if any, between the day and night rate. It appears from these results that such a difference can not exceed 0.005 second, about one-tenth that previously announced by the Lick Observatory[4]. The writer is verbally informed that the Naval Observatory results from 1913 to 1918, reduced but not yet published, bring this slight difference to a still smaller figure.

The existence of gravitative absorption should cause a pendulum clock to run slower by night than by day, on account of the absorption by the earth of the gravitative action between the pendulum bob and the sun. Taking Majorana's coefficient of absorption (6.7×10^{-12}) the average absorption of gravitation by the earth during the night would amount to about three per cent. of the solar gravitative acceleration at the distance of the earth, which is about 0.0006g. The total gravitative acceleration to which the pendulum bob is subjected would therefore be reduced at night by about 0.00002g, or 2 parts in 100,000, and the average time of swing increased by 1 part in 100,000.

Taking 0.005 second as the greatest permissible change in 12 hours, the observations of Eichelberger and Morgan would limit the change in time of swing to something like 1 part in nine million.

Majorana himself, in a later series of experi-

[1] *Phil. Mag.*, 39: 488, 1920. *Atti della Reale Accademia dei Lincei*, 28, 1919, and 29, 1920.

[2] *Astrophysical Journal*, 54: 334, 1921.

[3] *Astronomical Journal*, No. 795, January 1922.

[4] *Lick Observatory Bulletin*, No. 330, April, 1921.

ments[5] carried out with a much more massive screen (9603 Kg. lead instead of 104 Kg. mercury) apparently finds an absorption coefficient of only one-third the value given by his earlier experiments. The actual difference in weight found was only 0.002 milligram. In view of the extremely small quantity to be detected and the large amount of evidence against the existence of such an effect, it may be fairly assumed that Majorana's result is in error.

PAUL R. HEYL

BUREAU OF STANDARDS,
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SCIENTIFIC BOOKS

A Study of Some Social Beetles in British Guiana and of their Relations to the Ant-plant Tachigalia WM. M. WHEELER. Zoologica, Dec. 24, 1921.

Five Years' Observations (1914-1918) *on the Bionomics of Southern Nigerian Insects, chiefly directed to the Investigation of Lycænid Life-histories and to the Relation of Lycænidæ, Diptera and other Insects to Ants.* CHARLES O. FARQUHARSON. Trans. Entomological Society of London, 1921. (Published January, 1922).

THERE are many excellent reasons for the study of insects. They constitute the majority of living animals, so far as at present known; and in their relations to one another and to the environment present biological complexes the analysis of which tests the powers of the keenest observers. We go to the Protozoa to find the problems of heredity and environment reduced to the simplest terms; but we turn to the world of insects to learn what life can do in developing the most intricate, diverse, and many-sided adaptive mechanisms and habits. It may be said that the most elaborate poem consists of nothing but letters of the alphabet, and in the same sense all the phenomena of insect life are implied in the simpler reactions of unicellular animals. But after all, the poem is very much more than letters or words, and the biologist who tries to express the masterpieces of vital activity in terms of simple and universal reactions can only do so by shutting his eyes to the real nature of the phenomena. It is, in fact, necessary to look in two directions at once; to be equally alert to detect general laws or principles, and to perceive special cases, which in a real and significant sense are unique.

Not only do the insects thus illustrate the wonders of life, but they afford us excellent material for evolutionary studies, whereby we may eventually understand in some measure how the most complex structures and reactions arose. They do this because the species are so excessively numerous, and there is every reason to suppose that much of their evolution has been *lateral;* that is, by the development of segregates without the disappearance of the original stock. Thus it may well happen that a sufficiently extensive collection will show a series of forms, along with their prototypes, the latter still existing under the original conditions. Recent studies have revealed the existence of many slightly divergent races or species, more or less different in their adaptations and reactions, exposing the very mechanism of evolution to our view. These phenomena, read in the light of the remarkable genetic studies on *Drosophila* and other insects, begin to acquire extraordinary significance and interest. It must further be said, that if we are to take full advantage of the wealth of biological opportunity afforded by the insects, we must turn to the tropics, where the number and diversity of species is at a maximum. In the tropics essentially similar climatic conditions have persisted for ages, permitting the development of biocoenoses which may be compared with old and highly diversified civilizations. But the detection and analysis of these requires resident study or permanent stations, as the English naturalist, A. R. Wallace, long ago insisted. Expeditions, traveling rapidly over the country, appear more adventurous or romantic, and often return with very large collections; but any one who has occasion to study the specimens so collected, must keenly realize the lack of biological information.

For all these reasons, the Tropical Research Station in British Guiana, established by Mr.

[5] *Comptes Rendus,* 173: 478, 1921.

William Beebe, is certain to become classical ground. Not only is the station most favorably situated for research, but it is securing the interest and cooperation of some of the most brilliant American naturalists. Although much work has already been done, it represents no more than a minute inroad on the resources of the locality. But whatever may be accomplished hereafter, it will not often happen that any more interesting story will be written than that by Dr. W. M. Wheeler on the insects associated with the plant *Tachigalia.* This genus of leguminous trees has long been known to harbor ants within the enlarged and hollowed petioles. The very name of the genus was derived by Aublet (1775) from the native name indicating this association. Dr. Wheeler, in the short time at his disposal, was able to detect no less than 50 species of organisms associated primarily with the leaves or terminal shoots of the plant, or secondarily with the organisms thus associated. Twenty-eight of these were ants, half of them representing new species, subspecies or varieties. The others included various kinds of insects, seven of which proved to be undescribed, and have been discussed in short supplementary articles by a number of specialists. The regular or normal inhabitants of the petioles are certain ants, beetles and coccids. The ants comprise two species of *Pseudomyrma* and two of *Azteca.* The coccids are all of one species, identified as *Pseudococcus bromeliæ* (Bouché)[1]. The beetles have been described by Messrs. Schwarz and Barter, of the U. S. National Museum, and are found to represent two species of Silvanidæ, one of them so remarkable as to be placed in a new genus. The discussion centers around these beetles, which prove to have very singular habits. Both adults and larvæ feed on the parenchyma of the *Tachigalia* petioles, but they also solicit and drink the sugary excrement of the coccids. When a beetle finds a coccid, it proceeds to apply its antennæ to the rounded surface of the mealy-bug's back, like "an expert pianist moving his hands from side to side over the key-board, or a masseur with his hands in soft gloves, massaging a patient." The beetle may spend as much as forty or more minutes in this operation. If the coccid is in the proper condition, it discharges a drop of liquid, which the beetle at once greedily swallows. The beetles do not seem to be able to judge whether the coccid is capable of responding, and will work for long periods without getting any results. Not only do the adult beetles behave in this manner, but the larvæ also solicit food from the coccids. Dr. Wheeler not only describes the interrelationships of the various insects in considerable detail, but gives a most interesting discussion of the general problems of instinct and habit involved; a discussion which has the advantage of being based on a minute knowledge of actual facts, rather than general presumptions as to what ought to be true. This discussion ends with a speculative passage which can not fail to attract the reader's attention.

"Fouillée believes that every appetition involves a rudimentary cognition and that automatic behavior like that of the habits and reflexes is merely lapsed appetition. If it could be shown that the latter really can have this derivation and that such ontogenetic mechanisms as habits can acquire representation in the germ-plasm and hereditary transmission, we might be in a position to give a consistent account of all animal behavior, and one which would lead us to regard the reflexes and the tropisms as ultimate, highly specialized end-stages instead of primitive, elemental components of behavior" (p. 118).

Charles O. Farquharson was trained in the University of Aberdeen, and went out to Nigeria as government mycologist. Through Dr. W. A. Lamborn, entomologist at the same station, he became interested in insects, and both men were greatly stimulated by Professor E. B. Poulton of Oxford, with whom they constantly corresponded. Owing to conditions arising out of the war, Farquharson was obliged to spend

[1] Bouché's description, quoted by Signoret, is partly inaccurate, and may not refer to a *Pseudococcus* at all. The current identification of the species is traditional, and probably cannot be justified or confirmed. The "*P. bromeliæ*" found on pineapples in Florida (Quarterly Bull. State Plant Board of Florida, October, 1917, p. 47) is almost certainly *P. brevipes* (Ckll.), and cannot be Bouché's species.

much of his time in doing routine work unconnected with sciences, but he managed to make a great number of interesting observations, which he hastened to communicate to Professor Poulton in letters, along with specimens of most of the species referred to. He hoped, on returning home, to work up his results and publish his more important discoveries, but he lost his life through a collision at sea within a few hours of Liverpool. Professor Poulton has edited his letters, adding a brief memoir and numerous notes, together with a series of contributions, from specialists, describing many of the new or interesting species found.

The paper is so long, and its contents are so varied, that it is impossible to give an adequate summary. The principal section, however, refers to the transformations and habits of a number of species of Lycaenidae, and brings out a number of new and curious facts. It is a strange coincidence, that almost simultaneously with Dr. Wheeler's publication of the observation of beetles obtaining liquid nourishment from coccidæ in South America, Farquharson's account of similar habits in Lycænid butterflies in Africa appears. The butterfly concerned is *Teratoneura isabellæ,* a long account being given, showing that the attending ants are driven away, apparently by flapping the wings. Professor Poulton suggests that an offensive odor is also produced. Later, two other related butterflies, of distinct genera, were found to have the same habits. Unfortunately the coccids were not preserved, and we can only conjecture that they were some species of *Pseudococcus.* Both of the works reviewed were capable of being completed only by the cooperation of rather numerous specialists, entomologists and botanists. It becomes increasingly evident that much of the best work in bionomics must necessarily be cooperative, no single individual, however learned, being capable of dealing with all of the species and problems involved. It is pleasant to find, in the papers before us, that the desired assistance was freely given and is completely acknowledged. Only in this spirit is it possible for men to work harmoniously together, and any who fail to conform to proper standards should be made to feel the disapproval of their colleagues.

T. D. A. Cockerell
University of Colorado.

SPECIAL ARTICLES

SEALING TUNGSTEN INTO PYREX

The author has spent considerable time in evolving a good method of sealing tungsten wire into Pyrex and fastening the copper lead-wires to the tungsten. The method here described is easily accomplished and the freedom from breakage is certain. It is hoped that the present detailed description may save others sufficient time to justify its publication. An elementary knowledge of glass-blowing is assumed.

The sealing-in glasses and the order of joining are:

tungsten—G705H—G702P—Pyrex.

The numbers are used by the Corning Glass Company to designate these glasses. Some glass-blowers prefer to omit G705H and seal the tungsten directly to G702P. The G705H is of lower melting point, may be used in the gas-air flame and hence offers less chance to oxidize the tungsten.

Clean the wire by sandpaper only or warm in the flame, dip in a saturated aqueous solution of sodium or potassium nitrite (or nitrate) and then polish with very fine sandpaper or even the thumb nail. Draw small tubes of each of the three kinds of glass having an internal diameter slightly larger than the diameter of the wire. Cut a short length from each and string them on the wire in the order (above) in which they are to be sealed. The flame should be applied first to the middle of the G705H bead and the others in turn be brought along the wire and melted to the preceding one. The wire with its glass coating, Fig. 1-a, may then be sealed in in the usual manner but joining Pyrex to Pyrex. In case the tungsten wire is small and it is desired to protect it from the flame the Pyrex enclosing tube may be extended through the final seal, Fig. 1-b, and the excess glass broken off after the seal is accomplished.

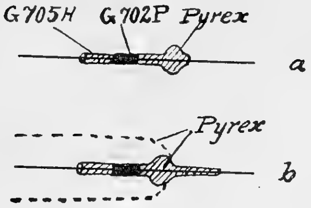

Fig. 1.

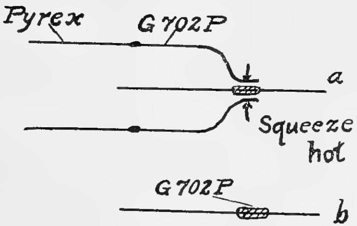

Fig. 2

A seal using only G702P and Pyrex may be made as indicated in Fig. 2. Join tube of G702P to Pyrex and draw down as indicated. The wire coated with a small bead of G702P (or even the bare clean wire) may be placed in position, Fig. 2-a, and the seal made by squeezing with tweezers when hot. Squeeze as soon as possible to prevent oxidation. This seal may also be made by squeezing a bead of G702P in a Pyrex tube but with less freedom from breakage.

To join copper to tungsten:

(a) electroplate tip of tungsten wire with copper or nickel and solder (silver solder for higher temperatures).

(b) melt nickel wire to tungsten in oxygen flame using borax as flux or even no flux. Nickel becomes very brittle and it is best to then solder to the nickel bead thus obtained.

(c) form arc of 10 to 20 amps. between tungsten and nickel wires to coat tungsten with nickel; solder.

(d) German silver (for this use of it I am indebted to Mr. Cummings of the Department of Chemistry of this University) flows much better than nickel. Use method (b) with borax as flux. Copper wire may be joined at once in flame just as in joining copper to platinum.

The method used will generally depend upon facilities available.

L. T. Jones

Department of Physics,
University of California

A NEW SCLEROTINIA ON MULBERRY

A disease of mulberry characterized by enlarged portions of the fruit has been noted by Orton[1] and more recently by Taubenhaus.[2] The authors have found a species of Sclerotinia to be the cause of this disease and will describe it as follows in the *Journal of Agricultural Research:*

Sclerotinia carunculoides n. sp.

Apothecia one to several from a single sclerotium, disc cupulate to sub-cupulate; 4 to 12 mm. in diameter; inside snuff-brown,[3] outside Prout's brown; stalk cylindrical, flexuous, smooth, attenuated downward, 15 to 42 mm. in length, reaching a diameter of 1.5 mm., color Prout's brown; asci cylindrical to cylindro-clavate, 104 to 123 x 6.4 to 8 μ, average 117 x 7 μ, 8-spored; ascospores uni-seriate, reniform, hyaline, 6.4 to 9.6 x 2.4 to 4 μ, average 7.6 x 3.1 μ, with 2 bodies on the concave surface; namely, a body more or less rhombic in shape as seen from above, 2 x 4 μ, and adjoining it, a more or less hemispherical body 3 μ in its longest diameter; paraphyses filiform to cylindro-clavate, simple or branched, septate or non-septate, 94 to 128 x 1.8 to 2 μ; microconidia hyaline, sub-globose, 2 to 4 x 2 to 3.2 μ, average 2.8 x 2.5 μ; sclerotia black, fairly regular, sub-spherical with depressed surfaces.

[1] *Experiment Station Record,* Vol. XIV, No. 6, pp. 351-352, 1903.

[2] *Nature Study Review,* Vol. 17, No. 7, pp. 282-285, 1921. Illus.

[3] Ridgway, Robert, *Color standards and color nomenclature,* 43 p., 53 col. pl., Washington, D. C., 1912.

On fruits of cultivated *Morus alba*. Type material collected at Scranton, S. C., U. S. A., March, 1921. Specimens have been deposited in the Office of Pathological Collections, Bureau of Plant Industry, U. S. Department of Agriculture, Washington, D. C.

The manuscript giving a more complete account of this organism went to press November 26, 1921, but since congressional action has suspended the publication of the *Journal*, it is deemed advisable to publish this preliminary account at this time in order that plant pathologists interested in this disease may be on the watch for the apothecial stage at blossoming time.

E. A. Siegler,
A. E. Jenkins
Bureau of Plant Industry,
Washington, D. C.
February 1, 1922

THE AMERICAN MATHEMATICAL SOCIETY

The two hundred and twenty-first regular meeting of the American Mathematical Society was held at Columbia University, New York City, on February 25, 1922. The attendance included seventy-five members of the society. The election of thirty-five new members was announced.

The secretary announced the gift, by an anonymous donor, of the sum of $4,000 to pay for an additional volume of the *Transactions*, to be printed in 1922. The society adopted a resolution thanking the donor for this very generous gift.

Professor C. N. Haskins, of Dartmouth College, was selected to succeed Professor L. E. Dickson, of the University of Chicago, as one of the three representatives of the society in the Division of Physical Sciences of the National Research Council.

The afternoon session was especially marked by the presentation of a paper by Professor J. L. Coolidge, by request of the program committee, on *The basis of mathematical probability*. A number of members of the Actuarial Society attended, by invitation, to hear this paper.

The following papers were read:

Invariant points in function space: G. D. Birkhoff and O. D. Kellogg.

A property of certain functions whose Sturmian developments do not terminate: O. D. Kellogg.

The boundary problems and developments associated with a system of ordinary linear differential equations of the first order: G. D. Birkhoff and R. E. Langer.

Developments associated with a boundary problem not linear in the parameter: R. E. Langer.

Ricci's principal directions for a Riemann space and the Einstein theory: L. P. Eisenhart.

Normal congruences and quadruply infinite families of curves: J. Douglas.

Qualitative properties of the ballistic trajectory. Second paper: T. H. Gronwall.

The reflection of X-rays in a finite number of equidistant parallel planes: T. H. Gronwall.

The basis of mathematical probability: J. L. Coolidge.

On the "Alabama paradox" in the problem of apportionment of representatives: E. V. Huntington.

On the d'Hondt method of apportionment, and its counterpart: E. V. Huntington.

Theorems on sequences of sets of points: G. A. Pfeiffer.

The Fredholm theory of Stieltjes integral equations: C. A. Fischer.

A closed set of normal orthogonal functions: J. L. Walsh.

Kinematics in a complex plane and some geometric applications: A. Emch.

On functions with integrals of elementary character: J. F. Ritt.

Geometrical properties of the system of all the curves of constant pressure in a field of force: E. M. Morenus.

Spherical representation of conjugate systems and asymptotic lines: W. C. Graustein.

The distribution of current in a long cylindrical conductor: C. Manneback.

Operational solution of equations of nth degree: A. Press.

Maximal cuspidal curves: T. R. Hollcroft.

Method for the separation into partial fractions of powers of trigonometric functions: I. J. Schwatt.

The expansion of the continued product, $\prod_{k=1}^{n}(x+k)$: I. J. Schwatt.

R. G. D. Richardson,
Secretary

SCIENCE

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Vol. LV April 7, 1922 No. 1423

THE EARLY TRAINING OF SCIENTISTS

It is a strange feature of the modern educational process that though children are born richly endowed with scientific instincts into a world which has gladly accepted a multitude of gifts from science, they encounter, from the cradle to the university, constant opposition to the education of these instincts.

The child is excellent raw-material for the making of the scientist. First of all, he is curiosity incarnate; he does not confine his attentions to those matters which adults consider practical, but tries to learn all he can about an environment which he finds brimming with interest. Moreover, he is an experimentalist, and the days are too short for the experiments he wishes to perform upon everything at hand, from the bric-a-brac to the patience of his elders. He relies upon experiment rather than upon authority for learning truth. Authoritative representations concerning the fragile qualities of glass, the taste of pepper or the temperature of a stove are to him but suggestions for experiments. Although his experimental technique is simple and his capacity for reasoning and theorizing are undeveloped, he has made a splendid beginning towards a scientific career.

In his further development, however, he meets with opposition at every turn. Many of his experiments earn punishment from his parents, who discourage his curiosity and even pervert the truth for their own ends. At school, book-learning is substituted for observation and experiment, and even when the topic is nature or science it is often taught in a very didactic way by a teacher who, though having taken many courses in pedagogy, may have but little appreciation of the spirit and method of science. At Sunday school he is likely to find a teacher who praises as religious virtue the docile acceptance of dogmatic authority and to whom the term "doubt" is one of opprobium.

The repressive process, alas, does not end here, for we in the university who next take him in hand delight in giving him the impression that the subject has been thoroughly elucidated. We take little pains to help him to realize the existence of vast fields awaiting exploration. Moreover, we are so anxious to guard him from errors of fact that we announce in advance what he is expected to find in his experiments. He is told to mix solution A with solution B and "to note the red precipitate which is formed." The precipitate he gets may happen to be yellow, but he has learned by this time that it is safer to call it red in his note-book. Why quarrel with the instructor, it is wiser to give the answer he wants and keep him in a good humor.

I am convinced of the justice of the foregoing diatribe, as I have had an intimate acquaintance with the problem, not only as a child, a student and a parent, but, I must confess also, as a teacher. Indeed, so thoroughly convinced have we been in the department of chemistry of the University of California of the importance of giving the student, so far as we can, a real training in the scientific method and spirit, that we have taken great liberties with that most conservative of all university courses, the freshman course in general chemistry. So many have asked for information concerning our methods that I am encouraged to assume sufficient general interest to justify an exposition of our attempt at the solution of this important problem.

We have been inspired by the opportunity offered by a fundamental course to present science in such a way as, first, to win for scientific careers the keen-minded students who are repelled by the drudgery and memory work of the old-fashioned course in descriptive chemistry; and, second, to encourage the average student to adopt the scientific attitude towards his everyday problems, an attitude so necessary in combatting the superstition, prejudice, selfishness and dishonesty in the world of ordinary affairs.

Although the following paragraphs describe a course in chemistry, our aim in giving this course is not simply to teach chemistry, but through it to teach science. Whether the student proceeds to advanced work in chemistry or enters one of the numerous fields for which it is prerequisite, or even takes no further scientific studies, it is important for him to have scientific training. The medium for this training is with us chemistry, but other subjects can, of course, be taught with a similar purpose in view.

In order to attain these ends we have been convinced that the laboratory work must be the central feature of the course, and that it must involve the solution of problems rather than the mere performance of illustrative experiments. This makes the work harder and therefore more interesting. The doctrine that the interest of the pupil is to be gained through ease and practicality is an educational fallacy. The student belies this doctrine in his own practice. Football is difficult and impractical, but it arouses far more interest than dishwashing, which is both easy and practical.

The teaching of elementary chemistry has been slow to reflect the modern state of the science, which is no longer chiefly descriptive, but to a high degree mathematical and deductive. It has largely continued, in the language of Le Chatelier, to present "une énumération indéfine de petits faits particuliers: Formules de combinaisons, densités, couleurs, action de tel on tel corps, recette de preparation, etc." Laws and principles appear to the student as dykes intruding into the mass, but not fusing with it. While it is difficult and probably undesirable to abandon altogether the traditional method, we have sought to substitute for much of the purely informational material, a grasp of great principles such as the atomic, molecular, kinetic and ionic theories, the mass law, and the periodic system of the elements, and to make them not mere definitions, but tools to be used with intelligence and skill. It is of little use for the student to define the mass law unless he can actually use it in controlling a new chemical reaction. There is little point in committing the periodic table to memory unless he can apply it with assurance in predicting chemical behaviors.

We have been fortunate in being able to include general chemistry and qualitative analysis in one intensive course of two laboratory periods, two quiz periods, and two lectures per week throughout the year. It has thus been possible to minimize the usual break between these subjects and to develop systematically from the general principles of chemistry to their application in the problems of analysis. In the laboratory manual, written by Professor W. C. Bray with the assistance of Dr. W. M. Latimer, the effort has been to stimulate the student, through proper experiments; first, to gain a working conception of the atomic theory, the molecular theory and the behavior of gases. There follows next, a study of acids and bases and of titration, in order to develop and apply the idea of concentration. A further study of acids, bases and salts leads to the ionic theory. In this connection we have not considered it necessary to discuss an element at length before studying one of its compounds. Acetic acid, for example, is a quite familiar substance, whose acid properties may be investigated before studying organic chemistry, and it is not necessary to discuss sulfur, sulfur dioxide and the manufacture of sulfuric acid in order to do some laboratory work with the acid. There follow assignments on strong and weak acids and bases and the uses of indicators to measure the concentration of hydrogen ion; rapid reversible reactions and equilibrium; the reversibility of neutralization reactions, or hydrolysis; the properties of sodium, potassium and ammonium ions and the tests for sulfate and nitrate ions; the chemistry of calcium ion, developing solubility equilibria and the transformation and solution of precipitates; carbonic acid, carbonate and bicarbonate ions; the salts of copper, sulfur and zinc, which prepare the way for the study of complex ions, amphoteric hydroxides and the important reactions utilized in qualitative analysis.

Unknown solutions of increasing difficulty are introduced during this period, but more emphasis is placed upon the student devising methods of analysis than upon committing to memory and using the orthodox schemes, which few chemists ever use in actual practice without appropriate short-cut modifications. Oxidation and reduction reactions and electric cells are next introduced, followed by a study of ions whose separations involve oxidation and reduction.

The effort is made constantly to throw the student upon his own responsibility, especially in observing accurately and in drawing general conclusions from his experiments. There are numerous questions calling upon him to predict results of untried experiments.

The lecture work is organized to supplement closely the laboratory work and to contribute an element of stimulus and inspiration. The topics in the early part of the course are taken up in much the same order. When acids, bases and salts are introduced in the laboratory, the lectures take up the alkali metals followed by the alkaline earth metals. The chemistry of the metals is so much simpler than that of the non-metals that we have been more than satisfied by our abandonment of the usual order of presentation in which the halogens are introduced early in the course. An intensive study of the periodic system and its use in predicting and correlating not only physical properties but chemical characteristics as well, continues throughout the year with necessary interruptions from time to time by other topics.

A reference book has been written for the course in which the aim has been to present clearly and briefly the principles of chemistry. The topics have been arranged in convenient order for reference rather than as in the lectures. The program of the lectures can thus readily be altered from year to year to try experiments of instruction, and making it easier to avoid the stagnation so fatal to even the best of courses.

But though general principles are emphasized in the teaching, we feel that the final test should not be the statement of the theories but their application. In our examinations, therefore, we usually say little about theories and principles, asking the student rather now to prepare one salt from another; how to accelerate or retard given reactions; how to shift certain equilibria; how to dissolve various precipitates; whether he would expect a given acid to be stronger or weaker than another, or a certain salt to be more hydrolyzed than another; what properties of substances make them useful for certain purposes.

The success with which the more intelligent students are able to answer such questions has convinced us of the efficacy of this form of instruction. The students seem also to grasp something of the enthusiasm and interest in the science of chemistry which turns some of them ultimately into capable research workers. We have noted with considerable satisfaction moreover, that even the more purely descriptive type of chemistry is rather readily learned. It is evident that the habit of correlating facts with each other and with theory has made the assimilation of the information comparatively easy.

In order to achieve its object such a course must have the advantage of contact with the more advanced work and the research carried on in the department, and must be taught by men interested in discovery. It has been our policy, therefore, for all members of the departmental staff to take part at more less frequent intervals not only in the weekly conferences of instructors, but also in the laboratory and quiz sections. This practice has been effective in unifying the purposes of all the departmental courses. The junior assistants are all candidates for the Ph. D. degree, and hence actively engaged in research. The better students are frequently invited to see the work these graduate assistants are carrying on in the research laboratory, which proves a source of considerable inspiration.

Thus beginning with students from the high school, many of whom have not had even high school chemistry (for we admit students if they have had high school physics and trigonometry), we are able to accomplish in a single intensive course what is ordinarily extended over two years; and by continuing the same intensive method in the more advanced courses, to prepare the student for serious research at the beginning of the senior year. The large proportion of students who go on into graduate work and the output of the laboratory in research are evidence of the rich fruit of the method. We are confident also that those students who have studied elementary chemistry as preparation for some allied science have received a far better training for their later work than a more purely informational course could afford.

JOEL H. HILDEBRAND

ARE IODIDES FOODS?

IT has been considered by some biologists and chemists that living matter originated in the sea and the elements of living matter correspond to those found in the sea water. We might look, therefore, to the composition of sea water for the elements we should expect to find in living matter. Sea water consists largely of H_2O and sodium chloride, and besides those the chief ingredients are magnesium, calcium, potassium and carbonates, sulphates and bromides, but there are also present the following elements in traces: ammonia, lithium, rubidium, cæsium, strontium, barium, manganese, zinc, iron, cobalt, nickel, lead, copper, silver, gold, radium, fluorine, iodine, nitrate, phosphate, silicate, aluminium, boron and arsenic. In searching for these substances in living tissue they have been found chiefly in marine organisms. However, chemists are finding them to a greater and greater extent in tissues of mammals. Damiens[1] finds bromine in a large number of animals and Gautier[2] finds iodine in quite a number of animals. We are familiar with the fact that fluorine is a regular constituent of bones and teeth and iodine of the thyroid gland. In experiments on the nutrition of animals, I have found it very convenient to feed them evaporated sea water and in this way insure a supply of all the rare elements. Cameron and Carmichael[3] have not observed any deleterious effect in feeding rather large doses of sodium iodide to white rats and rabbits. The use of sodium

[1] Damiens, A., *Comptes Rendus*, 1920, clvvi: 930. Damiens, A., *Bull. Soc. Chem. Biol.*, 1921, iii: 95.

[2] Gautier, A., *Comptes Rendus*, 1920, clxx: 261; 1899, cxxix: 66.

[3] Cameron and Carmichael, J., *Journal of Biological Chemistry*, 1920, xlv: 69.

iodide in preventing goiter in sheep and in preventing the hairless pig malady is quite well known. The use of iodide in the treatment of goiter was first brought out by the work of Dumas, who was born in 1800 and studied pharmacy in Geneva. Dumas and Coindet found that iodine was valuable in the treatment of goiter. The use of sodium iodide in the prevention and cure of goiter was strikingly emphasized in 1917 by Marine and Kimball.[4] This leads to the natural conclusion that the cause of goiter, or at least one of the causes, might be the lack of iodine in our diet. Iodine seems to be very rare in food and soils (Private communication of Oswald Schreiner) or else the former methods of detection have not been sufficient for such traces as do exist (See Kendall and Richardson[5] for later methods). Iodine has been found in a number of rocks such as slates (Gentile[6]), limestones (Lembert[7]), dolomite (Rivier and Fellenberg[8]) and granites (Gautier) in Europe and has been reported in vapor from Vesuvius (Matteucci[9]), but it seems to be leached out so rapidly from soils it is seldom to be detected. Forbes[10] failed to find iodine in about half of the specimens of foods, and Cameron[11] had a similar experience. The question of the relation of goiter to locality has caused much discussion and most persons have come to the conclusion that goiter is due to the presence of some substance rather than the absence, but since much fruitless work has been done in the attempt to find this substance it would be well to investigate more thoroughly the question of the absence of some substance.

[4] Marine, D., and Kimball, O. P., *Jour. of Lab. and Clinical Med.*, 1917, iii: 40.

[5] Kendall, E. C., and Richardson, F. S., *Journal of Biological Chemistry*, 1921, xliii: 161.

[6] Gentile, 1849, *Jahresber. d. Chemie*, 251.

[7] Lembert, 1851, *Jahresber. d. Chemie*, 319; *Jl. Pharm.* (3), xiv, 240.

[8] Rivier and Fellenberg, 1853, *Jahresber. d. Chemie*, 924.

[9] Matteucci, 1899, *Comptes Rendus*, cxxix, 65.

[10] Forbes, E. B., *Bull. Ohio Agri. Station*, No. 299, page 487.

[11] Cameron, A. T., *Journal of Biological Chemistry*, xviii: 335.

Goiter occurs largely in mountainous regions or regions far from the sea. Iodine is so rapidly leached out of the soil that the supply of it may depend upon salt spray blown from the sea. During storms the waves are broken into a spray and the water evaporated and the salt carried for long distances through the air. This salt is washed down out of the air by rains and contaminates the rain water. In the accompanying figure 1 taken from Emmons[12]

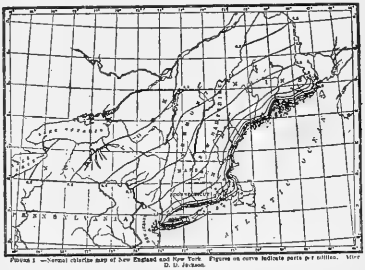

Figure 1.—Normal chlorine map of New England and New York. Figures on curve indicate parts per million. After D. D. Jackson.

Fig. 1

is shown a map of the eastern states, indicating the relative amount of sea salt in the rain water. Determinations were made by the weight of a certain constituent (the chlorine ion) by the ordinary silver nitrate titration, but sea water is of very uniform composition in regard to everything except H_2O. That is to say, when the salts are diluted or concentrated, they are all changed in the same ratio, and the dry salt would be of uniform composition, so that the chlorine titration would indicate the relative amount of iodine. Evaporated sea water contains 50 parts per million of iodine, whereas the chlorine forms 55 per cent. of the evaporated sea water. The lines on the map indicate parts per million of chlorine in the rain water and the iodine would be about one ten-thousandth of this amount, or, in other words, a part per million of chlorine would be about a part per ten billion of iodine. We can say, therefore, that the amount of iodine in the rain water rapidly decreases as we go from the coast, and is least

[12] Emmons, W. H., 1913, *U. S. Geol. Survey Bull.*, 529.

in the Great Lakes region. Figure 2 (taken from Davenport and Love[13]) shows a map of

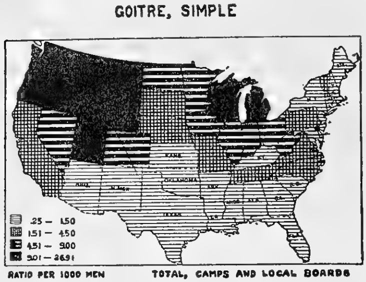

Fig. 2

the goiter as reported by the Draft Board and we have more or less the same distribution in the opposite direction and see more goiter towards the lake region and less toward the coast. Owing to the fact that no chlorine maps have been made for the rest of the country, it is not possible to extend this comparison. It is reported, however, from various sources (and is my personal observation in Minnesota) that the whole Great Lakes region is quite goiterous, and this is necessarily a region in which very little sea salt falls upon the land since the air blowing over it has already been washed free from sea salt by previous rains. Besides this goiterous region, various mountainous regions in the country have been reported to be goiterous and this is also true of Europe. These mountainous regions may be relatively near or far in relation to the sea. We often speak, however, of the clear mountain air free from dust, and it seems very probable that sea salt, being very heavy, would tend to remain in the lower strata of air rather than rise to mountain heights. Volcanic dust when thrown to great heights may remain in the upper air for a considerable time, but this is true only of the very finer particles of dust. The larger particles settle very rapidly. In fact, so rapidly as to sometimes bury towns. We may suppose the same things are true of the sea salt in the air.

[13] Davenport, C. B., and Love, A. G., 1920. *Scientific Monthly.*

The very finest particles may be carried to greater heights than the larger ones, provided they can escape the rain long enough to reach that height in the first place. The volcanic dust is thrown rapidly to the great height. The sea salt is thrown into the air at the sea level and its reaching a great height is very fortuitous. Therefore, we may suppose that the occurrence of goiter in mountainous regions fits in with the deficiency hypothesis. The absence of iodine from the rain water and soil in a region would necessitate its absence from the plants growing in the region and the animals subsisting entirely upon the plants and rain water. Man, however, may receive considerable food from some distance. Food rich in iodine, such as fish, oysters, squid, sea-hares, sea urchin ovaries and sea weed, is consumed to a much greater extent along the sea coast than in inland regions. Sea weed is not a general article of diet and is only eaten habitually by the Japanese and certain other peoples living close to the sea. Sea food, owing to its perishable nature, is largely consumed close to the sea. Therefore, even with considerable means of food distribution, the relation of goiter to distance from the sea might still be maintained. Water might hold the same relations. Water flows toward the sea and therefore does not bring iodine from regions richer in it. Water courses rise either in mountainous regions or in inland lakes which are goiterous regions. Certain mineral springs may be exceptions but the consumption of such mineral water is rather limited.

The principal other factor in the diet is salt. Salt was first obtained by the evaporation of sea water. The process used reduces the amount of iodine, but the extent of reduction may depend upon the amount of refining that the salt undergoes. The sea water is evaporated in shallow ponds until the calcium carbonate precipitates. It is then further evaporated in other ponds until the sodium chloride crystallizes out. The mother liquor from the sodium chloride crystals, known by geologists as the bittern, contains most of the iodine along with magnesium chloride and other salts. This crude sodium chloride, which may have some iodine clinging to it, was formerly consumed in this condition but nowadays is often further purified by washing and recrystallization so that the iodine, which is in very low concentration in the sea water, is reduced to infinitesimal quantities. Salt was not purified to as great an extent in the early days as it is now. When it comes to rock salt Nature has already purified it to some extent. Van't Hoff showed the mechanism of stratification of the rock salt deposits. The sodium chloride layers are already more or less purified. This salt when it is mined in the dry state or when it is obtained from salt springs, which consist of water which has come in contact with these salt deposits, is still further purified for table use. Hayhurst[14] investigated some of the salt works in Ohio where the salt is obtained from deep wells. Bromine and a trace of iodine are separated out of the salt and the bromine sold as a by-product.

I have been unable to obtain any evaporated sea water, that is to say, salts obtained from the sea water without fractional precipitation or purification, from any commercial salt manufacturers on the coast. Through the kindness of Metz & Company, Dr. Sherndahl evaporated 100 gallons of sea water for me to use in experimental feeding. This, together with sea water which I have had opportunity to evaporate, has been dried by baking it in an oven. When the last traces of water are eliminated in this way, hydrochloric acid fumes are also given off. The cause of this, as pointed out by Sorensen, is a reaction between magnesium and the other salts whereby oxides of the alkaline earth metals are formed with the elimination of hydrochloric acid. If the baking is continued long enough no calcium or magnesium chloride remains and therefore the salt remains dry. If the sea water has been evaporated in an iron kettle some iron oxide is added to it, which improves it from a nutritive standpoint. The necessity of baking may be eliminated by adding 6 grams of H_3PO_4 to the liter and this salt may aid in the treatment of rickets. In my animal experiments this evaporated sea water has been used for generations of animals as the salt ration, with gratifying results. It is very low in phosphoric acid unless H_3PO_4 has been added, and if casein is used as the protein there is not sufficient phosphoric acid in the casein for the nutritional requirements. The question as to whether there is sufficient calcium or not for the total calcium ration has not been definitely settled. If wheat flour is used for the carbohydrate portion of the ration there is sufficient additional calcium in the wheat flour to bring the calcium up to the requirements.

[14] Hayhurst, E. R., Science, 1921, liv: 131.

The question arises whether it would not be advisable for us to feed our children an impure salt. If iodine is the only mineral constituent that might be deficient it could be easily added to the salt. We have not proved, however, that the other mineral constituents of sea water are not necessary in the diet. Therefore, it would seem much simpler to use evaporated sea water as the salt ration if it could be obtained, and it only remains to create a demand for it. The present process of commercial evaporation of sea water could be simplified if an impure salt was desired. That is to say, only one pond would be necessary for the evaporation of the sea water. Sea water could be evaporated in this pond as far as practical by the sun. The total contents of this pond, including both solids and liquids, could then be removed and evaporated by heat and thoroughly mixed, and baked at a high enough temperature to produce a dry salt. In case the crystals of salt were large, owing to the slow evaporation at first, they could be ground. In baking, however, there is a tendency for these crystals to break up. The inclusion of a little earth with the salt would not impair its nutritive qualities and the product would be sterilized by the high temperature used in baking. It has been shown that salt obtained by the usual methods from the salt evaporating plants on the French coast is reeking with bacteria. The production of a sterile product might be an advantage. The dietary salt of several adults, children and infants has been limited to the above described from Metz for many months with gratifying results, in a goiterous region.

J. F. McClendon

The Laboratory of Physiological Chemistry,
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GEOGRAPHY AS A PROFESSION

INTRODUCTION

Modern geography is a young science, and usually college students know little of its content. If they think of it at all, it is usually as a subject which they were forced to study when young, but sloughed off when they became men. They do not recognize that the causal element now stressed so strongly has given it a content which has placed geography in the university curriculum and added greatly to its practical worth.

RELATION TO OTHER SCIENCES

The first point to appreciate is that a liking for geology, physics, biology, mathematics, astronomy, history, economics, anthropology, or ethnology, excludes no one from becoming a geographer. Geography is not an isolated science. It is an intensively interlocking combination of other sciences directed towards a broad, but specific field of study. The great war, if it has proven anything, has proven that geography and its ramifications present problems worthy of the keenest and best trained intellects of the day. The fact that geography is now understood to be of value in settling disputes between new states, in understanding the possibilities of commerce open to this nation's newly created merchant marine, and in interpreting to the advantage of all concerned the prides, prejudices, and virtues of those with whom foreign trade does or may bring close contact, has added greatly to the prestige of the science and those professing it.

OPPORTUNITIES IN GEOGRAPHY

Several types of employment are open to the geographer. The following list is not exhaustive, but suggests the major opportunities offered.

1. The government now recognizes as never before the value of trained geographers. There can be little doubt but that its need of such men will increase.

2. Map-publishing houses must employ skilled geographers.

3. Great corporations, commission houses, and banks, as the United States expands its foreign trade, are recognizing more and more the necessity of having trained geographers on their staffs. Certain banks have found it necessary to establish their own schools in order to give adequate geographic training to men in whose charge they wish to place their foreign branches.

4. Although the world is commonly thought of as pretty well explored, the facts are that many large areas even on our own continent are known only very superficially. Skilled geographers are needed to accompany scientific exploring expeditions, and with the increasing need of tropical products, the demand for such men will increase.

5. Men can not take advantage of the preceding opportunities without adequate training. At this present moment, universities are handicapped in giving this because of the lack of trained teachers. The supply by no means meets the demand. The student who prepares himself to teach university geography is taking advantage of one of the best opportunities in the entire pedagogical field and rapid promotion is certain for him if he deserves it.

TYPES OF INVESTIGATION POSSIBLE

The main types of investigation possible are as numerous as are the sciences allied to geography, with almost innumerable subordinate lines under each. A study of the table of contents of a half dozen leading geographical journals at home and abroad will give some idea of their variety. Within their covers will be found studies of all phases of weather and climate, of the physics of the atmosphere, of map-making and map-interpretation; explanations of the distribution of the races and languages of man, and of the relations between man and his natural surroundings; discussion of why some countries are great and others weak; accounts of exploration; reasons for the courses and materials of trade; and the whys and wherefores of the surface of the land and the bottom of the sea. This is just a hint of the variety of interesting, instructive, and profitable studies which come to the geographer.

COMPENSATION

Few geographers will become rich. The desire for wealth can never be the compelling reason for entering this subject any more than others. There are, however, varied reasons why a young man may well consider it as a life pursuit.

1. Vigor of body is the natural reward of the active geographer. This needs no amplification.

2. The geographer is brought into intimate contact with many lines of human interest and endeavor. Soils, crops, commerce, landscapes, weather, all kinds of natural resources, both developed and potential, interest him. And, if he travels, as he must to progress far in his science, he gains an insight into the hearts of men and nations second to none. The geographer becomes in reality a "citizen of the world" with much power to promote international understanding and good-will.

3. The modern science is young—younger even than its sister science, geology. Two important results follow:

(*a*) The opportunities for employment are numerous. Those who enter the subject now are on the "ground floor" as it were, in a movement which promises to be of much educational and economic importance.

(*b*) The opportunities for original discoveries and contributions are great. With their accomplishment comes the reward which the consciousness of having added to human knowledge always brings. The full power of this needs to be experienced to be understood. There is also the additional satisfaction which comes from being a pioneer in the development of new aspects of an important subject.

These advantages are on the whole quite similar to those of geology. In this connection, it may be interesting to know that while numerous men enter geology from other subjects, few leave it—and of those who do, by far the larger number change into this closely allied science, geography. The application of the broad learning of many years to a study which opens unlimited possibilities for bringing to mankind material prosperity, mutual good-will and friendly understanding, is intensely fascinating to the maturing man who feels a call to serve humanity, yet desires to labor and investigate in his chosen fields of science. Any young man who has seriously thought of scientific work as an attractive life profession must find in geography an appeal which merits his careful consideration.

H. P. Little
National Research Council

VIENNA

While in Vienna last summer I was like other visitors deeply impressed with the supreme importance to the world of the problem of relieving this sadly stricken capital. At that time the exchange rate for the Austrian crown was about 600 to the dollar and it has since fallen to a rate of 10,000 to the dollar. The average salary of the professional man even six months ago was only the equivalent of between $100 and $200 a year, and the recent financial panic has brought the intellectual worker to straits which are almost beyond belief.

There are, it seems to me, three reasons why the situation in Vienna makes a unique appeal to the professional men and women of America. In the first place the actual suffering is far greater in Austria than in any other country outside of Russia. In the second place, there is at stake here not only the life and health of individuals but the life of a civilization, one of the most liberal and enlightened in the world. The universities and schools of Vienna have for centuries been the eastern outposts of the intellectual life of western Europe and in music, in medicine, and in many other arts and sciences her contribution has been unrivalled. In the third place, a peculiar responsibility rests upon America in this connection because the recent panic would have been entirely prevented if the congress of the United States had not delayed for six months the passage of the foreign debt funding bill which was essential to the carrying out of the Ter Meulen plan for the financial rehabilitation of Austria.

We can take great pride in what has been done by the American Relief Administration, the American Red Cross and the Friends Relief Mission to mitigate the suffering of the people of Vienna. With the passage of time, however, it is natural that the enthusiasm of service should somewhat relax. It is important to remember that the situation is if anything to-day more critical than ever, and that the year 1922 will probably determine whether Vienna shall survive or perish as a center of intellectual and artistic life. I am therefore venturing to ask if you will not print the enclosed extracts from a letter just received from Miss Hilda Clark of the Friends Relief Mission, who has just returned to Vienna after a visit to the United States. I have personally no connection with the Friends Service Committee but I admired the work they were doing in Vienna beyond measure and I can assure the readers of Science that gifts of money or of clothing sent to the American Friends Service Committee, 20 South 12th Street, Philadelphia, for the use of the professional men and women of Vienna will accomplish a service of unique value for humanity and civilization.

C.-E. A. Winslow

Yale University,
February 3, 1922

EXTRACTS FROM MISS CLARK'S LETTER

I am interested to find, on getting back here, that the worst effects of the financial collapse of last autumn have not yet begun to show, at any rate, among the majority of the working-class population. Unfortunately, the reason for this is one which no one dares to think can be more than temporary. It is, that wages have boldly been put up, and in many trades, have almost risen to follow the increased cost of living so that people are actually better off than they were two years ago.

This applies particularly to food. The situation in regard to clothing is rather curious. Even in those trades where the rise in wages has been greatest, the fluctuation in prices is so uncertain that any article of clothing, for which it is necessary to save from week to week, is likely by the time the necessary money to buy it has been saved, to have doubled in price. You will see what a strong discouragement this is to people to save, and how impossible they feel it. Really, the home maker is in much the same difficulty as the manufacturer, and the working man or woman has not always the intelligence to cope with it. This tends to make people, especially, of course, the more thoughtless, even if earning the best wages, spend their money on food each week, rather than save it for clothing. I do not think anybody would quite understand and sympathize with them who has not been, to some extent, in the same position.

Fortunately, the expenditure on food does, after all, help to restore the physique of the workmen, which had got so very much undermined before this rise in wages took place, but it creates a great deal of misapprehension on the part of social observers in the town whose first idea is that the working people are much better off than they really are.

This would not matter, were it not that there appears to be no hope at all that the present wage level can be maintained without causing a great increase in unemployment. It is not thought that industry can stand the present cost of production, as Austria has only obtained her markets, during the past year, by being able to undercut other manufacturers. It seems inevitable that she will go through the same phase of unemployment as has occurred in other countries. To meet this, she has at present absolutely no resources except a very uncertain amount of savings made by the most successful of the war-profiteers.

Perhaps one should add to her assets the extraordinary courage and grit a great proportion of the people are showing, and the energy with which they are turning to the increase of their home food production. Unfortunately, a good deal of capital is required to carry this out to a sufficient extent to enable her to tide over an industrial crisis, but the amount of capital needed is very much lessened by the energy and hard work which the men themselves are giving.

First of all, they have increased the allotment garden production, and having nearly all the land that can possibly be reached by the people living in the present houses in Vienna, they are moving out to live in the country close to, and building houses with their own hands to live in while they cultivate the land. In this way, their labor is not withdrawn from the industries which are still working, and if there is temporary unemployment, they will be ready to return when conditions improve.

I think it is important that people should realize that to provide capital for this increase of the home food production is the only way of averting absolute starvation if unemployment on a large scale should occur, even if this were only temporary. There is no reason to suppose that industry here could not recover directly conditions in Europe generally improve, or that Vienna would not be able to take her place on equal terms with other countries without the advantage of a cost of production subsidized by foreign relief.

With regard to the actual physical condition of the people at the moment, especially of the children, in which the people who have so generously helped in America are naturally most interested, thanks to this increase in wages, which has kept the majority of the working class from coming on our hands for relief, we have been able, with our limited programme, to do what was necessary to save the lives of the children, so far, this winter.

In the middle-class, where rises in salary, and fixed incomes have not come anywhere near the increase in the cost of living, the suffering is very terrible, and increasing as the colder weather sets in; we are now in the grip of a snowstorm which makes life almost impossible for people who have not been able to buy either clothing or fuel, and whose food has been reduced to about a quarter of that needed to maintain their vitality. The professional classes here have few children, and have had hardly any since the war, so that the relief for young children, which is our main piece of work, does not very much help them.

We have, therefore, turned our attention very specially to them this winter, and are particularly increasing, as far as our funds will allow, the help for the young children between the ages of 14 and 18 who, even if given one meal a day by the American Relief Administration, and only a very few of them get this now that the numbers have been reduced, are really not able to keep body and soul together while they are training themselves to earn their living.

The students in the university are still getting some help from the World's Student Christian Federation, but this, unfortunately, is coming to an end, and it is terrible to think what will happen, if they are unable to continue it, as the position of the students is certainly worse than it has ever been.

We are specially turning our attention to the lower grade or trade colleges of a lower standing than the university, and which are not included in this student relief,—where a great many of the poorest of the professional classes are trying to get their boys and girls trained for work which will enable them to earn their living more quickly than they could if they had to take the whole university course. We are now helping nearly 500 in this way, providing a fortnightly ration of extra food, enough to give about a third of the minimum calory requirements for an adult, and are also dealing with the whole family, who are often found, after individual investigation, to be in the most pitiable plight. All these families have had a ration of clothing averaging from six to ten garments per person, towards which they pay a trifling sum, which covers overhead expenses, and other help has been given where it was felt that the family could be placed in an independent position.

The students selected for help have been generally those in their final year, as it is found that this is the time when they tend to break down from the strain of combining study and a job, in the attempt to earn their keep. We are hoping to double the number, but if only we could obtain the funds we ought to increase it to 2,000 or 3,000.

At present, the need for clothing is, perhaps, the most pressing general requirement. We do not, of course, need to raise funds for those in receipt of the best wages, even though they are in the difficulty I described in the beginning of my letter, but it must be remembered that the great majority are still only in receipt of wages that will barely provide the minimum food for a family, and have absolutely nothing to spend on clothing, and in the professional classes, this is universally the case. They are faced with losing their jobs because they have not got the clothes in which to stand, and the bitter weather now upon us is, of course, making the need tenfold more urgent.

People may feel that it is now too late to send clothing for this winter, but if you are able to make it known how great the need is, I hope you will not let people be discouraged by the idea that it may be too late, because people require clothes to wear in the summer, and particularly in the case of underclothing, we did not find last year, that the demand was greatly lessened at the end of the winter.

SCIENTIFIC EVENTS

MEXICAN ARCHEOLOGY[1]

At a meeting of the Royal Anthropological Institute on November 22, Mrs. Zelia Nuttall gave an account of recent archeologocal investigations in Mexico. As an introduction to her report, Mrs. Nuttall referred briefly to the fact

[1] From *Nature*.

that after a period of quiescence of some centuries the great volcano Popocatapetl had again become active in 1920, and that its activity still continued.

During the last decade evidence that great volcanic disturbances had taken place at long intervals has been forthcoming. Two distinct types of figurines have been found in conditions which indicate that the topography of the valley has been changed and its inhabitants destroyed by great catastrophes antedating the arrival of the Nahuas or Aztecs.

Of these figurines the first, provisionally distinguished as the sub-gravel type, was brought to Mrs. Nuttall's notice in 1920, when specimens were offered for sale by Indians, and she herself discovered an example *in situ* under a gravel bed at Atzacapotzalco. They were delicately fashioned of fine clay, with slender bodies, long faces, smooth-hanging hair, some wearing chaplets. All presented a worn and polished surface. In the Valley of Mexico the gravel beds extend under the lava flow at the base of the extinct volcano Ausco.

Under the lava bed, to which Dr. Tempest Anderson assigns an age of at least 20,000 years, Mrs. Nuttall in 1908, and afterwards Senor Gamio, head of the Department of Archeology of Mexico, have discovered a second type of figurine, to which the name "sub-lava type" has been given. This type is characterised by turbans and caps, evidently of fine stuffs or fur, and decorated with circular ornaments of stone or shell. They indicate that the southern part of the valley was inhabited by a race totally distinct from that of the "sub-gravel type" and the Aztec. The distribution of the clay figurines is now under investigation. They have been traced as far as Guatemala.

Mrs. Nuttall also described the results of recent excavations at Teotihuacan, during which a small pyramid was opened up and reconstructed by Senor Gamio. A tunnel pierced at the height of 35 feet to the center of the pyramid revealed that it had been formed of mud filled with innumerable fragments of pottery vessels which had prevented the mud from cracking when it baked in the sun. A remarkable discovery was that of the remains of the ancient pyramid temple with a wonderful sculptured frieze which had been partly destroyed and then concealed by another terraced pyramid temple built in front. The sculptured serpents' heads and the masks of the water-god Tlaloc are of a form hitherto unknown. Associated with them are sculptured shells, principally the conch shell and the pecten or pearl shell. Not only is it remarkable that sea-shells should be represented in sculpture in the heart of the continent, but the association of the water-god with the ocean is entirely new.

In the discussion which followed Mrs. Nuttall's paper, Mr. Maudslay expressed the hope that it might be possible before long, by the elaboration of a system of stratification, to date Mexican antiquities. As Mexico appeared to have been untouched by outside influence, the study of its antiquities afforded evidence of the highest value for the study of the development of the human mind acting by itself. Mr. T. A. Joyce emphasized the importance of the evidence relating to the figurines, and pointed out that the British Museum had acquired a figurine of similar technique from Ecuador. Professor Eliot Smith expressed the opinion that, contrary to what had been stated by Mr. Maudslay, Mexican antiquities showed clear evidence of influence from outside and in particular from Asia. Mrs. Nuttall's work showed that this culture must have crossed the Pacific.

THE ROYAL AGRICULTURAL SOCIETY OF ENGLAND

THE council of the Royal Agricultural Society of England has, as reported in the London *Times*, unanimously adopted a report from the chemical committee of the society, which had been instructed "to consider in what way, in view of the altered circumstances, the scientific side of the society might be developed." The council afterwards appointed the following research committee to carry out the research proposals made by the chemical committee:

The Duke of Devonshire, Lord Bledisloe, Professor W. Somerville, D.Sc. (Oxford), Mr. Dampier Whetham, F.R.S. (Cambridge), Mr. Henry Overman, and Mr. John Evens, with Mr. Charles Adeane (chairman of the finance committee), Mr. J. L. Luddington (chairman of the chemical committee) and Mr. C. Coltman-Rogers (chairman of the botanical committee) as *ex officio* members.

The chemical committee recommended that the society should form a fund definitely reserved for research, into which payments should be made as funds allow. The following paragraphs summarize their proposals:

(*a*) That the results of the past experimental work of the society should be collated, abstracted and published.

(*b*) That the society should continue to devote part of its scientific energies to agricultural research, and should at once establish a separate fund for its support.

(*c*) That members of the society be invited to make suggestions as regards practical problems which they consider require experimental investigation.

(*d*) That members of the society be invited to cooperate, by the provision of land, stock, etc., in carrying out such work.

(*e*) That scientific institutions as occasion arises be asked to aid the society in the elucidation of problems that can not be dealt with on an ordinary farm.

(*f*) That a research committee of eight members be set up, to review proposals and to initiate and supervise experiments.

(*g*) That the research committee should submit to the council in November estimates for the forthcoming year's work, and in March a report on, and the audited accounts for, the work of the last year.

(*h*) That arrangement be made at once for the publication of past experimental results, and that experiments be initiated as soon as possible.

The committee points out that the society has successfully undertaken a large amount of valuable and varied experimental work, not only at Woburn, but elsewhere, and results of much service to agriculture have thereby been secured. The work has included the manuring of crops and grass, green manuring, sowing down land to grass, the quality of seeds, finger and toe in turnips, the treatment of farmyard manure, cheese making, the fattening of cattle, sheep and pigs, and the rearing of calves. The results are reported in the *Journal*, but, although available, are not convenient of access. The committee believes that farmers and students would benefit greatly if the society would issue, in at least two volumes, one dealing with crops and the other with stock, the experimental results it has achieved. A substantial fee would have to be paid for the work, but there should be no difficulty in finding a firm who would relieve the society of any financial responsibility in respect of publication.

The committee holds that further experimental work is vital to the interests of the society. For "research without reference to utilitarian ends" the society is not fitted, either in respect to technical equipment or of personnel; but it is eminently quality to undertake research which deals directly with problems that arise in practice. Its members consist largely of practical farmers with long experience of the land and of the difficulties and problems of its cultivation.

At the moment the committee suggests that the following questions might well engage the society's attention:

(*a*) The value of ground mineral phosphates, more particularly in the improvement of pasture.

(*b*) The use of various forms of lime on grass and tillage crops.

(*c*) The use of wild white clover, wild red clover, bird's foot trefoil, etc., in laying land down to grass.

(*d*) The profitable utilization of whey.

MOLDING SANDS

The Committee on Molding Sand Research under the guidance of Division of Engineering, National Research Council, and the American Foundrymen's Association, has made progress in its program of research. The United States Geological Survey and the various state geological surveys have promised to cooperate with the sub-committee dealing with this phase of the work under the chairmanship of Professor H. Ries, of Cornell University. This sub-committee has prepared a letter of instructions to the state geological surveys, which will standardize methods of making the surveys of molding sand resources.

Work on standardization of tests is well under way. Questionnaires have been sent out to gather information on the present methods of testing physical properties of sand. A digest of replies to these questionnaires is expected to be available shortly.

Many firms and universities have offered to cooperate in the research work. Every endeavor will be made to maintain their interest and to assign problems to those universities and industrial laboratories offering to cooperate; due regard being given to the facilities and talent available. A list of research subjects has been compiled, which is given in part below:

1. Recovery of used molding sand through restoring bond to the sand by subjecting it to contact with water vapor under high pressure.

2. The effects of additions of certain chemical reagents upon the physical properties of clays and clayey materials, such as molding sand.

3. Effects of water content on the bond and permeability of a molding sand.

4. Effects of different water per cents. in molding sand on the milling and drilling speeds of light gray iron castings.

5. Research on fusion quality of facings (function of "peeler").

6. Tests of various kinds of clays for restoring bond to molding sand.

7. Comparison of the life of different molding sands.

8. Effects on plasticity of bond in molding sand and reduction of water content when using oil.

9. Effects of wet and dry storing of sand on bonding quality.

The American Steel Foundries Company has permitted a representative of the committee to make a digest of the sand reclamation work carried on by the engineering staff of the A. S. F. and has assisted in the preparation of this digest. Because of the scarcity of steel molding sand of the best quality and the problems arising from having to dispose of large quantities of refuse sand, this company has carried out an extensive investigation of methods of reclaiming the good material which is usually lost, whenever the so-called refuse sand is thrown away. After experimenting along different lines and thoroughly going over methods employed in other plants, a process of reclaiming old sand called "centrifugal scrubbing" was developed.

After establishing the principle of this method, equipment was designed which permits a recovery of about 70 per cent. of refuse sand. Cost figures for 1921 show that a ton of reclaimed sand costs about $1 per ton against the cost of new sand, at the plant, of $2.65 to $3.85 a ton. The process involves cleaning the sand grains of adhering fused material, then separating by air currents the good sand from the bad material. Included in the 30 per cent. loss is some good bonding material which, because of its similarity to bad material, can not be economically separated.

The report covers the theory of sand reclaiming, centrifugal air scrubbing process, cost of reclaiming sand by the latter process, and a description of the proposed sand reclaiming unit.

THE BRITISH INDUSTRIAL FATIGUE RESEARCH BOARD

THE second annual report of the Industrial Fatigue Research Board has recently been issued. As reported in the *British Medical Journal* it contains "a comprehensive summary of the chief results obtained by the board since its inception some three years ago. These results have been published in a series of sixteen reports, which represent the output of the board's investigators over a period of about two years, for there is necessarily a considerable delay before the results of the inquiries reach the stage when they are ready for publication. If any critic had doubts as to the value of the board's work, and the importance of its further development on the lines laid down in this report, we think that such doubts would speedily be laid to rest by an impartial study of its pages. They contain a solid body of information which is of direct value to employers of labor, and to welfare workers and factory inspectors; the practical application of this information to the remedy of adverse industrial conditions would produce a very real improvement in the health and efficiency of the workers. In the analysis of published work with which the report opens the various tests of efficiency and fatigue employed are briefly described, and then a more detailed account is given of the results obtained in various industries concerning output in relation to hours of labor and the duration of work spells and rest pauses. A subsequent section of the report deals with the impersonal physical conditions of the worker's environment, such as temperature, humidity, ventilation and lighting, and the effects of these conditions on efficiency. Personal factors, such as vocational selection and guidance, time and motion study, and the effects of such conditions as seating and clothing, are treated in considerable detail, whilst a shorter section deals with such matters as organization and the relative importance of human and mechanical factors in efficiency. Most of the sections are illustrated by diagrams reproduced from the published reports of the board, and they show at a glance the hourly and daily variations of output observed under various conditions, the effect of regular rest pauses on output, the improvement of output caused by more adequate lighting and by better ventilation, and the value of certain psychophysiological tests in measuring the skill of compositors. The future of the board is said to be full of promise, for, in addition to the investigations already made in certain branches of the textile, iron and steel, and boot and shoe industries, others are now in progress in the laundry and the pottery industries, whilst application has been made to the board by various trade boards and research associations for the institution of inquiries into several other important industries."

THE MEDICAL FELLOWSHIPS OF THE NATIONAL RESEARCH COUNCIL

As reported briefly in Science last week, the National Research Council has established fellowships in medicine created for the purpose of increasing the supply of thoroughly qualified teachers in medicine in both clinical and laboratory subjects and in both curative and preventive aspects. The fellowships are supported by appropriations of the Rockefeller Foundation and the General Education Board amounting in total to one hundred thousand dollars a year for a period of five years. Those receiving awards will be known as fellows in medicine of the National Research Council.

To qualify for appointment as a fellow, a candidate must have the degree of doctor of medicine or doctor of philosophy from an approved university, or preparation equivalent to that represented by one of these degrees. Only citizens of the United States or Canada will ordinarily be appointed, although the fellowship board is authorized to set aside this provision in exceptional cases. The fellowships will be open to both sexes.

Since the principal purpose of establishing these fellowships is to increase the number of competent teachers in the field of medicine, each incumbent will be required to gain experience in teaching. As creative work is regarded as essential to the best teaching, emphasis will also be placed upon research.

Fellows will be at liberty to choose the institutions or universities in which they will work, as well as the men under whose direction they will carry on their researches, subject to the approval of the fellowship board.

Appointments are to be made for a period of twelve months, beginning at any time in the year, with an allowance of six weeks for vacation. The time may be extended, however, if in the judgment of the board the work which the fellow has done justifies it. The stipends are not definitely fixed in amount; but they are intended to enable the individual to live comfortably while carrying on his special work as a fellow.

The fellowships will be administered by a special committee, known as the Medical Fellowship Board of the National Research Council.

Correspondence concerning the fellowships should be addressed to the Division of Medical Sciences, National Research Council, Washington, D. C.

INTERNATIONAL CHEMICAL CONFERENCE AT UTRECHT

In June of last year, Professors Biilmann, Bruni, Ernst Cohen, Donnan, Victor Henri, Kruyt, van Romburgh, Schenk, Walden and Wegscheider met in conference at Utrecht, and agreed to hold there in 1922 a scientific chemical meeting, the date of which is now fixed for June 21, 22 and 23 of this year. The program will consist of several general papers, together with a number of shorter scientific communications.

This invitation has been sent to those whose names are given in the accompanying list:

America (United States): L. M. Dennis, M. Gomberg, F. G. Keyes, G. N. Lewis, W. A. Noyes, Th. W. Richards, J. Stieglitz, E. W. Washburn, W. R. Whitney.

Czecho-Slovakia: J. V. Dubsky, A. Simek.

Denmark: E. Biilmann, N. Bjerrum, J. N. Brönsted, J. Petersen, S. P. L. Sörensen, Chr. Winther.

Germany: M. Bodenstein, G. Bredig, F. Föster, O. Hahn, A. Hantsch, P. Pfeiffer, R. Pschorr, R. Schenck, Schlenck, A. Stock, A. Wohl, H. Wieland.

France: M. de Broglie, Mme. P. Curie, Darzens, A. Debierne, V. Grignard, Victor Henri, P. Langevin, Ch. Marie, C. Matignon, Ch. Moureau, J. Perrin, G. Urbain.

Great Britain: A. J. Allmand, E. C. Baly, F. G. Donnan, A. Findlay, H. Hartley, W. C. McC. Lewis, F. A. Lindemann, J. W. McBain, W. H. Perkin, N. Sidgwick, F. Soddy, J. Walker.

Italy: A. Angeli, G. Bruni, L. Cambi, A. Miolati, M. Padoa, N. Parravano, G. Plancher, G. Poma.

Holland: H. J. Backer, J. J. Blanksma, J. Böeseken, Ernst Cohen, A. F. Holleman, F. M. Jaeger, H. R. Kruyt, W. Reinders, P. van Romburgh, F. A. H. Schreinemakers.

Norway: H. Goldschmidt.

Austria: E. Abel, J. Biliter, F. Emich, A. Kailan, R. Kremann, A. Klemenc, W. Pauli, F. Pregl, A. Skrabal, R. Wegscheider.

Russia: M. Centnerschwer, W. Ipatiew, N. Kurnakow, Lasarew, Schiloff, L. Tscitschibabin, L. Tsugajew, P. Walden, N. Zelinsky.

Switzerland: E. Baur, P. Dutoit, Ph. A. Guye, F. Fichter, J. Picard, W. D. Treadwell.

Sweden: S. Arrhenius, S. Oden, The. Svedberg.

Professor W. A. Noyes is acting as chairman of the committee to select American members of the conference, the other members being Professor Stieglitz, Professor Lewis and Dr. Whitney.

SCIENTIFIC NOTES AND NEWS

At the annual meeting of the National Academy of Sciences to be held at Washington from April 23 to 26, Dr. Hendrik Anton Lorentz, of the Rijks Universiteit, Leiden, will deliver the evening address on April 24, at the invitation of the Academy and of the Carnegie Institution of Washington.

The general meeting of the American Philosophical Society will be held in Philadelphia on April 20, 21 and 22. At the reception on Friday evening, Dr. Vernon Kellogg, of the National Research Council, will speak on "The Power and Impotence of Man."

Professor Albert Einstein, of the University of Berlin, delivered the first of a series of four lectures in Paris on the "Theory of Relativity," under the auspices of the Collège de France.

Professor A. C. Seward, professor of botany at the University of Cambridge, was elected president of the Geological Society of London at the annual general meeting.

Dr. E. B. Poulton, Hope professor of zoology at the University of Oxford, was elected president of the British Association of Economic Entomologists at the annual meeting, held on February 24.

Dr. B. H. Ransom, chief of the zoological division of the Bureau of Animal Industry, U. S. Department of Agriculture, has been elected a foreign corresponding member of the Royal Academy of Agriculture of Turin, Italy.

Professor Herbert M. Boylston, of the Department of Metallurgy and Mining at the Case School of Applied Science, has been appointed on the Board of the Engineering Foundation for a term of three years as representative of the American Institute of Mining and Metallurgical Engineers.

S. M. Kinter has been appointed manager of the research department of the Westinghouse Electric and Manufacturing Company, succeeding C. E. Skinner, who has been appointed assistant director of engineering in the same company.

Colonel James Milliken has been elected president of the Pittsburgh Testing Laboratory succeeding George H. Clapp, who remains with the organization as a member of the board of directors.

Dr. Bertrand E. Roberts has been appointed epidemiologist of the State Department of

Health in the place of Dr. Edmund Boddy, who has resigned.

DR. GEORGE P. DONEHOO, a member of the American Association for the Advancement of Science, and secretary of the Pennsylvania Historical Commission, has been appointed by Governor W. C. Sproul, state librarian and director of the Pennsylvania State Museum.

DR. ARTHUR S. RHOADS, formerly assistant in forest pathology of the U. S. Bureau of Plant Industry, and more recently of the office of Cereal Investigations and the office of Fruit Disease Investigations of the same bureau, has resigned to accept the position of pathologist at the Missouri State Fruit Experiment Station at Mountain Grove, Missouri.

DR. H. C. BRYANT, economic ornithologist in the Museum of Vertebrate Zoology of the University of California, will again be in charge of the Yosemite Free Nature Guide Service, during the summer of 1922. This service furnished by the National Park Service with the cooperation of the California Fish and Game Commission, aims, through the medium of lectures, field excursions and office hours, to interest and instruct summer visitors in regard to the fauna and flora and the means to be taken to conserve it. During the season of 1921, over 31,000 persons heard lectures and campfire talks, and over 2,200 were given first-hand acquaintance with living things on field excursions.

AT a meeting of the Board of Directors of the Gorgas Memorial Institute, at Washington on April 1, announcement was made that the Panama Government had provided a site for the proposed Gorgas Institute of Tropical and Preventive Medicine. The site is adjacent to the St. Thomas Hospital, which contains laboratories and buildings and represents a cost of approximately $500,000. Dr. Richard Strong, professor of tropical medicines at Harvard University, has been elected director of the institute. The board also announced the selection of the directors of the Gorgas School of Sanitation to be established at Tuscaloosa, Ala. They are: Dr. S. W. Welch, of Alabama; Dr. Charles F. Dalton, of Vermont; Dr. A. J. Chesley, of Minnesota; Dr. E. G. Williams, of Virginia; Dr. Lloyd Noland, medical director of the Tennessee Coal and Iron Company, and J. A. Laprince representing the United States Public Health Service. This board will meet at Tuscaloosa during the last week in May and arrange the courses. At that time they will also probably elect a faculty.

A MEMORIAL to the late Dr. Charles Baskerville, professor of chemistry in the College of the City of New York, who died last January, is planned by the faculty and students of the college. It is proposed that the memorial will take one or more of the following forms: (1) The placing of a bronze tablet on the Chemistry Building, which is to be renamed Baskerville Hall. (2) The founding of a fund to provide for a medal to be called the Charles Baskerville Prize and to be awarded each year to the student doing the best work in chemistry. (3) The establishment of a scholarship to permit students who qualify to pursue courses in advanced chemistry. Subscriptions to the fund should be sent to Professor W. L. Prager of the college.

WE learn of the death on March 19, at Los Angeles, California, of Mrs. Martha Burton Williamson, long a prominent figure in that city, a contributor to the conchological literature of the Pacific Coast, and the donor of a large collection of shells to the Los Angeles City Museum. She had been for many years vice-president of the Historical Society of Southern California.

DR. BENJAMIN MOORE, Whitney professor of biochemistry in the University of Oxford, and formerly professor of physiology at Yale University, died on March 3, at the age of fifty-five years.

DR. AUGUSTUS D. WALLER, professor of physiology and director of the physiological laboratory of the University of London, died on March 11, at the age of fifty-five years.

THE death is announced from Paris, at the age of 84, of the dean of French mathematicians, Camille Jordan, member of the Académie des Sciences, professor emeritus at the Collège de France and the Ecole Polytechnique. He will be particularly remembered for his "Traité des substitutions," which appeared in 1870 and is still to-day the great classic in the theory of finite groups for his "Traité d'Analyse" and especially for his editorship of the *Journal de Mathématiques* in which he followed Resal in 1884, guiding its destinies until this very last year. He had the intense satisfaction of seeing it recently saved from extinction, most probably owing to the strong support that it received from America.

Professor Dr. Theodor Liebisch, late professor of mineralogy at the University of Berlin, died at his home in Berlin on February 9, after a protracted and painful illness. A correspondent writes: "Liebisch was born on April 29, 1852 and from about 1890 to 1900 he was professor of mineralogy at the University of Göttingen. During this period there were many Americans studying for the doctor's degree with their major in chemistry. Most of these men took mineralogy under Professor Liebisch as one of their minors, and it is hardly too much to say that he was one of the most highly respected and best loved professors in the university. He perhaps did more in a personal nature for the American students in those days than did any other professor. All Americans respected and admired him for his deep learning, his ability as a teacher, his inspiration for research work and his extremely kind and ever-thoughtful nature. About the year 1900 he was called to the University of Berlin, and served there until about 1920, when he retired from active work. He was the author of many books, his most important being "Grundriss der Physikalischen Krystallographie."

A Georgia Academy of Science was organized on March 25 by a group of twenty-two scientific men, invited to the University of Georgia for that purpose. The delegates came from Emory University, the Georgia School of Technology, Mercer University, Oglethorpe University, the University of Georgia and the Georgia Experiment Station. Practically all phases of scientific endeavor were represented. Membership in the academy is to be a recognition of noteworthy service to science or to the scientific development of the state, and the number is limited to fifty. It is the aim of the academy to foster every means of encouraging scientific research, to develop the natural resources of the state, and to stimulate in the people a realization of the fact that their prosperity depends very greatly on the scientific training of a large number of Georgia men.

The Sigma Xi research fellowships for the coming academic year will be awarded in May. Applications should be made to Professor Edward Ellery, Union College Schenectady, N. Y. The awards are made for work in sciences other than physics and chemistry and to men and women who have already taken their doctor's degree. Applications should be accompanied by reprints of published articles and by reference to two or more persons competent to speak about the ability of the candidate in his or her special line. The minimum award is sixteen hundred dollars.

Dr. William Crocker, director of the Thompson Institute for Plant Research, addressed the Brooklyn Institute of Arts and Sciences on March 25 on "The present outlook for plant research in Europe."

Dr. W. J. Humphreys, of the U. S. Weather Bureau, recently lectured before the West Virginia University Scientific Society on "Fogs and clouds."

UNIVERSITY AND EDUCATIONAL NOTES

It is announced that the three million endowment fund for Wesleyan University has been oversubscribed by a hundred thousand dollars.

Mr. Hamilton B. Tompkins has bequeathed the residue of his estate to Hamilton College, his alma mater, with a stipulation that $100,000 be set aside for the increase and support of the college library, this fund to be known as the Hamilton B. Tompkins Library Endowment Fund. Five thousand dollars is left to Wells College.

Dr. Frank Thilly, professor of philosophy at Cornell University, and Professor Madison Bentley, professor of psychology in the University of Illinois, will lecture during the summer session of the University of California.

Dr. William A. R. Taylor, now instructor in botany in the University of Pennsylvania, has been promoted to an assistant professorship.

Mr. Arthur Lee Dixon, M.A., F.R.S., fellow and tutor of Merton College, University of Oxford, has been appointed Waynflete professor of pure mathematics in succession to Professor E. B. Elliott, fellow of Magdalen, who has resigned.

Mr. Arthur Lapworth, D.Sc. (London), F.R.S., at present professor of organic chemistry in the University of Manchester, has been appointed to the Sir Samuel Hall chair of chemistry and to the directorship of the chemical laboratories.

DISCUSSION AND CORRESPONDENCE

GENETICAL ANALYSIS AND THE THEORY OF NATURAL SELECTION

In my Toronto address I lately referred to John Ray as the first who laid stress on the sterility of interspecific hybrids. I was then writing away from books and must apologise for this slip. The passage in the *Historia Plantarum* 1686, 1, pp. 40 and 42, that I had in mind is probably the first in which anything approaching a genetical definition of species is attempted. Ray there lays down the excellent principle that forms which, though differing from each other, can be bred from seed of the same plant, should be regarded as of the same species. Not till the Linnean period, more than half a century later, did the cognate question of the sterility or fertility of interspecific crosses assume prominence.

Professor Osborn has expressed great vexation at the tenor of my address. After considering his remarks, I do not know that I can add much to what I have said. The divergence between the conceptions to which genetical analysis introduces us and the doctrines of which Professor Osborn has been so long a distinguished champion is indeed wide.

Paleontological observations have served a useful purpose in delimiting the outline of evolution, but in discussing the physiological problem of interspecific relationship evidence of a more stringent character is now required; and a naturalist acquainted with genetical discoveries would be as reluctant to draw conclusions as to the specific relationship of a series of fossils as a chemist would be to pronounce on the nature of a series of unknown compounds from an inspection of them in a row of bottles. The central tenet of Darwinism that species are merely the culminations of varietal differences, such as we find contemporaneously occurring, is not easily reconcilable with the new knowledge. It was my purpose once more to direct the attention of naturalists, especially geneticists, to this deficiency in the evidence, by no means without hope that it may be supplied.

Professor Osborn, in extenuation, suggests that my tongue ran away with me and that I could not have meant what I said. That defense, however, is not available, for I had taken the precaution which I understand he learned from Huxley, and I had prepared a written text. This, in all important passages, I followed verbatim, and it appears without serious modification in Science for January 20. I may even plead guilty to having spoken and written to the same effect on many previous occasions, and Professor Osborn will find the theme developed in "Problems of Genetics" (New Haven, 1913, and in my presidential address to the British Association in Australia (1914).

W. Bateson

March, 1922

A SUGGESTION TO MR. BRYAN

I think most readers of Science must feel indebted to you as I do for reprinting W. J. Bryan's attack on Evolution. It may be true that only the psychologists will be able to find in it data of value to their science but to them the importance of this contribution of Mr. Bryan's must be large indeed. The rest of us welcome the diversion which it affords. A Don

Quixote of Mr. Bryan's calibre only appears once or twice in a century and the opportunity to study in cold print the celebrated Nebraskan's proposal to resurrect the "special creation of species" myth must be appreciated by our scientific brethren who are interested in studying the mysterious ways in which the human mind sometimes works when it approaches subjects unfamiliar to it.

My principal object in writing you is to suggest that Mr. Bryan should be invited to use the pages of SCIENCE to attack an even greater heresy than Evolution. Since Mr. Bryan still gets his biology from the Bible it appears to be a safe inference that he must draw his geography from the same source. Bible geography, or "flat geography" is, I am informed, taught nowadays only in the mountains of eastern Tennessee. Why should not our Bold Knight from Nebraska (or is it Florida?) aim his lance at the teachers of modern or "round" geography and admonish them to hark back to the geography of Joshua? This is perhaps a subject which has been overlooked by this eloquent defender of Biblical science. I can hardly believe it to be lack of courage which has led Mr. Bryan to attack the few and widely scattered teachers of evolution instead of the thousands of teachers of modern geography. Whatever the explanation of Mr. Bryan's neglect to denounce the heresies to be found in the textbooks on geography may be, I beg to suggest that the heretical character of the modern teaching in geography should be brought to the notice of Mr. Bryan.

EDWARD M. KINDLE
CANADIAN GEOLOGICAL SURVEY

THE WRITING OF POPULAR SCIENCE

TO THE EDITOR OF SCIENCE: Both Dr. Alfred H. Brooks[1] and Dr. Edwin E. Slosson[2] have recently called attention to the fact that relatively few popular scientific works are being now written in this country; and the former expresses the opinion that there is to-day relatively less popular knowledge of science and less interest in its methods and advancement than there was a generation ago. This opinion will probably be generally accepted as correct. That it should be true in spite of the large amount of scientific work that has been, and is being done, and in spite of the serious attempts of scientific associations and other agencies to create a popular interest in science, indicates that it is high time for scientists to consider seriously themselves, science and the public, in an endeavor to ascertain wherein the difficulty lies. Most scientists will agree with Dr. Brooks that the lack of popular knowledge of science is directly due to the form in which science is presented, and that "what is needed is the presentation of science in a form comprehensible to the educated and thinking man." But to secure such presentation, it is necessary to understand the public, the point of view of those we desire to reach, the mental background with which the science we present must be harmonized; to understand science and ourselves; to keep in mind what constitutes science; to have a clear idea of what we wish to give the public. Otherwise we are in danger of merely groping blindly, and of, perhaps often, prostituting the name of science.

We all acknowledge that science is *organized* knowledge. That neither an isolated fact, nor an infinite number of isolated facts, is science; no matter how true and exact the facts may be. It is only when two or more facts are seen to be related, that science comes into existence. Science does not consist of facts, but of recognized relations between facts. Science is essentially a mental phenomenon[3].

But are there not, only too often, offered under the guise of science mere isolated facts trimmed with sufficient allegory and superficial analogies to fill a respectable amount of space and to attract the layman's attention? This is not science, but merely information—the raw material out of which science is made.

[1] *Journal Wash. Acad. Science*, 12: 73-115, 1922.

[2] SCIENCE, 55: 241, 1922.

[3] Since this was written Dr. F. L. Hoffman's admirable vice-presidential address (SCIENCE, March 10), entitled "The Organization of Knowledge" has come to my attention. In this, the essential distinction between mere facts and science is strongly emphasized.

It has no cultural value other than what the reader can supply by coordinating it with other information that he has acquired from other sources. Only by, and to the extent of, such coordination does the fact become scientific.

Is it not here that the scientist needs to consider both himself and his reader? For him, this fact he offers has a wealth of associations; he sees it in its relations to numerous other facts; the mere fact that this particular fact *is*, has for him far-reaching implications; it is against such a rich and harmonious background that *he* sees the fact. But with the layman it is far different; he can furnish but a meager background, often merely a dead black drop. The fact as presented with its allegory and analogy may appear to him very beautiful, or wonderful, or surprising, but it does not mean anything to him. Is it surprising that he does not enthuse over it? A person likes to feel that he is getting somewhere. An article that establishes a recognized relationship between two or more facts meets this desire, and by the serious minded public would surely be received more favorably, than one that merely retails information.

But the choosing and presenting of a relation between facts is difficult. The scientist is embarrassed by the complexity of the relations that he recognizes; what portion of the vast web shall he choose? And having chosen, how can he supply the proper surroundings to give it in any fair degree its true significance when seen against the drab background that will be furnished by the reader? To succeed, he must know how to present his facts and arguments so that they will fit into his reader's experiences and habits of thought. He must be acquainted with his reader. Is it not here that the great difficulty lies? The scientist of this country seldom has the leisure, and often has not the inclination, to become really acquainted with the experiences and the mental processes of the non-scientist. As a result, he is unable to present his scientific knowledge in a form that is readily understandable by the layman.

The remedy is to be found in a more intimate acquaintance of the scientific and the non-scientific classes with one another. In the endeavor to secure such improved acquaintance, the scientist is called upon to take the initiative, and to do the most. He must cultivate the acquaintance of the non-scientist; must study him; must show him, in a way that he can understand, what science really is; must make him see that scientific work does not consist in merely collecting wonderful, interesting, or surprising facts and observations, nor in inventing useful or weird contrivances, but in ascertaining how facts are related to one another, so that he may be able to forecast with confidence the results that will follow from a given act, and conversely, may be able to specify what set of acts will give a desired result. The non-scientist must be made to see that science does not consist in making inventions, but in furnishing the raw materials out of which inventions are made. Once get the army of non-scientists to understand these things, and the securing of their interest in science and its advancement will cease to be a problem.

The public can learn what science is, only by being shown properly labeled examples of it. These must be understandable, but nevertheless must be real and rigid science; and in no case should the reader be relieved of all necessity for thinking. Among the types of subjects that appear to be suited to this purpose are: (1) Accounts of discoveries, in which the reason for undertaking the work and the main steps in the establishing of the conclusions are given. (2) Accounts of experimental research, or of precise measurement, in which the line of reasoning, illustrations of check experiments, etc., are given. (3) Accounts of experiments designed to established suspected relationships between observed facts. Unsuccessful experiments should not be ignored. (4) Accounts of the establishing of relationships between observed facts by purely inductive methods.

If we would avoid giving the public a false idea of what science really is, let us discourage the practice of placing the label "science" on presentations of mere isolated facts, and let us clearly inform the public, by word as well as by example, that science consists in the establishing of relations, not in the cataloguing of facts.

N. E. Dorsey

404 Maryland Building,
Washington, D. C.

QUOTATIONS

THE EARNING POWER OF RESEARCH

A few years ago the X-ray tube was an erratic apparatus not in any very general use. The research laboratory of the General Electric Company realized that there was a possibility of utilizing pure electronic emission from a hot filament to produce controllable X-rays in a perfect vacuum. They conducted extensive research upon such devices as then existed, and as a result the tungsten target took the place of platinum in the standard gas tube of that day. Research had also to be applied before the laboratory learned positively that available electrons already existed and that there was a possibility of controlling them, as, for example, focusing them on a target. The research has been continued, until today practically all the X-ray tubes of the country are made by the company in accordance with the discoveries of the man whose name the tubes bear. The Coolidge tube is also used abroad almost to the exclusion of other types. These remarkable results have been achieved through very careful, accurate, and often discouraging studies of electric phenomena in high vacua, with very pure materials. The perfection of the tube is the nucleus of an annual business, including accessories and generating apparatus used in X-ray work, of from five to ten million dollars a year. The benefit cannot be measured wholly in monetary return, for everyone is familiar with the humanitarian benefits.

Our oldest industries have been the most reluctant in establishing research laboratories. But the experience of a leader may guide the entire industry. Some years ago the Ward Baking Company established a fellowship at the Mellon Institute. The research soon brought results and the application of a more balanced yeast nutrient to the dough gave better fermentation and better bread. It was discovered that the baker can grow yeast in the dough and control fermentation wastes. This conservation amounts to 2 per cent of the flour, 15 per cent of the sugar, and sufficient yeast to make the total saving 45 cents net per barrel of flour used. It is estimated that this process saves American, Canadian, and British bakers not less than $40,000 per day, without detriment to the quality of the bread.

In 1915 a control laboratory was installed with one chemist. Today there are a variety of control laboratories with twenty-five technical workers. A chemist has frequently saved two months' salary for his employer with a report on samples from a single carload of butter. The control which has been established as a result of research upon the raw materials makes possible uniformity in the finished product. Time, temperature, and other factors which influence fermentation have been established, and since no two carloads of flour are alike the data are vital in determining how fermentation must be varied to secure uniformity. The study of enzymes, proteins, colloids, yeasts, bacteria, and nutrient value is pointing the way to still better bread, higher nutritive values, economy in production, and the elevation of the entire industry. It is no wonder that during these days of industrial depression this pioneer in research as applied to baking has increased the number of its scientific workers. Results continue to justify the increase.—*The Journal of Industrial and Engineering Chemistry.*

SCIENTIFIC BOOKS

A Monograph of the Existing Crinoids. Volume 1. The Comatulids. Part 2. By Austin Hobart Clark, Curator, Division of Echinoderms, United States National Museum. Bulletin 82. Washington, 1921. 4 to Pp. xxvi + 795; with 949 text-figures and 57 plates.

The first part of Clark's monograph appeared in 1915.[1] The present brochure, fully twice the size of its predecessor, constitutes the concluding part of the general introduction to The Comatulids. The systematic description of the group will follow. The major part of this work has already been completed and much of it has appeared in a series of monographs and

[1] Reviewed in Science, N. S., Vol. XLII, No. 1080, p. 342, Sept. 10, 1915, by Frank Springer.

shorter papers which have supplied the first adequate account of the free crinoids. It has been no mean task, for when Mr. Clark tackled the problem, the classification of the comatulids was in a state of hopeless confusion. The resolution of this chaos into a system was a brilliant piece of analysis and construction, and constitutes a notable achievement in the field of animal taxonomy. The present volume contains an enormous amount of detail, and maintains the high standard of Part 1. It has a wealth of illustration—no less than 1,364 figures, the greater part drawn by the author, as there are few photographs. Such figures as have been taken from previous authors have in almost all cases been retouched by Mr. Clark to bring out points previously overlooked or misinterpreted. Nine hundred forty-nine drawings appear in the text.

What might be termed the background of the work has been stated by Mr. Frank Springer in his review of Part 1, and need not therefore be recounted here. The present volume contains a very large amount of entirely new and original matter. It begins by taking up the description of the radials of the comatulids at the point at which it was left at the end of Part 1. The articular faces of the radials of 52 species are described in detail from dissections preserved in the collection of the National Museum and reference is made to the 20 described more or less satisfactorily by previous authors. The whole subject of the structure, relationships, physiology and homologies of the socalled post-radial structures (arms and pinnules) is exhaustively treated. All of this matter is original and is based upon specimens in the National Museum. The perisomic plates, or those developed within and entirely confined to the ventral surface, come in for detailed description for the first time, the subject being handled in an entirely new way; and the side-plates and covering-plates of the pinnules of 203 species in the National Museum collection are also treated.

A complete and detailed account of the anatomy, embryology, and regeneration of the comatulids is given. There is at present no single source from which this information can be derived, as it is widely scattered through a great number of usually short papers in various languages.

The spawning season of 24 species is given; previously that of only 4 species was known.

The pentacrinoid young of 28 species are described and the first comparative account of the pentacrinoids is given.

A considerable amount of information is assembled concerning the habits, reactions to various stimuli and food, concerning which up to the present there has been no adequate source of information.

All of the numerous parasites and commensals on the crinodis are listed and when necessary for comparative purposes, many of those occurring on other echinoderms. Parasitism and commensalism among marine invertebrates has been greatly neglected and this section therefore forms an important contribution to the subject. Incidentally, a detailed account of the myzostomes, almost exclusively parasitic on the crinoids, is given, together with a complete list of all the known species. No other list exists at present.

The coloring of the comatulids, remarkable for its brilliancy and diversity, is treated in detail for the first time, the color of 160 species, in many cases from the author's own notes taken at sea, being given. The pigment is described and the chemical composition of the skeleton is discussed.

Such, in bare outline, are the contents of an extraordinarily well conceived and thoroughly executed treatise, upon the publication of which the author as well as the authorities of the National Museum are to be congratulated, for the work will always remain a point of departure for future investigation.

The press-work of this volume is excellent and an improvement over that of Part 1. The half-rag paper is also a decided advance, although really too thin to carry the larger text figures, since the printing on the reverse shows through. A few copies of such fundamental memoirs as the present should be printed upon heavy, full-rag paper, or better still upon linen, and deposited in, say, half a dozen "strategic" libraries of the world. Too many of our basic monographs are printed upon paper which will be relatively short-lived.

W. K. Fisher.

SPECIAL ARTICLES

A NEW VARIETY OF BARLEY WITH STRIKING CHARACTERISTICS

The new variety of barley, which the writer has provisionally called Mack's Branched barley, has never been recorded in literature heretofore. It was discovered by Mr. J. M. Mack, of Fallbrook, California, in a wheat field mixed with much barley. Specimens of the new form were sent to the University of California in 1921 for further investigation; and the writer has been much interested in it in connection with his genetic studies in barley. It is a six row barley possessing the following characteristics:

1. An Increase in the Number of Nodes accompanied by an irregular Shortening of Internodes. The number of nodes in ordinary varieties of barley varies from three to seven, the uppermost internode below the spike being always the longest; while Mack's Branched barley has from 10 to 30 nodes on each tiller without elongation of the uppermost internode. The shortening of the internodes and the increase in the number of nodes make the straw much stiffer; and indeed the variety would be most resistant to lodging if not for the fact that too heavy a weight is carried at the upper portion as a result of branching.

2. The capacity to Branch at Any Node. Tillers arise from the first node at the bottom in ordinary cultivated barleys. Wessling barley has a branched spike, but the branching is confined to the head. No form has been recorded heretofore as branching freely at any node and also capable of secondary and tertiary branching, which is a characteristic of Mack's Branched barley.

3. The capacity to Produce Roots at any Node. Although it is possible to induce some of the common varieties of barley to produce roots at nodes near the base, the setting of roots at the upper nodes when covered with soil is quite a unique character possessed by this form alone.

4. The Capabilitay of Vegetative Propagation. The fact that this variety of barley is capable of branching and rooting at every node suggested to the writer the possibility of vegitative propagation. Abundant roots were secured by the layerage method in a period of 2 weeks in the open field in January. Cutting off a tiller and transplanting it in a pot in the greenhouse has resulted in slower recovery than in the case of mount layerage; but nevertheless a main root has arisen from a node near the place of cutting and hence it is reasonably sure that the cutting will succeed as a separate plant.

The possibility of vegetative propagation of this cereal is of considerable scientific interest, if it is not yet of practical agricultural interest. This new form is of appreciable value especially to those interested in genetic studies of barley, because it makes possible the continuous propagation of the heterozygote. This will make backcrossing in barley as a means of genetic investigation more practical, although it is still doubtful whether backcrossing can be extensively employed in this cereal, the process of artificial fertilization being so tedious in contrast with the ease of growing self-fertilizing hybrid generations.

Although the new form is apparently of no agricultural value by itself, yet the branching and cold resistant characters may be utilized to advantage by hybridization with some of the commoner types of cultivated barley.

Nothing is yet known concerning the origin of this interesting form, as it was discovered in a mixed field. All that we know is that its striking characteristics are constant and breed true under the different environmental conditions to which it has been subjected. The writer plans to make a number of crosses between this form and several of the cultivated varieties in the coming spring, as this interesting barley certainly deserves an intensive genetic study.

Kwen S. Hor

University of California

[1] *Phil. Mag.*, s. 5, Vol. 24, p. 87.

[2] *Phil Mag.*, s. 5, Vol. 24, p. 423.

THE FEDERATION OF AMERICAN SOCIETIES FOR EXPERIMENTAL BIOLOGY

The Federation of American Societies for Experimental Biology, which comprises the American Physiological Society, the American Society of Biological Chemists, Inc., the American Society for Pharmacology and Experimental Therapeutics, and the American Society for Experimental Pathology, met for their annual scientific program, December 28-30, 1921, under the auspices of Yale University. Two joint scientific sessions were held. The first joint session was called at 9:30 on the morning of December 28 under the presidency of Dr. J. J. R. Macleod of the Physiological Society. Twelve scientific papers representative of the research work of the four societies were presented and discussed at this session. An equally strong joint session was held at the close of the third day, beginning at two o'clock on December 30 and consisting of eleven papers. Sessions of the individual societies filled the remaining four periods of the meeting.

The executive committee of the Federation is composed of the presidents and secretaries of the four constituent societies as follows: J. J. R. Macleod, executive chairman; C. W. Greene, secretary; D. D. Van Slyke, C. W. Edmunds, F. G. Novy, V. C. Myers, E. D. Brown and Wade H. Bown. The first executive committee meeting was called at 4:30 p.m., December 27, at which time the following business was transacted. The report of the treasurer of the Information Service Fund, Dr. Joseph Erlanger, was presented showing a net balance of $312.34. The secretary of the Information Service presented the annual report showing progress during the year. This appointment service undertakes to call to the attention of universities and scientific institutions and others the availability of scientists in the different technical lines represented by the societies. The late Dr. S. J. Meltzer, who keenly appreciated the difficulties confronting the young men preparing in science in the way of securing information of openings in their lines, and the equal difficulty met by institutions in finding men of scientific preparation and fitness in particular lines, contributed the original fund to meet the expenses of this activity. It is the hope of the Federation that increasing use of this institution will be made through the secretary, Professor E. D. Brown, of the University of Minnesota.

The problem of correlation of overlapping programs as between the Federation and the American Association for the Advancement of Science, together with the desirability of holding periodical joint meetings, was presented and discussed. Such cooperation was favored by the Federation. Informal discussion was had of the necessity of the appointment of a permanent secretary to care for the increasing general business of the Federation. This was referred to the incoming executive committee.

The most important act of the Federation was the presentation and discussion of a resolution calling attention to the decreasing supply of young men entering the pre-clinical medical sciences. The general discussion tended to show that aside from the effects of reconstruction activities, there are certain special causes operating to deter young men from choosing the biological sciences even though attracted by their intrinsic interest.

It was recognized that there is always the need of giant personalities and great teachers who stimulate and lead young men by an attractive presentation of the science itself. However, the financial advantages and the secondary rewards of a professional career too generally outstrip the financial income and perquisites of research and teaching in the biological sciences. Scientific investigators do not expect great financial returns but they do have a right to sufficient income from their activities to avail themselves of the usual journals, meetings, and other necessary instruments for scientific work. The standards of maintenance of the social and family position of the scientist and the education of his children are well defined. Many teachers hesitate to urge upon their brilliant students careers which do not of themselves guarantee this degree of support. The net result is that it takes an idealistic temperament with a certain amount of utopianism to adopt as a life work scientific professions which involve so much of sacrifice to person and family.

In recent years also there seems to be a tendency in educational and scientific institutions to break away from the recognized paths blazed by the trained and conservative leadership of those who have made the present standing of the basal medical sciences in America. It is admitted that academic ruts may become established which may possibly best be eradicated now and then by drastic innovations. But the question is raised whether the rewards of promotion in rank and of calls to institutions of recognized leadership have not too often been made on the basis of some special demand which for the time being has swayed the control in these institutions. The break in morale is the same in science as would occur in business or military organizations when awards fall too frequently outside the groups of seniority in leadership and scientific attainment.

The executive committee after confirmation by the constituent societies approved and passed the following resolution with instruction that the same should be published and by other means called to the attention of administrators and others responsible for scientific appointments in American institutions.

RESOLUTION OF THE FEDERATION OF AMERICAN SOCIETIES FOR EXPERIMENTAL BIOLOGY

Adopted December 30, 1921

The Federation of American Societies for Experimental Biology, comprising the American Physiological Society, the American Society of Biological Chemists, Inc., the American Society for Pharmacology and Experimental Therapeutics, and the American Society for Experimental Pathology, as the official body representing workers in these various fields, feels that it is its duty to call the attention of the authorities of our universities and endowed foundations, of the medical profession and others, to the grave situation now existing in respect to recruits in these branches of biological and medical science.

1. A country-wide investigation, recently published, has revealed that the number of young men of ability entering on careers in the sciences basal to medicine and surgery is inadequate to fill the available positions.

2. This condition is due to two factors:

a. The number of positions in the preclinical sciences in universities and other institutions has increased more rapidly than the number of men entering these fields; and

b. The improvements and increased opportunities for laboratory investigation in clinical subjects, together with the greater remuneration in clinical departments, have made such positions relatively more attractive. In response to the urgent demand for men of scientific training to fill clinical posts, many are becoming clinicians who under former conditions would have remained in the preclinical sciences. With the increasing growth of scientific medicine it becomes evident that the only clinical teachers and investigators competent to carry forward modern medicine are those who have had sound training and experience in one or more preclinical sciences and have later acquired clinical skill and judgment.

3. The great contributions to knowledge and human welfare which the sciences represented in this Federation will make, is to be determined by the number of able workers in these sciences. An adequate application of physical sciences to biological and medical problems will come only from the broadest development of physiology, biochemistry, pharmacology and pathology; and the aid of these sciences in the progress of clinical medicine will largely depend upon the ability of these departments in our universities to supply the basic training to those who later enter upon clinical work. They must therefore furnish the recruits both for their own laboratories and for the clinics; failure to do so will prevent the progress now underway.

The Federation submits these facts to the thoughtful consideration of university authorities, and strongly recommends that immediate efforts be undertaken to improve the status and facilities of the basal medical sciences, so as to increase the number and ability of the recruits drawn to these sciences.

The cordial invitation of the University of Toronto to hold the next annual meeting of the Federation in the halls of that institution was accepted and it was ordered that the annual meeting for 1922 be called at the University of Toronto, Toronto, Canada, December 28-30, 1922.

Chas. W. Greene,
Secretary of the Executive Committee

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PSYCHOLOGY AS A CAREER[1]

PSYCHOLOGY is the science which deals with the nature of human and animal behavior and with the direction of its forces from the point of view of mental life.

There are as many words in the dictionary with mental connotation as with physical. There are as many mental phenomena subject to scientific study as material phenomena. The mental sciences may in the near future have as many branches and embrace as large scope as the material sciences.

As out of the pure physical sciences have come engineering, medicine, architecture, and other forms of applied material sciences, so in the near future will come the applications of psychology to education, medicine, industry, art, and all other varieties of human endeavor in which scientific knowledge of human or animal behavior can be made of practical value.

The opportunities for a career in mental science will, in the near future, be as numerous as in the material sciences.

No science is more intimately and practically related to the conduct of human life than is psychology. It is, indeed, concerned primarily with those facts and principles of experience and action upon which our understanding of ourselves as conscious beings and our ability to understand and sympathize with our fellows depend.

PURE PSYCHOLOGY

As now taught in the best colleges and universities, psychology is presented in several fairly differentiated courses. Ordinarily there is one general introductory course of one year furnishing a general survey of the subject from

[1] This article is one in a series published from the various divisions in the National Research Council under the general topic, "Opportunities for a Career in Science."

varied points of view. Beyond this, specialized courses are offered.

Technical laboratory courses in experimental psychology furnish training in the fundamental principles of scientific procedure in observation, measurement, statistics, interpretation and formulation of the laws of mental phenomena. This course furnishes a technique which should be employed in all branches of psychology regarded as scientific or experimental.

Physiological psychology usually reviews the facts about the nervous system as taught in neurology for the purpose of tracing the physical basis of mental life and showing the relation between the mental and the neural.

Genetic psychology is divided into two parts; mental evolution dealing with the training and development of mental life in the species, and mental development dealing with the unfolding of mental life and the integration of behavior in the life of the individual. Within this field lies also the problem of the inheritance of mental traits.

Abnormal psychology deals with mental phenomena that are strange and irregular deviations from the normal but not strictly regarded as disease; such as hypnotism, mediumship, and alterations of personality.

Animal psychology presents a field of great interest in itself; but it is of special significance in that it throws light upon human life, particularly in the study of the simplest and the highest forms of animal behavior.

Social psychology treats of the social aspects of mental life and often blends into other subjects, such as anthropology, social origins, social ethics, social welfare, and eugenics. Sometimes race psychology, or the psychology of peoples, is differentiated from social psychology.

Individual psychology is perhaps the most conspicuous field of interest at the present time as it is the foundation for "human engineering" in all its forms of selection and guidance of individuals as well as for an intimate and accurate account of character or individuality of a person. It has recently gained great impetus through the development of so-called mental tests.

Statistical psychology is a basic requirement for mental measurement, particularly as employed in mental and physical testing and in psychology applied to education, commerce, sociology, and vital statistics.

Psycho-analysis has come in from the medical side as a unique and new approach to the study of mental disorders such as hysteria, morbid fear, aversions, and suppressed desires; but also throws much light upon the nature of normal mental life. This is yet a polemic field in which we find great enthusiasms and antagonisms in contest.

Behaviorism is a purely objective study of human and animal life without reference to the testimony of consciousness.

These items may suffice to indicate roughly the principal points of view that the student entering upon a career in psychology must acquaint himself with as each contributes a distinct element to the conception of psychology as a whole.

Applied Psychology

Psychiatry, as the science and art of the treatment of mental diseases, is the only fully specialized profession which may be regarded as applied psychology, although in many respects it has developed independently and has contributed much to normal psychology. But aside from psychiatry proper, there are many specialties in medicine in which expert knowledge of the human mind and behavior is fundamental; as in the care and treatment of children, and the mental treatment of all types of defectives and delinquents. Preventive medicine, public health education, and sanitation are built largely around psychology as the science of human behavior.

Educational psychology presents numerous phases. Thus we have the psychology of the course of study, of the child, of the adolescent, of the learning process, of discipline, of particular types of training, and of special classes. The science and art of education is primarily applied psychology.

The psychology of business and industry appears in several large and distinct fields; such as the psychology of advertising, of salesmanship, of personnel, and of vocational selection and various types of efficiency activities.

Legal psychology appears in two groups of interest; first, the psychology of evidence or testimony and pleading; and second, the psychology of crime, delinquency, defective mentality, penology, dependency, correction, and special types of mental deviation.

Applied social psychology takes such forms as the psychology of social amelioration, eugenics, race betterment, child welfare, community welfare, recreation and amusement, and vocational and avocational guidance.

The psychology of art appears in the psychology of music, of graphic and plastic arts, and of literature, dealing in each case with the psychology of art principles, the psychology of the individual, and the psychology of training for the art.

The psychology of religion is applied mainly in the interpretation of religion and religious life, and in the organization of character building and religious education.

The above rubrics should not be regarded as an adequate classification of the fields of pure and applied psychology; they are listed merely as a suggestion for the purpose of showing the scope of the sciences and the types of outlets for a career.

FITNESS FOR A CAREER IN PSYCHOLOGY

The requirements for a career in psychology are in general the same as for other sciences; and psychology presents a wide range of outlets through particular types of human interest. In determining whether or not the student is qualified for a career in science, he might make use of a little device in applied psychology as illustrated in the following rating scale:

ANALYZED RATING OF FITNESS FOR A SCIENTIFIC CAREER

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.

Let the student rate himself and then ask three or more persons whom he regards as most competent and who know him well to rate him independently. Record the rating on a scale of 1-100 in which 1 represents the poorest example of this trait, and 100 the best that the person rating has ever observed in *college students*. College students, as a selected class, then become the "measuring scale."

These grades may be grouped as follows: 1 to 10 very poor; 11 to 30 poor; 31 to 50 low average; 51 to 70 high average; 71 to 90 excellent; and 91 to 100 superior.

These ratings will differ, but the very differences may throw significant light on the situation. For example, on "originality" the professor of literature may rate an individual low on the basis of observed work in poetry; whereas the chemist may rate him high on the basis of observed work in science. These represent two types of originality; or one person rating may have encountered the flashy fertility of ideas, whereas another may have observed a planful and persistent initiative, both of which represent originality, but of different types. For this reason the ratings on a given trait should not be averaged but analyzed. The student should seek a full and frank discussion of the grounds for each rating as this will analyze the situation further and throw important light on the nature of his character and capacities.

Nor should the ratings on the ten points ever be averaged. A man may be very high in one capacity and low in another and such differences are significant; but an average of them would be misleading. No person is uniformly high or low in all. These traits are not of equal value; some traits are more essential for one type of career than for another.

In general we may say that those persons who rank above 50 in the most essential traits give promise of achievement in a career in psychology.

Natural interest is another factor of which we should take account. A student seeking a career in psychology may have the opportunity of following his natural bent for interest in pure science or its applications to the educational, social, ethical, medical, artistic, and other fields of human interest in which he may find his natural bent.

Training

The study of psychology is usually begun in the second year in college; whereas many other subjects are begun in the high school or in the freshman year. As a result, it usually becomes a more advanced subject and there is more necessity for carrying it into graduate study. Most standard colleges and universities now offer good introductory courses in the subject, but beyond the elementary work, the student should seek institutions in which the particular phase of psychology that he desires to pursue is most adequately represented. The best is none too good for one who desires to specialize. In selecting, let the student choose, not on the basis of size of institution, but with reference to the men who are recognized as most worth while in a particular specialty.

As a prerequisite to a career in psychology, it is desirable that one should have command of French and German as a large portion of the literature on the subject is in these languages. He should also have pursued elementary courses in mathematics, biology, and physics. Other college subjects may be carried to advantage with, or in sequence to, an elementary course in psychology.

There is now a movement on foot to provide for the certification of psychologists. Such certification will be based on certain types of courses, usually covering about three years of graduate work, and will entitle the psychologist to practice within his field of specialization. Legislation covering such licensing is now being passed by dfferent states.

Psychology is a new science. In seeking advice, only those who are conversant with current literature and present movements in the subject should be consulted.

Types of Career

There are at present four distinct types of outlet:

Teachers of Psychology—The nature of this work and its opportunities are perhaps best known.

Scientific Research—The coming in of experimental psychology has opened up most fascinating new fields of investigation and many agencies furnish opportunity for a career as original investigator. The leading universities usually encourage this in connection with some teaching; but there are opportunities in universities, scientific foundations, surveys, and privately supported enterprises for persons who are unusually qualified for this type of work.

Specialists and Consulting Psychologists—Here the opportunities are most varied and new fields are opening rapidly as a result of research in each of the branches of applied psychology.

Technicians—All the specialists require technicians of various kinds as assistants. Most of these positions are, however, used as stepping-stones or apprenticeships in the gaining of experience for independent work.

Highly qualified advanced students can often find scholarships, fellowships, assistantships, and other financial provisions, given theoretically in recognition of some type of apprenticeship to graduate students. The remunerations open to persons who seek a career in psychology vary so much that figures would not be significant. In general, they depend upon the natural ability, the degree of training, and successful specialization.

C. E. Seashore.
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HORTICULTURE AS A SCIENCE[1]

Like most applied sciences, horticulture has evolved by very slow degrees from an art, governed by rules justified by experience, to a

[1] Read before the Association of Southern Agricultural Workers, Atlanta, Georgia, February 21, 1922

science based on laws or principles of universal applicability. The term "applied science" would seem to connote that these laws or principles are ascertained first and that they are then applied to specific conditions, but as a rule the applications are known and are practiced, having been hit upon by empirical means and the first function of an applied science is usually to "explain" them by discovering the principles involved. When a considerable number of principles have become established in this way, new applications for them are found and the applied science becomes in effect what its name implies.

A large part of the experimental work in horticulture has been conducted with the object of devising new rules and of ascertaining new facts of an empirical nature. More recently, however, considerable effort has been made to find principles of more or less universal applicability and this has been accomplished by a study of the fundamental factors determining plant growth and productivity. Though many valuable practices have not yet received scientific elucidation and though much good work remains to be done in the way of discovering new rules, a large body of well established principles has been accumulated and successful practice depends to an ever increasing degree on their recognition.

A comprehensive investigation of almost any horticultural problem involves much the same succession of stages as has been outlined for the development of the science; (1) The field for investigation is usually explored by experimental work of an empirical nature. (2) This is followed by scientific study to determine laws or principles. (3) This in turn is followed by more experimentation to test the feasibility of applying to particular conditions the principles that have been discovered. It seems customary to extol the scientific study which aims to formulate laws and to dignify it by some such appellation as "fundamental research." By implication, the attendant phases of investigation seem to be deprecated on the ground that they are largely empirical. However, this invidious distinction is unwarranted, as every investigator learns sooner or later, for these three aspects of investigation are like three links in a chain and progress in horticulture depends on their parallel development. Principles are of little value to the horticulturist if they cannot be applied, just as a collection of experimental data is of small import until it receives interpretation.

The strictly scientific aspect of horticulture is closely allied to botany and it is difficult to state wherein the distinction between the two lies. It is largely a difference in emphasis, since the horticulturist is interested only in those phases of botany that may be applied to his specific purposes. Nevertheless, the development of horticulture has followed closely in the steps of botany. During the last century the attention of most botanists was directed to morphology and taxonomy, a tendency reflected in the advances made by horticulturists in the subject of pollination and fruit setting and in the development and description of varieties. At present these subjects are better rounded and more nearly complete in their major aspects than almost any other phase of horticulture. Now that plant physiology is in ascendency, more rapid progress is seen in the nutritional problems of horticulture—in fruit bud differentiation, in pruning and in fertilizer treatments.

The dependence of horticultural science not only on botany but on other sciences as well may be illustrated by reference to recent work on the so-called Hardiness Problem. Although this has engaged the attention of both horticulturists and botanists for many years, until lately little was accomplished other than a substantial verification of the Laws of Temperature formulated by De Candolle nearly a century ago. Investigators were still faced with the seemingly contradictory facts that death from low temperature is due to loss of water from the cells by ice formation in the intercellular spaces and that nevertheless hardy plants usually contain less water than tender plants. What seems to be a satisfactory solution of this problem was made possible by some chemical investigations of Foote and Saxton at Yale University. This work showed that water may exist in different forms, and that the water held by colloids possesses properties different from those of "free water," particularly with regard to the temperature at which it freezes. This work suggested to Bouyoucos of the Michigan Agricultural College a classification of soil water into "free" water, which freezes at 0° C. or slightly below, colloidally adsorbed water which freezes at temperatures from a few degrees below zero down to -78°C., and combined water, which freezes only at temperatures below -78°C. This classification was applied by McCool and Millar to the water of plant tissues. The work of these investigators suggested an explanation of the greater tenderness of plant tissue with the higher water content. If hardiness depended not on the total water content, but on the content of colloidally adsorbed water which does not freeze at ordinary freezing temperatures, then a plant tissue might contain any amount of free water and still be tender, while a relatively small amount of water in the adsorbed condition would impart a considerable degree of hardiness. Recent investigations at the University of Missouri have shown that these surmises are correct, at least for some plants.

If hardiness depends on the amount of colloidally adsorbed water, what colloid holds it in this adsorbed state? Some botanical investigations by Spoehr of the Carnegie Institute suggested the probable answer to this question. He found that in cacti water-retaining capacity is correlated with pentosan content and that when the water-retaining capacity is increased or decreased by changes in environmental conditions, the pentosan content likewise increases or decreases at the same time. Pentosans were therefore investigated in fruit plants and vegetables and a correlation was found between pentosan content and hardiness. This correlation is remarkably close if hot water soluble pentosans only are considered. These findings indicate that certain pentosans, probably pectin-like substances, are the colloids that hold water in an adsorbed state. This is further substantiated by the fact recorded by Spoehr that dryness tends to increase the pentosan content of cacti and likewise their water retaining capacity. It is well known that cultural practices or climatic conditions that tend to dry fruit plants out in the fall, increase maturity and hardiness. Consequently the very conditions that lead to a low total moisture content probably increase the amount of water-holding colloids and the quantity of colloidally adsorbed water—hence the greater hardiness of plant tissues with the lower moisture content.

This understanding of the conditions associated with hardiness in plant tissues permits accurate outlining of the treatment or treatments that decrease susceptibility to low temperatures. It makes possible also an estimate of the magnitude of the effects that may be produced in that direction, and a recognition of their limitations. Such practices thus become incorporated in scientific horticulture.

This example indicates the intimate relation between progress in horticulture and progress in other sciences. Subjects which on superficial consideration might never be suspected of contributing data valuable for the solution of horticultural problems are seen to be worthy of study. If little headway has been made along certain paths of investigation, it is not infrequently because the methods, the facts or the technique essential to the solution of specific problems has been lacking. To this day, the official method for the determination of starch recommended by the Association of Official Agricultural Chemists is not an analysis for starch but for total hydrolyzable polysaccharides. Furthermore it is only within a comparatively few years that a satisfactory method for determining total sulphur content has been available. As a result, much painstaking labor has gone for naught, though some have noted, but have been at a loss to account for, the discrepancy between the results of such determinations and the unmistakable evidence of microchemical findings. The investigator can well afford to acquaint himself with recent advances in other fields and the broader his fund of information the more successful he will be. It might be suggested that progress in Physics, Meteorology and Forestry should be watched as well as that in various branches of Botany, in Chemistry, Soil Science and Agronomy. This task which would have been out of the question a few years ago is greatly facilitated now by the increasing number of abstract journals and substantial help is afforded investigators in many institutions by Plant Science Seminars, Scientific Societies and the like. Even though such conveniences be lacking much can be gained by personal contact with investigators in other fields and by a mutual exchange of criticisms and suggestions.

Treatment — that is, orchard practice, whether it be pruning, irrigation, fertilizing, thinning or what not—is an aspect of horticulture that may be compared to medicine, and the comparison is instructive because it indicates a possibility of development in horticulture from the application of scientific methods used by the physician or surgeon. Cultivation, pruning, the use of fertilizers and other treatments have been considered only in the light of one standard, the effect on crop production. The limitations of this one-tracked system may be demonstrated by reference to some recent experiments on fertilizer treatments.

If apple trees are bearing poor crops, a spring application of some quickly available nitrogenous fertilizer will frequently increase the yield. Such increases are very striking on weak trees, but some results obtained at Missouri show they can be obtained also on trees in good condition—on trees that are already bearing fair or even good crops. This effect of quickly available nitrogenous fertilizers applied a couple of weeks before blossoming has been shown to be produced by increasing the set of fruit. Fruit setting, however, is only one step in fruit formation. The process begins with the formation of fruiting wood and involves in succession fruit bud differentiation, bud development to the time of blossoming, pollination, fruit setting and finally fruit development. The failure or limitation of a crop may be occasioned by interference with any one of these successive processes. It would make little difference how favorable conditions might be for fruit setting, if fruit bud differentiation had not occurred. Recent investigations have shown that those conditions in apple trees, produced by spring applications of quickly available nitrogenous fertilizers, which are so favorable to fruit setting, do not favor fruit bud differentiation. Hence if poor crops result from deficiency in the initiation of fruit buds, spring applications of quickly available nitrogen would only accentuate the trouble.

This work reopens for investigation the entire orchard fertilizer problem which was thought by many to have been solved in the last few years by experimental work with sodium nitrate in the orchard. The same kind of fruit tree may present many different nutritional problems for treatment. Each problem requires special study and the remedy in horticulture, as in medicine, depends on accurate *diagnosis*. The use of fertilizers to correct the alternate bearing habit in apple trees constitutes a problem as distinct from their use in increasing the set of fruit as spraying peaches for San Jose scale is from spraying to control scab. As investigators, we are too ready to dispose of problems by assuming that either the nutrition, the moisture or the temperature relations are involved and that cultivation or the application of some fertilizer will lead to maximum growth and productivity. We would spare ourselves the effort of analyzing the problem—of making a diagnosis to determine the precise difficulty to be overcome. The time is not far distant when fertilizer treatments alone will be as numerous and as specific as all the horticultural practices recognized today. We must dispense with the idea of a mass attack on a bulk problem and apply more detailed methods, if we are to make rapid progress. Aside from technical improvements in such fields as spraying and marketing, the lines of pomological investigation along which greatest progress seems possible are treatment, propagation and plant improvement and treatment according to diagnosis promises to be one of the most fruitful.

There is no cure-all, no patent remedy for promoting growth, for inducing hardiness or for increasing crops. These can be accomplished only by careful study and hard work. No practice can be recommended for all circumstances or for all fruit plants, nor can the same practice be guaranteed to produce the same effects under different conditions. Treatment should be regarded not so much in terms of practice as in relation to the specific physiological processes to be affected. Much work must be done before specific measures to influence these different processes in the desired direction are found. Many practices that have not proved generally efficacious in the past may be shown to have great value for specific conditions. Pomologists must think in terms of limiting factors, and not merely in terms of the soil elements that may limit plant growth but also in terms of the physiological processes that may be limiting fruit production. For all this work, an accurate knowledge of the chemical changes associated with different physiological processes is of the utmost value because a thorough understanding of the conditions desired may suggest means for their accomplishment.

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A SUGGESTION AS TO METHOD OF PUBLICATION OF SCIENTIFIC PAPERS

THE processes of scientific publication are admittedly in an unhealthy state. Various influences contribute to the acuteness of this condition, but it is likely that a time of stress has merely emphasized weaknesses inherent in the ordinary procedure for printing scientific papers. The "jammed" plight of the periodicals is slowing the vital current of new results. It becomes desirable to consider alternative methods of printing, perhaps better adapted to the present character of our needs. In this country and abroad several suggestions have already been offered; the most drastic of these has urged the publication of abstracts only, completed manuscripts to be deposited for reference in some central place—a scheme having so many unfavorable features as to merit little serious attention; it is not merely *results* we wish, but also some at least of the steps in their derivation.

I have in mind more especially the field of zoology. To-day this subject is specifically served by a fine group of journals, and by an "advance" bibliographic service of filing cards bearing author-abstracts. This system of publication is maintained through the cooperation of the Wistar Institute. These journals were founded some years ago, and each was designed to cover a particular group of zoological interests. They do not now correspond, in titles or in any individuality of contents, to major aspects of zoological development. Their fields of service overlap, sometimes to an embarrassing degree.

Investigators acquire separata of papers of particular concern to them. There is thus brought about a quite unnecessary duplication in the distribution of published work, and a proportionate waste of paper. Subscriptions for support of the journals are drawn from membership dues of the Zoological and Anatomical societies. Members therefore receive most or all of the journals, in this way accumulating a mass of unused, largely unusable, material; while still necessarily relying upon the convenient "reprint" for actual reference and use.

I believe that these difficulties may be obviated, and the course of publication simplified and expedited. With the hope of attracting discussion of this matter, I outline here a plan regarded as practicable and to the point. The foundation of new journals has little to recommend it; these are likely soon to suffer the fate of the older ones. Save in some special fields, the journal method of publication has become measurably antiquated.

The journals should be abolished. They do not represent rational subdivisions of zoological activity. There is no real reason why papers accepted for publication should be grouped to make up a "number." It is certainly more desirable that a paper be printed when it is ready for printing. If issued and originally distributed as a "separate," unnecessary duplication of distribution can readily be avoided. This plan requires some central agency, such as we now have, for handling the mechanical details of publication. Serial numbers could be assigned to papers as issued. An entire series might then be bound by libraries, though the more sensible way would be to have them filed alphabetically by authors.

In some essentials this procedure is already followed by the *Archives de zoologie expérimental et général,* by the Royal Society in its *Transactions,* by the Museum of Comparative Zoology, and by the University of California *Publications.* My suggestion, however, involves an important additional element. Society subscriptions continuing as at present, it would be a simple matter to have each member receive a certain number of published papers, more or less equivalent in total bulk to the journals now obtained. But it would be possible for the subscriber to select, through the Advance Abstract Bibliographic Cards, those papers specifically desired. Additional papers, not regularly obtained in this way or from the authors, could then be purchased at small extra outlay. The American Anatomical Memoirs and the few special reprints issued by the Wistar Institute have made a beginning in this direction.

The actual working of this plan would perhaps require that at, say quarterly, intervals there be issued Bibliographic Cards carrying the serial numbers assigned to the individual papers about to be printed. An accompanying order blank, by which articles desired could be requested by number, would give a simple, quick method of indicating one's needs. It would at the same time serve to show the printer the size of the issue to be prepared, after allowance had been made for reserve stock and for blanket subscriptions. The three-months' period mentioned is sufficiently long. The experience of the *Journal of General Physiology* shows that with efficient management it is possible to print accepted articles within less than that time, even under present conditions.

Authors should by this scheme be in some degree relieved from the expense of purchasing separata for extensive private distribution. One's library shelves, moreover, would no longer be encumbered with journal numbers which must be bound at ruinous expense or else remain unsightly.

Any working plan of this type must be conceived as applying chiefly to contributions of the character and average length now appearing in the journals. Incidentally, this scheme may show the way out of the difficulties sometimes made in connection with the rather arbitrary rule now enforced by the journals as to the maximal length of acceptable contributions. Although sometimes abrogated for reasons obscure, it has tended to be avoided by authors splitting the material of an essentially unitary piece of work into a number of articles. While the length rule has perhaps acted to restrain some wordiness, it is hardly a rational rule; one could wish it supplanted by editorial persuasion!

It may be suspected, as a conceivable result of the plan outlined, that the quality of the papers might be automatically improved. A paper which from the first is to "stand alone," rather than be supported fore and aft by comfortable neighbors, is likely to be more carefully written, perhaps even more carefully thought out.

There will remain, however, distinct and obvious need for the continuance of the journal form for the publication of short notes; perhaps also for periodicals in which the general results of investigation may be summarized and discussed; and certainly for at least one periodical such as the *Proceedings of the National Academy of Sciences.* It is my belief that under the operation of the plan I have suggested such journals would have a distinctly higher value than at present.

W. J. Crozier

Zoological Laboratory,
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CHARLES W. WAIDNER

Dr. Charles W. Waidner, chief physicist and head of the Division of Heat and Thermometry of the Bureau of Standards, who died on March 10, 1922, is the fourth leader this bureau has lost by death since last May. The others are E. B. Rosa, chief of the Electrical Division; L. A. Fischer, chief of Division of Weights and Measures, and S. S. Voorhees, engineer-chemist. Waidner, Rosa and Fischer were of the original group gathered together in 1901 at the time the Bureau of Standards was founded, and to its development each devoted his life.

Born on a farm in the suburbs of Baltimore, March 6, 1873, Waidner received his early training in the public and private schools of that city. He attended Johns Hopkins University where he graduated in 1896, and continuing in the graduate school, in which he was a pupil of Rowland, he received the degree of Ph. D. in physics in 1898. The subject of his thesis, "A comparison of mercury and resistence thermometers and an adjustment of Rowland's value of the mechanical equivalent of heat," in collaboration with F. Mallory, is the one to which Waidner devoted practically his entire professional career, namely, the determination of fundamental constants and standards relating to heat, and he became the first authority in the country on thermometry and heat measurements.

He served as instructor in physics at the Hopkins and also at Williams College, going to the Bureau of Standards on August 1, 1901, one month after its establishment. In 1903, he organized the Division of Heat and Thermometry, of which he was appointed chief, a position which he held until his death. It is characteristic of him to note that the first books he ordered at the bureau were a set of Regnault's works.

It is perhaps not without interest to recall the chaotic state existing in 1901 in this country with respect to thermometric data. Clinical thermometers were being certified to a scale one-tenth degree in error; manufacturers of thermometric instruments of precision each had his own "standards," usually of nebulous or ambiguous origin; for pyrometric data, one had to go to Germany; the temperature scale in the fundamental range 0° to 100°C of the International Bureau was available with difficulty and delay through French-made thermometers; there was practically no national or international agreement relating to heat measurements.

Waidner took up and successfully solved, in collaboration with his associates, each of these problems. Starting with the scale and methods of testing of clinical thermometers, calorimetric thermometry and the substitution of the electrical resistance method as standard in this range as for a portion of the higher and lower temperature ranges, this work included also exhaustive studies of the limitations of mercury-in-glass thermometers, and the introduction and development of optical and thermo-electric methods in pyrometric measurements. In the course of this work it was necessary to devise many new designs of apparatus and Waidner was exceptionally skillful in this field, and his designs have been used as models by many others.

He also saw the necessity of improving calorimetric methods to secure greater precision and his work, for example, on methods of measuring heating values of gases is recognized as fundamental for gas testing. He was responsible for the establishment of the distribution of materials of determined calorific value for calorimetric standards on which the testing of fuels depends; and also of pyrometric material standards of certified melting point, permitting the calibration of pyrometers by the user.

The investigations carried out by him or under his supervision on high temperature measurments were started when the subject was comparatively unknown in this country. This work provided pyrometric standards and methods of control for American manufacturers of pyrometers, and was of fundamental importance in the development of an industry which now finds application in many branches of manufacture.

As the bureau expanded, Waidner was able to devote less time to actual experimental work, but to the last was very active in the initiation and direction of the problems in heat, and many of the more recent papers from the bureau on such subjects, although they do not bear his name are nevertheless largely his product. During the past few years his interest centered mainly about several groups of engineering problems, one relating to the determination of constants of importance especially to the refrigerating industry; another concerned with the extensive investigations on the fire-resisting properties of structural materials; and a third, dealing with the methods of testing petroleum products.

During the war he had charge of the execution of many lines of research, including the elaborate work done by the bureau on aviation engines, the atmospheric conditions which are encountered at heights up to thirty thousand feet being produced for the first time in a specially designed altitude chamber. This work was of importance in many ways, such as in fixing specifications for gasoline for aviation engines, and determining their performance with variations in design.

His contributions to knowledge appear almost exclusively as a long series of papers in the scientific and technologic series of the Bureau of Standards. His work was most painstaking and thorough and was always thoughtfully planned and skillfully executed. He was a delightful and inspiring companion to work with, as I can testify from an almost daily association extending over twenty years.

Dr. Waidner was a man of wide acquaintance, a member of the Washington Academy of Sciences, the Philosophical Society of Washington, the Cosmos Club, the American Society for Testing Materials and a fellow of the American Physical Society and the American Association for the Advancement of Science.

In addition to his scientific position, Waidner naturally had at the bureau many important administrative and advisory functions to perform, some of them bringing him into close contact with his fellows. Thus, as a member of the editorial committee, continuously from its formation in 1903, he is largely responsible for the policy and standard of the bureau's publications. This position, as well as that of the chairman of the personnel committee, he filled with consummate tact and devoted conscientiousness. He had the saving grace of wit and common sense, and broke many a deadlock with a happy thrust that left no sting.

His associates will remember him not only for his high standard of work but for his ever ready kindly advice, some times given to good effect when not asked for, his sterling character, genial personality, intense loyalty to his friends and to the institution of which he was a dominating mind, and above all, during the past few years, for his grit and cheerfulness in combating the disease that finally took him off.

S. W. STRATTON

BUREAU OF STANDARDS

SCIENTIFIC EVENTS

VIENNA INSTITUTE FOR ICE AGE RESEARCH

SCARCELY any department of scientific research is of more general interest than that which concerns prehistoric man, his development during the Ice Age and the changes then taking place in the conformation of land and sea. Yet, with the exception of the Institute of Human Paleontology in Paris, generously endowed by Prince Albert of Monaco, there has hitherto been no special center for the investigation of this period.

A public institution for study of the Ice Age has now been established in Vienna in connection with the Natural History Museum of the Austrian Republic, and every effort will be made to investigate the phenomena of the Ice Age on a broad scientific basis.

The geographical position of Vienna renders it well adapted for this purpose, since the land structures associated with the glaciation can be studied in the vicinity and observed in their ancient relations to the environment of prehistoric man. Lower Austria is well known to have furnished a rich store of ancient stone implements and weapons.

The Vienna Institute is under the leadership of Dr. T. Bayer, director of the anthropological and ethnographical collections. Dr. Bayer's papers in which he demonstrates the existence of no more than two distinct periods of glacial conditions may be said to have created a new basis for this field of research. He is assisted by a group of colleagues and it is hoped to extend the circle of workers to include those in other countries who are devoting themselves to this period of research. They are invited to enter into communication with Dr. Bayer at the Natural History Museum, Vienna, who will be pleased to give fuller information as to the present activities of the institute.

JULIUS PIA

VIENNA, MARCH 16

THE ALL-RUSSIAN CONGRESS OF ZOOLOGISTS IN PETROGRAD

The first All-Russion Congress of Zoologists, Anatomists and Histologists is to be convened from April 23 to April 30 in Petrograd. At this congress it is expected to have the following sections: 1. Systematics, Zoogeography and Ecology; 2. Morphology (with Embryology); 3. Anatomy and Histology; 4. Experimental Zoology and Genetics. For the general sessions of the congress the following addresses will be delivered:

L. S. Berg: Polyphiletism and evolution.

A. S. Dogel: The causes which lead the living body to old age and death.

G. A. Kojevnikoff: Polymorphism and evolution.

N. K. Koltzoff: Eugenics, its problems and methods.

N. M. Koulagin: Zoology, science and agriculture.

M. M. Novikoff: Modern opinion regarding structure of chambers.

A. N. Severtzoff: The origin of fish and problems of phylogeny connected with this question.

P. P. Soushkin: The history of fauna of Siberia and Central Asia.

U. A. Philipchenko: The problem of experimental study of variations.

V. M. Shimkevich: About the regularity of the systematical indications.

V. M. Shimkevich is chairman and K. Derugin and V. Tonkoff are vice-chairmen.

ASSOCIATION OF GEOLOGISTS AND NATURALISTS IN PEKING AND VICINITY

There has recently been effected an informal association in Peking to bring together the geologists and naturalists resident in Peking and the vicinity for discussion of problems of mutual interest and the furtherance of intellectual intercourse among men of science in the Far East. Several meetings have been held at the residence of Dr. Roy Chapman Andrews at the headquarters of the Third Asiatic Expedition, at the residence of Dr. J. G. Anderson, at the Peking Hotel, in Central Park and elsewhere. The meetings are preceded by an informal dinner. On March 22 Dr. Walter Granger was expected to present the results of his recent expedition to the fossil fields of eastern Szechman province.

Those who have previously attended these meetings include:

Dr. V. K. Ting, honorary director of the Geological Survey of China.

Dr. W. H. Wong, director Geological Survey of China.

Dr. J. G. Andersson, mining adviser to the Chinese government.

Dr. E. E. Ahnert, director Geological Committee of the Russian Far East, Vladivostock.

Dr. Roy Chapman Andrews, director of the Third Asiatic Expedition.

Professor George B. Barbour, professor of geology, Pei Yang University, Tientsin.

Dr. Davidson Black, director of the department of anatomy, Peking Union Medical College.

Dr. Walter Granger, paleontologist to the Third Asiatic Expedition.

Dr. Otto Zdansky, associate paleontologist to the Geological Survey, China.

Professor Charles P. Berkey, geologist of the Third Asiatic Expedition.

Mr. Clifford Pope, assistant zoologist of the Third Asiatic Expedition.

Dr. F. R. Tegrengen, mining geologist.

Professor F. K. Morris, associate geologist of the Third Asiatic Expedition.

Dr. A. W. Grabau, paleontologist of the Geological Survey of China and professor of paleontology, National University, Peking.

Dr. Harry Smith, assistant professor of botany, Uppsala, botanist and explorer.

Père Licent, naturalist and explorer, Tientsin.

The gatherings are said to have proved highly stimulating. Frequent meetings during the winter and spring months are planned.

THE MENDEL CENTENNIAL

In commemoration of the hundredth anniversary of the birth of Gregor Mendel, there will be held a scientific gathering in the city of Brünn, Czechoslovakia, from September 22 to 24. A *Festchrift* containing original contributions in the field of genetics will be published.

The secretary of the local committee, Professor Dr. Hugo Iltis, has asked me to call this celebration to the attention of American geneticists and to extend to them a cordial invitation to take part in the celebration in any or all of the following ways:

(1) By accepting membership on the International Committee: (2) by being present in person at the gathering in Brünn on the date mentioned; (3) by making a voluntary contribution toward the expenses of the gathering and of the *Festschrift;* and (4) by submitting a manuscript for publication in the memorial volume. Such MSS. should be sent to Professor Dr. Hugo Iltis, Bäkergasse 10, Brünn, Czechoslovakia, and should be in his hands by the end of May, 1922. Money contributions should be made payable to the Mendelfeier-Konto, Böhmische Eskompte-u. Kreditbank, Brünn. It is hoped that American geneticists will cooperate as fully as possible to make the celebration a success.

Geo. H. Shull

COLLOID CHEMISTRY AT THE UNIVERSITY OF WISCONSIN

The chemistry department of the University of Wisconsin announces that Professor The. Svedberg, of the University of Uppsala, will be in residence during the second semester of the scholastic year of 1922-23 and the summer session of 1923.

While at Wisconsin, Professor Svedberg will organize and direct the research work in colloid chemistry, and will also give two lectures each week on the subject and conduct two weekly seminaries. One seminary will be devoted to the broader aspects of colloid chemistry and the other to its biological applications.

Professor Svedberg is recognized as one of the international authorities on the subject of colloid chemistry. He is the author of many papers dealing with the fundamental principles of colloid chemistry and has written the best known treatises on the preparation of colloids. His work has been recognized by the award of numerous prizes and special research funds and he has been honored by numerous foreign societies.

During the summer session of 1923, lasting for a period of six weeks, the lectures given during the second semester will be repeated for the benefit of educators and research workers who find it impossible to attend the university during the regular session. A seminary will also be conducted throughout the summer session.

Advanced workers who desire to do work under the direction of Professor Svedberg should communicate with Professor J. H. Mathews, director of the course in chemistry, since only a limited number of research workers can be accommodated.

YALE UNIVERSITY AND DR. CHITTENDEN

At the regular monthly meeting of the Yale Corporation, held on March 11, the following resolution was adopted in connection with the resignation of Dr. Chittenden as director of the Sheffield Scientific School, which takes effect at the close of the present university year:

Even in his undergraduate days in the Sheffield Scientific School Director Chittenden had begun to pave the way to a distinguished career as a teacher and investigator in physiological chemistry, for the development of which as an independent branch of study he has been responsible not only at Yale but in large measure in the United States. His was in many respects the path of a pioneer in a borderline science which inevitably led both at home and abroad to recognition and honors in which the institution that Director Chittenden served has shared abundantly.

Not less successful has been Dr. Chittenden's leadership as director of the Sheffield Scientific School for nearly a quarter of a century. His unflagging energy and broad vision have contributed largely to increase the material resources of the school, to enlarge the scope of its usefulness as an institution for professional training in science, and to stimulate and encourage investigation. The recognition at Yale of the important part which the study of science should play in modern education is due in no small degree to Dr. Chittenden's influence. Research at Yale has always found a staunch supporter and advocate in him.

To a man of Dr. Chittenden's training and ideals even the partial abandonment of the pursuit of science necessitated by the call to an executive post must have meant a personal sacrifice. He has accepted this, as he has undertaken many other public tasks, in a spirit of service which deserves grateful recognition on the part of Yale Universiy.

The Yale *Alumni Weekly* says in an editorial article:

The resolutions adopted on the resignation of Director Chittenden by the Yale Corporation place a richly merited emphasis on the character of the service which the retiring administrative head of the Sheffield Scientific School has rendered since he succeeded Dr. George Jarvis Brush in 1898. The latter was the first incumbent of an office which offered unusually large opportunity to a man of energy and imagination. That Dr. Chittenden has taken advantage of the opportunity is strikingly demonstrated by a review of the development of the school under his far-seeing administration. This sympathetic interest has covered not alone his own special field of physiological chemistry, in which he as well as other members of the Scientific School faculty group have accomplished important results, but also other departments, including those in engineering. It is doubtful if any administrative officer of the university has ever followed more intimately the work of his office or brought to his task a more generous measure of loyal and intelligent effort. The qualities which distinguish the Scientific School and elevate it to the front ranks of institutions of its class must be attributed largely to the man who now quietly lays down duties which he has unremittingly carried on for almost a quarter of a century. Graduates of the university, whatever their school affiliations and interests, will unite in paying tribute to such a record of service. They will look for years to come for the results of the successive contributions of Director Brush and Director Chittenden and will certainly find those results in an ever more useful Sheffield Scientific School.

SCIENTIFIC NOTES AND NEWS

Sir Ernest Rutherford, Cavendish professor of experimental physics in the University of Cambridge, has been named as president of the British Association for the Advencement of Science for the annual meeting to be held at Liverpool next year.

A dinner in honor of Dr. Mansfield Merriman, editor of the *American Civil Engineers' Handbook* and former professor of civil engineering at Lehigh University, is to be given by the New York alumni of that institution at the Aldine Club, New York City, on April 18. John R. Freeman, George H. Pegram, Robert Ridgway, Henry S. Jacoby, Frank P. McHibben and Ralph J. Fogg will be the speakers.

Ramon y Cajal will reach the retirement age on May 1, and a committee has been formed in Spain to organize a national demonstration showing the high regard in which he is held. An organizing committee has been appointed, the president of which is Dr. C. M. Cortezo, president of the Royal Academy of Medicine, and the secretary, Dr. C. Pittaluga. The plans of the committee include a special edition of Cajal's works, the construction of a monument and an increase in the appropriation allotted by the government for the maintenance of the Instituto Cajal.

Sir Frank Dyson was elected president of the British Optical Society at the annual meeting held on February 9. At the same meeting Professor A. A. Michelson, of the University of Chicago, and Dr. M. von Rohr, of Messrs. Carl Zeiss, Jena, were elected honorary fellows of the society.

Mr. G. V. Colchester has been appointed to the post of geologist on the Geological Survey of the Anglo-Egyptian Sudan in succession to Mr. C. T. Madigan, who now holds a lectureship in geology at Adelaide University.

Dr. Charles D. Woods, who for nearly 25 years was director of the Maine Agricultural Experiment Station and more recently consultant in agriculture in the United States War Department, has accepted the directorship of the Division of Agricultural Information with the State Department of Agriculture of the Commonwealth of Massachusetts.

Mr. C. S. Brinton has been appointed chief of the Philadelphia Food and Drug Inspection Station of the Bureau of Chemistry, effective March 1, 1922. This appointment is made to fill the vacancy caused by the transfer of Mr. Arthur Stengel to the Bureau of Chemistry in Washington.

Mr. D. D. Berolzheimer, assistant technical editor of the Chemical Engineering Catalog and co-author of the Condensed Chemical Dictionary, has been appointed manager of the information bureau of the Chemical Catalog Company, Inc., and of the service department of the *Journal of Industrial and Engineering Chemistry*.

Mr. Arthur D. Holmes, who has been research chemist with the E. I. du Pont de

Nemours & Co. at the Jackson Laboratory, has resigned to accept a position with the E. L. Patch Company, Boston, Mass., to establish a research laboratory which will be concerned with investigations along biological and physiological lines.

Dr. Perley Spaulding, of the Bureau of Plant Industry, sailed on April 4 for Europe, where he will make a prolonged investigation of the white-pine blister rust. He will spend about eight months in Europe, covering the entire growing season, and visiting all parts except Spain, Russia and the Balkans. He will also represent the United States Department of Agriculture at the general assembly of the International Institute of Agriculture at Rome on May 8 to 18.

Nature reports that an expedition, consisting of Professor J. W. Gregory, of Glasgow University, and his son, Mr. Christopher J. Gregory, which has for its primary object the investigation of some features in the mountain structure of northwestern Yunnan and western Szechuan, expected to leave for Burma at the end of March. The area is one of special geological and biological interest. It includes some mountains of which the height varies, according to the available information, from 20,000 to 25,000 feet; and as these mountains occur in line with the Himalaya and the mountains south of Assam it has been suggested that they represent a prolongation of the Himalaya. Some zoological and botanical collections will be made which it is hoped will be worked out in the British Museum of Natural History and in the India Museum, Calcutta. The expedition will travel via Rangoon, and hopes to start from Bhamo, near the northwestern frontier of Burma, at the beginning of May.

We learn from the *Journal* of the Washington Academy of Sciences that Secretary of Agriculture Wallace has appointed a committee of six scientific men from the department to consider the problem of land utilization. The committee consists of Messrs. L. C. Gray, of the Office of Farm Management and Farm Economics; C. V. Piper, of the Bureau of Plant Industry; G. M. Rommel, of the Bureau of Animal Industry; C. F. Marbut, of the Bureau of Soils; E. E. Carter, of the Forest Service; and S. H. McCory, of the Bureau of Public Roads.

Governor W. D. Stephens, of California, has appointed the following as a committee to investigate the agricultural colleges of the United States and report on a plan for improving the agricultural work of the state: G. H. Powell, Los Angeles; W. S. Guilford, Butte City; Elwood Mead, professor of rural institutions, University of California; James J. Hollister, Gaviota; Samuel G. Mortland, Fresno; Sheridan W. Baker, Santa Rosa, and R. G. Sproul, comptroller of the University of California.

On the request of W. D. Bancroft, the National Research Council has appointed the following committee on theory of reactions of nonelectrodes: Julius Stieglitz, of the University of Chicago, Roger F. Brunel, of Bryn Mawr College, H. S. Fry, of the University of Cincinnati, L. W. Jones, of Princeton University, James Kendall, of Columbia University, G. N. Lewis, of the University of California, and W. A. Noyes, of the University of Illinois.

The National Canners' Association has just contributed to the University of Chicago $10,000 a year for two years for investigation into the causes of disease connected with their work. The investigation is to be under the direction of Professor Edwin Oakes Jordan, chairman of the department of hygiene and bacteriology, and will be in cooperation with the United States Public Health Service. Dr. J. C. Geiger has been detailed by the surgeon general of the United States to carry on this work under Professor Jordan, and for this purpose he has been appointed for two years to an associate professorship of epidemiology in the department of hygiene and bacteriology.

Dr. F. W. Aston, of the University of Cambridge, delivered an address on "Isotopes and the structure of the atom" before the joint meeting of the Washington Academy of Sciences, Philosophical Society of Washington and the Chemical Society of Washington, on March 29. Dr. Aston also gave lectures on March 30 and 31 before the North Carolina Chapter of the Society of Sigma Xi.

The Harben lectures will be given during the meeting at Plymouth of the Royal Institute of Public Health from May 31 to June 5 by Dr. T. Madsen, director of the State Serum Institute, Copenhagen.

The death is announced of Professor V. I. Palladin, the well-known plant physiologist, at the age of 63 years. Palladin published many scientific contributions, notably on the fundamental molecular phenomena of respiration. An English translation of his text book of plant physiology is used in many American universities.

Jules Schevitz, secretary of the Oklahoma Public Health Association, died on March 22, 1922, at the age of twenty-four years. A correspondent writes: "During the four years of his association with the work, he built up a statewide organization for the promotion of the public health, established tuberculosis dispensaries, initiated infant and child welfare activities, conducted a state-wide public health survey of urban conditions and succeeded in getting legislative action for the construction of three tuberculosis sanatoria."

The Pacific Division of the American Phytopathological Society will meet in Salt Lake City, Utah, from June 22 to 24, in conjunction with the summer session of the American Association for the Advancement of Science. It is hoped that any members of the parent society who are contemplating a trip to the Rocky Mountains or the Pacific Coast will arrange to be at Salt Lake for this meeting. Those who wish to present papers should notify S. M. Zeller, secretary-treasurer, Pacific Division, American Phytopathological Society, Oregon Agricultural College, Corvallis, Oregon.

The fourth annual meeting of the American Society of Mammalogists will be held in New York City from May 16 to 18. The sessions on the first two days, May 16-17, will be devoted to the reading of papers, discussion and business, and will be held from 10 A.M. to 4:30 P.M. in the American Museum of Natural History. A session will also be arranged for the evening of May 17. On May 18 the society will visit the New York Zoological Park as the guest of the New York Zoological Society. Headquarters will be at the Hotel Majestic, 72d Street and Central Park West.

The second national convention on commercial engineering called by the United States commissioner of education will be held on May 1 and 2 at the Carnegie Institute of Technology in Pittsburgh. Dr. Thomas S. Baker, acting president of the institute, has invited about 200 colleges in the United States and Canada to appoint delegates, many of which have already announced appointees. Invitations have also gone out from Washington to engineering professional societies, to individuals, and to more than 1,400 chambers of commerce and trade organizations. Dr. Glen Levin Swiggett, of the United States Bureau of Education, is chairman of the national committee, which includes prominent representatives of commerce and engineering interests throughout the country.

The National Committee on Mathematical Requirements announces that, owing to unfortunate delays in printing, its complete final report, "The Reorganization of Mathematics in Secondary Education," will not be ready for distribution before May, 1922. Requests for free copies of this 500 page report may be sent to J. W. Young, chairman, Hanover, New Hampshire. Owing to the labor and expense involved, the receipt of applications for copies of the report is not in general being individually acknowledged. Applicants may rest assured, however, that their requests will be filled when the report is ready for distribution.

The *Journal* of the American Medical Association reports that establishment in Washington, D. C., under permanent federal support of an institution where problems of disease and health may be attacked cooperatively along general chemical, physical, biologic, pharmacologic and other necessary lines, with the object of mastering these problems for the common good of humanity, are the proposals of a bill shortly to be introduced in the House of Representatives by Representative Roy O. Woodruff of Michigan. Dr. Woodruff is a physician as well as a dentist and he asserts that the practical advantage of such an institution was demonstrated during the World War by the existence of the American University experimental station.

The Bureau of Foreign and Domestic Commerce, in cooperation with the Bureau of Mines, has completed arrangements to produce in this country motion picture films showing methods of production and employment of American machinery and similar products. The actual cost of the photography, as well as the expenses incurred in the making of additional prints of the films, is borne by the cooperating company. After the picture has been completed and approved, the work of distributing the films, both in this country and abroad, is taken care of by the Bureau of Foreign and Domestic Commerce without any further expense to the company.

Further information in regard to radium in the Congo is quoted from the bulletin of the Belgian Chemical Society to the effect that the sample of minerals assayed by Professor Schoep of the University of Ghent yield 424 kg. of uranium and 139 mg. of radium to the ton. The minerals came from the Upper Katanga, in the concession of the Union Minière which has entrusted the industrial treatment of the uranium to the Belgian Société Générale Metallurgique de Hoboken, which has put up a factory for the purpose in the Antwerp district. Other deposits of the same minerals have been found at other points specified, and Professor Schoep has found two new kinds of minerals among them, extremely radioactive. He has named one "curite" and the other "kasolite," and announces that the crystals are soluble in nitric acid, and the radium salt can then be extracted from the fluid without passing through the usual calcination process.

Improvements of the wireless plant at the University of Iowa have increased the range of station 9YA to 1,000 miles under average conditions and 2,000 miles when conditions are favorable. The university is now broadcasting regular weekly programs under the direction of the extension division. Besides the regular programs all noteworthy happenings on the university schedule are broadcasted as they take place. Thus far nothing of a strictly educational nature has been attempted, the programs being arranged with entertainment rather than instruction in view.

Dr. Henry Norris Russell, professor of astronomy, Princeton University; Dr. Robert A. Millikan, of Chicago, head of the Norman Bridge Laboratory, California Institute of Technology; Mr. Charles W. Brown, professor of geology, Brown University, and Dr. Gilbert N. Lewis, professor of physics, University of California, have completed a series of lectures at Pomona College, covering recent advances in physical science. Their subjects were: "The evolution of the stars," "Modern atomic theories," "The energy, composition and structure of the earth," and "The chemistry of the stars."

The annual meeting of the Nebraska Academy of Science will be held at Nebraska Wesleyan University on April 21 and 22. On the evening of April 21 Dr. G. W. Stewart, of the University of Iowa will deliver an address on "Achievement in science." Weather permitting, this will be broadcasted by radio-phone. The annual address of the president, Professor J. C. Jensen, will be delivered at the general session on Saturday morning, the subject being "Recent research in atomic structure." In addition to a large number of papers, plans have been made for the showing of twelve reels of the finest scientific motion pictures available, and six or seven large manufacturers of scientific apparatus have agreed to send some of their latest models for exhibition.

At the regular meeting of the Biological Society of Washington, to be held on April 29, at 8 p.m., at the Cosmos Club, Washington, D. C., Dr. William E. Ritter, of the Scripps Institution for Biological Research, will address the society on "The usefulness and the peril of laboratory methods in biology."

UNIVERSITY AND EDUCATIONAL NOTES

McPherson College, McPherson, Kansas, is building a four story science hall modern in every way. The estimated cost is $160,000. It is expected to be completed by August.

A contract has been let for a new medical building at the University of Alabama, Tuscaloosa, at a cost of $82,000. Construction work will be started immediately.

The *Journal* of the American Medical Association states that the governor of Bengal laid the foundation stone of the new School of Tropical Medicine at Calcutta on February 14. The Indian government donated $195,000 for the site and will contribute toward the upkeep of the institution. Owing to the prevalence of tropical diseases in India, the work of the laboratory will be chiefly the investigation of causes of tropical diseases in an effort to discover more accurate methods of diagnosis and more advantageous process of treatment.

Stewart S. Bruce, formerly professor of metallurgy and ore dressing at the Michigan College of Mines, is temporarily filling the chair of metallurgy at the University of Idaho, Professor R. B. Elder having a leave of absence on account of illness.

The research chair of medical psychology in the University of Queensland, Brisbane, has been filled by the appointment of Dr. J. P. Lowson, university demonstrator in experimental psychology at the University of Cambridge.

DISCUSSION AND CORRESPONDENCE

OSBORN VERSUS BATESON ON EVOLUTION

Professor H. F. Osborn's challenge (this *Journal,* February 24, 1922) to Professor Bateson for his position on the evolution theory, ought to and probably will, make many a biologist gasp a little and wonder a good deal.

If one scans a bit thoughtfully the landscape of human life for the last few decades, he can hardly fail to see signs that the whole battle ground of evolution will have to be fought over again; this time not so much between scientists and theologians as among scientists themselves.

The purpose of this note is to put side-by-side two sentences, one from Bateson's Toronto address, the other from Osborn's challenge. Says Bateson: "Biological science has returned to its rightful place, investigation of the structure and properties of the concrete and visible world"; and Osborn: "If this opinion [Bateson's as to the failure of studies so far made to reveal the causes of the origin of species] is generally accepted as a fact or demonstrated truth, the way is open to search the causes of evolution along other lines of inquiry."

Of the many things that fairly beg to be said about both these sentences, this seems to me the most urgent: Why have biologists felt it so much more incumbent upon them to "search the causes" of the origin of the bodies which are subject matter of their science, than astronomers, and geographers and geologists have to search the causes of origin of the bodies they study?

Or, putting much the same question in another form: What would have been the effect on the sciences of astronomy, and geography, and geology, had their devotees given relatively as much time and energy to searching for causes as have evolutional biologists?

I doubt if any one acquainted however slightly with progress in the several domains mentioned would hesitate much for answers to these queries.

Undoubtedly those who investigate the heavenly bodies are interested, and deeply interested, in the causes which produced these bodies. And undoubtedly, too, all students of the earth want to discover the "causal factors" in earth production.

I venture here to be a trifle personal. Having been for years closely connected with investigations on the oceanography of the Pacific Ocean, I am greatly interested in oceanic causation. Indeed it would be a very great satisfaction could I contribute even indirectly and in the smallest way to discovering the causes of the Pacific Ocean.

But my oceanographic feeling has always been that "investigation of the structure and properties of the concrete and visible" greatest of oceans would be more fruitful than would search after the causes of it. Possibly I am wrong, but my guess is that the attitude of the great majority of modern astronomers, geographers, and geologists, toward their domains has resembled more my attitude toward oceanic evolution than my attitude toward biological evolution when, twenty years ago I supposed, as Professor Osborn seems still to suppose, that search for causes of this latter evolution is the supreme goal of biological study.

But I am mindful that there is a reason why biologists have been goaded to strain themselves more in search of originating causes in their domain than have other scientists in search of such causes in their domains. That reason is the historic circumstance that these other scientists have long since been relieved of danger from the germ of supernatural causation in their domains, while this germ still lingers in the biological domain.

The way by which biology may escape limbo in this matter, Bateson, along with a considerable number of naturalistic biologists, is apparently beginning to see. "Meanwhile," he says, "our faith in evolution stands unshaken."

What is the lesson, practical and theoretical, implied in such a declaration? What it is for Bateson of course I do not know. For myself it is this: *Let us stop trying to convince ourselves and others that we have discovered, or in a few minutes will discover, the causes of evolution, and devote our efforts to perceiving for ourselves and convincing others of the naturalness, through-and-through, of evolution.* In other words, *let us bestow much more time and energy upon the grounds of our faith in evolution as one of nature's grandest processes, than upon searching after, and speculating about, the causes of evolution.*

Wm. E. Ritter

University of California,
Scripps Institution for
Biological Research,
March 4, 1922

FURTHER CONSIDERATION OF THE SIZE OF VEIN-ISLETS OF LEAVES AS AN AGE-DETERMINANT

In a recent paper[1] regarding vein-islet measurements as a means of determining the age of the woody perennial upon which the leaves are borne, the use of fresh leaves under low magnification was criticised. The basis of the criticism was that different thicknesses of chlorophyll would affect the number of veinlets visible and thus affect the apparent size of the vein-islets. This of course, is true. The fact that it is true constitutes one of the important advantages of the method criticised and is an equally important objection to the *sole* use of the suggested method.

In my original paper it was pointed out that the palisade cells decreased in size with age as do all of the other kinds of cells in the leaf with the exception of the cells of the veinlets which increase somewhat in size. With increasing age both the lessening thickness of the chlorophyll-containing cells and the increasing size of the conducting cells will render the veinlets more conspicuous. The actual increase in the amount of conducting tissue in the leaf is emphasized by increased visibility. The use of fresh material under low magnification gives a morphological summation which the suggested method quite lacks and therefore I adopted it after a trial of both. In this case the method adapted to field use is the more precise, as an age-determiner.

As is well known, the venation of the leaf of any given species is affected by external agents. Different species respond to these factors in different ways. Since the size of the vein-islets is affected by these factors, a successful use of this method of age determination requires sufficient familiarity with the responses of the species used, to enable one to eliminate the differences not due to age. As soon as this is done the relation of the size of the vein-islets to age is clear.

Since the discovery that the "protoplasm" of plants was fundamentally the same as the "sarcode" of animals, the progress of physiology has been steadily toward a demonstration that in the essentials of composition and response the two are essentially alike. Any theory of senility which can not be applied to plant conditions is not a fundamental theory and can be disregarded. It is equally true that any characteristic so strongly marked as

[1] Ensign, M. R., Area of vein-islets in leaves of certain plants as an age determinant, *Jour. Bot.*, 8: 433, 1921.

is the process of senility in the animal can not be unrepresented in the plant world.

HARRIS M. BENEDICT

UNIVERSITY OF CINCINNATI

THE METRIC SYSTEM

REFERRING to the article, "Progress in Metric Standardization," by Professor Bingham in your impression for March 3, it seems impossible to make the metric party understand that while, in some applications, the adoption of the metric system is easy, in others it is supremely difficult. It has been shown repeatedly that the easiest of all units to change are those of capacity and that the easiest of all places in which to adopt the system is the scientific laboratory, and the metric argument is that, these changes being easy, therefore all others are easy, when the fact is that others are so difficult that they have not been brought about in any country in the world, the net result being a dual or mixed system to which the arguments advanced for the metric system have no application.

Your readers should obtain the recent Report of the National Industrial Conference Board on this subject, which is the result of an investigation that consumed a year and is the most exhaustive that has ever been made and which confirms *all* of our contentions. Moreover, the Report is signed, without reservation, by two members of the Council of the American Metric Association who, the facts being established, signed it because they could not do otherwise.

Within a year a committee of the Conjoint Board of Scientific Societies of Great Britain, representing forty-nine scientific societies, representing, in turn, every conceivable phase of scientific activity, have made a unanimous report recommending that the metric system be *not* adopted in Great Britain.

Moreover, these are but examples. During the past century seven investigations worthy of that name have been made in this country and Great Britain, the result of every one being adverse to the claims made for the system. The plain fact is that the metric party always lose when both sides are heard, the most recent example being at the late convention of the Chamber of Commerce of the United States of America.

The weakness of the metric party today lies in their refusal to read the anti metric case. Because of this, their representatives went before the Senate Committee on Manufactures during the past winter at Washington and repeated claims that were disproven twenty years ago. The case was thus made extremely easy for the opposition, as we had only to point out the facts in order to show not only that the metric party had no case, but also to discredit their witnesses as incompetent.

There is no better illustration of this failure to acquaint themselves with the facts than Professor Bingham's naive assumption that the opposition is composed of "a few gage manufacturers."

It is interesting to note that, after we have been assured for many years that the system is "universal" in Chemistry, you are now inaugurating a campaign to bring about its use by chemical manufacturers.

FREDERICK A. HALSEY,

COMMISSIONER OF THE AMERICAN INSTITUTE OF WEIGHTS AND MEASURES

THIS letter is suggested by Mr. Eugene C. Bingham's article on "Progress of Metric Standardization" in the March 3 number.

I am an ardent advocate of the metric system, and feel that one of the greatest difficulties in bringing it into general use has been our prolonged period of consideration, during which many of us have been really working with two systems, and have borne all the burdens which that condition imposes.

The Drug Trade and Pharmacy generally has probably gone as far in the change as any other commercial group, but if the system were made compulsory there would be a large number of changes, some requiring an act of Congress. For example, that requiring that certain medicines bear the content of certain drugs—Opium, in grains per fluid ounce.

For the transition period certain comparative tables will be necessary—a comparative table showing prices in dollars and cents per Avoirdupois pound or ounce equals dollars and cents per kilo or grams.

The Bureau of Standards recently advised me that they did not know of any such publication, yet it seems that this would be one of the first requirements for a commercial change, and if it were now provided, might clear the way for the next step. The willingness of certain chemical manufacturers and dealers to furnish goods in metric quantities, does not amount to very much—it is easily done, and has been done automatically since the demand appeared, but a few more practical suggestions with the necessary tools (such as conversion tables as above) would greatly smooth the way in the eyes of the average business man, who is probably accounted the greatest opponent of the change.

Henry Paul Busch

CONCERNING THE ARTICLE "A NEW GRAPHIC ANALYTIC METHOD

In an article entitled, "A New Graphic Analytic Method," in Science of October 7, 1921, Mr. R. von Huhn states a method of deriving the graph of a special case of a function of a function. Stated in more usual mathematical terms:

Given the curves that represent

$$y = kx + m,$$
$$z = hy + n,$$

the curve that represents the resulting equation

$$z = lx + q$$

is drawn.

Essentially the same method, in a far more general form, and in a more usual mathematical formulation has been given by several mathematicians. See the articles by E. H. Moore, "Cross-section paper as a mathematical instrument," in *The School Review*, May, 1906, and by A. Kempner, "Some hints on plotting graphs in analytic geometry," in *The American Mathematical Monthly*, Vol. XXIV, pp. 17-21, and, in particular, the more specific article by W. H. Roever, "Graphical constructions for a function of a function and for a function given by a pair of parametric equations," in "*The American Mathematical Monthly*, Vol. XXIII, pp. 330-333. E. R. Hedrick has suggested the modification of transferring points from one of the two like-named axes to the other by means of a 45° triangle and he has also emphasized the geometric interpretation of the operation as that of finding the projection on the plane xy of the intersection of the two cylindrical surfaces

$$F(x, y) = 0, \qquad \Phi(y, z) = 0$$

This perfectly general problem was well-known to mathematicians and hence the special case treated in the article mentioned above can not be regarded as novel.

Wm. H. Roever
E. R. Hedrick

Washington University

SPECIAL ARTICLES

THE PROPERTIES OF ELEMENTS AND SALTS AS RELATED TO THE DIMENSIONS OF ATOMS AND IONS[1]

(*An Application of Geometry to the Study of Inorganic Chemistry*)

Recently great interest has been aroused in connection with the determination of the dimensions of atoms and ions by various methods; particularly that of X-ray crystal analysis,—by Bragg, Landè, Hull, Davey, and others. Very recently Fajans and Grimm, and later Biltz and also Henglein have pointed out that there is a very simple linear relation between the volume of certain series of salts and the atomic volumes of their constituents. Six years ago Professor W. D. Harkins and the writer began work upon what are known as complex chemical compounds, such as ammines and hydrates, in an attempt to show *that a large number of the properties of these compounds, as well as those of simple salts, are very simply related to the sizes of the atoms, atomic groups, and ions, from which the salts are built.* This point of view has now been developed in considerable detail by the writer. *The simplicity of the relation is apparent when it is realized that for a number of groups in the periodic system of the most common elements, as many as 35 properties of their simple compounds have been found to be related in a linear way to the atomic and ionic volumes of*

[1] From an address presented at the University of Chicago in December, 1921, and to the Harvard-Technology Chemical Club in January, 1922.

their constituents, as will be shown later in detail.

The present paper will be limited to a consideration of these relationships in the case of the elements and simple compounds, and will indicate briefly some of the most interesting of a large number of cases which show the above simple relationship.

While the writer was working upon the more extended and general set of relations given in this letter, the above mentioned paper by Biltz appeared. In this he exhibited the volume relations which may be used as a basis for the general discussion. Biltz found that if the atomic volumes of certain of the noble gases (argon, krypton, and xenon) are plotted along one axis in a two dimensional plot, the atomic volumes of the three corresponding halogens give one straight line, the three alkalies another, the three members of group 4B another, and the three members of group 4A, a fourth straight line; while in all of the other groups there is a departure from linearity. It may be noted that the alkali and halogen groups on the one hand, and groups 4 A and B on the other, are equidistant from the group of the rare gases of the atmosphere in the periodic table of the elements as represented by Harkins and Hall. The facts found in this work are beautifully in accord with what might be expected from this particular model of the periodic system.

The relations found by the writer are much more general than those given in the preceding paragraph. *Thus it is found that if the atomic volumes of the five alkali elements are plotted on one axis* (as the X-axis) *of a three dimensional rectangular coordinate system the atomic volumes of the four halogens on the Z-axis, and the molecular volumes of the alkali halides on the Y-axis, practically all of the points (all except some of those for cæsium), lie quite nearly on a plane* $z = bx + cy + d$ *which passes nearly through the origin.* Thus the relationship is very much more simple than has heretofore been suspected.

It is even more remarkable that when instead of the molecular volumes of the salts, other properties are plotted on the Y-axis, it is found that *in a very large number of cases* the surface, while not a plane, is of the extremely simple form known as a *doubly ruled surface.* Commonly the surfaces found may be expressed by the equation $z = axy + bx + cy + d$. For the molecular volumes of the alkali halides, the following expression, in which z is the molecular volume, x the atomic volume of an alkali metal, and y the atomic volume of a halogen, holds rigorously: $z = .0074xy + .3655x + y - 9.07 = .00849xy + .3345x + .9442y - 7.49$.

Since it is difficult to present the characteristics of these remarkable doubly ruled surfaces in a very simple way, the discussion of the present paper will be given in terms of the projections of these surfaces on the various coordinate planes. Simply to present one example, the two dimensional plot for the halogens may be considered. If the atomic volumes of the four members of the halogen group, fluorine, chlorine, bromine, and iodine, are plotted along one axis of a plane rectangular coordinate system, and along the other any of a large number of properties of other groups of elements, of other properties of the halogens themselves, and of compounds in which they are substituents, perfectly linear relationships are found, for which simple equations may be derived and calculations made with which reputable experimental data agree quite accurately. Some of these properties linear to the *halogen atom dimensions* may be briefly enumerated as follows: atomic volumes, atomic radii, viscosities or boiling points of the rare gases; atomic volumes of the alkali metals and alternate members of group 4; *for the elementary halogens,* the molecular diameters, melting points, boiling points, critical temperatures, latent heats of fusion and vaporization, normal potentials, cubical coefficients of expansion, atomic frequencies, magnetic susceptibilities, cohesional dimensions, $\sqrt{a}$ and b of van der Waals' equation, and the heat of formation of ions from the elements; *for the hydrogen halides,* the molecular volumes and diameters, boiling points, melting points, critical temperatures, latent heat of vaporization and the energy of ionization; *for organic compounds,* the atomic volumes of the halogens in combination, the atomic refraction for the D

TABLE I.
Atomic and Ionic Radii ($\times 10^8$) for the Halogens.

	Bragg[2]	Davey[3]	Rankine[4]	Landé[5]	Grimm[5]	Schwendenwein[5]	Richards[6]	Henglein[7]
F^-		1.13			0.75	0.99		0.8525
Cl^-	1.06	1.56	1.27	1.60	0.95	1.232	1.40	1.00
Br^-	1.19	1.73	1.35	1.80	1.02	1.312	1.55	1.066
I^-	1.40	1.98	1.49	2.10	1.12	1.432	1.70	1.179

line, and the molecular volumes of numerous halogen-substituted compounds; *for salts,* the molecular volumes of practically all metal halides, the volume change in solution, the melting points, boiling points, latent heat of vaporization, heat of formation and specific compressibilities of the alkali halides and many others, the percentage contraction for halides of small cations, the distance between the centers of oppositely charged ions in crystals, and the radii of ionic halogens.

There are many interesting details of each item in the above enumeration of which space does not admit detailed consideration. For example the percentage contraction undergone when a salt is formed from the free elements, is found in this work to be related in a *fundamental* way to the *properties of the complex compound* formed from it. Thus when a nickel halide is formed by the union of nickel with any of the halogens (fluorine, chlorine, bromine, or iodine) the percentage contraction is the same (22.5 per cent.) in each of the four cases. In the case of the cobalt and cupric halides the magnitude of the contraction is not quite constant, but increases slightly from the fluoride to the iodide. The constancy of the percentage contraction is also found when any halogen is combined in turn with the alkali metals (lithium, sodium, potassium, and rubidium). The contraction amounts to 60 per cent. each for the four fluorides, 43 per cent. each for the four chlorides, 38 per cent. each for the four bromides, and 30 per cent. for the four iodides. It is seen that the relative contraction decreases with increasing number of non-nuclear electrons in the halogen atom. The contraction for the cæsium halides is greater than that given above for the other alkali halides. However in the oxy-acid salts cæsium shows the same contraction as the other salts of the alkalis, and in *molten halides* it is also *perfectly normal* as indicated by the careful researches of Jaeger. The anomaly of cæsium is therefore to be attributed to difference in crystal form. As a matter of fact cæsium halides possess cube-centered lattices, while all other alkali halides are simple cubic.

The ionic radii can be derived from experimentally determined crystal distances only by means of some assumption. The following table shows the widely varying values, multiplied by 10^8, which have been presented by eight workers.

It is a *singular fact that in spite of the wide discrepancies all of the values except those of Richards are quite accurately linearly related to the atomic volumes of the halogens at the boiling point,* showing that whatever basis of calculation may be the closely similar halogens are still related to each other in relatively the same way. Richards' values are calculated from the atomic volumes of chlorine, bromine and iodine at 25° where the three values are practically coincident, and this may explain the deviations in this case. However the *third powers* of the radii values, as direct functions of the volumes of single combined atoms, are found to be linearly related to gram-atomic volumes. This is apparently of greater signifi-

[2] From close-packing in crystals.

[3] From equality in size of ions with same number of external electrons: $K^+ = Cl^-$, $Rb^+ = Br^-$, $Cs^+ = I^-$.

[4] From viscosity of gaseous halogens, hence radii of atoms.

[5] From various aspects of Bohr theory. Represents actual distance from nucleus to outermost electron orbit.

[6] From extrapolation of compressibility-contraction curve to zero compressibility.

[7] From empirical considerations of linearity to molecular volumes, *Zeit. anorg. allgem. Chem.,* 120: 77 (December 14, 1921).

TABLE II
Atomic and Ionic Radii ($\times 10^8$) of the Alkali Elements[10]

	Bragg	Davey	Landè	Grimm	Schwen-den-wein	Richards			Saha[9]	Heng-lein
						Chlo-ride	Bro-mide	Iodide		
Li	1.50	0.98	0.88		0.50	1.15	1.20	1.30	1.34	1.00
Na	1.75	1.25	1.15	0.52	0.65	1.45	1.45	1.55	1.41	1.428
K	2.10	1.56	1.45	0.79	0.948	1.75	1.75	1.85	1.67	2.108
Rb	2.25	1.73	1.60	0.91	1.128	1.90	1.90	1.95	1.73	2.478
Cs	2.35	1.78	1.60	1.01	1.32	1.90	1.85	1.90	1.86	

cance that the chance linearity of *first powers.* The most recent values are those of Henglein, whose procedure is very questionable inasmuch as he takes Fajans' values for bromide and iodide ions and then *assigns values* to chloride and fluoride so that a straight line connects the molecular volumes of the halides of any alkali metal and the sizes of the substituent halogen ion. By using the same process for determining the sizes of the alkali ions it is of course possible at once to write an equation by which the molecular volumes may be calculated from the *constant size* of the ion. Henglein quite naturally observes a very good agreement between calculated and experimental values.

Table I indicates the definite progression in size and properties from one member to the next in such nearly perfect[8] families (or groups) of elements as the halogens and the alkalies.

It is interesting in this connection to compare the radius of the ammonium ion. Using the distance between ion centers found by Bartlett and Langmuir for the ammonium halides, and subtracting the radii of the halogen ions, the ammonium ion is found to have a radius of 1.90×10^{-8} cm., if Richards' values are used, or 1.76×10^{-8} with Davey's. In either case this is also the radius of the rubidium ion. That this equality is extended to the molecular volumes and other properties of both simple and complex ammonium and rubidium salts may be shown by numerous examples.

From the above considerations it is at once apparent that, by plotting the various properties of the halogens, *both free and combined,* which are linear to the dimensions of the halogens, a large number of possible new linear relationships may be predicted. It has never before been possible to ascribe such perfect and simple constancy and dependency of essentially all properties upon one fundamental variable of matter. The definite increase in size in passing from fluorine to chlorine to bromine to iodine atoms is paralleled in a linear fashion not only by all dimensions of the atom free or in combination, neutral or charged, but by practically every measurable property. That this extends even to variations in the electromagnetic stray fields which determine the strength of secondary valence forces and complex salt formation, will be indicated in a following paper.

Exactly as has been done with the halogens, the various properties of the alkali metals, free and combined, may be related. The ionic radii have been variously calculated as follows: These values (with the exception of those of

[8] According to the periodic table of Harkins and Hall the two groups of elements nearest the group of rare gases, that is the alkali and halogen groups, should be the ones in which linear relations may be expected to hold for practically all of the elements in the group. Such groups may be designated as "perfect." In this sense groups 2 to 6 inclusive are imperfect, since a considerable break in properties occurs between the second and third elements in each of these groups.

[9] From ionization potentials.

[10] Other values are those of Born from heats of hydration, Pleyer-Wegau from diffusion of metals in mercury, Stokes-Born from ion mobilities, Gunther-Schulze from volume changes in permutites and from polarization capacities, and Heydweiller from ion refraction.

Richards) are related in a linear way to many of the properties of the elements and their salts.

From the average of the most logical values of the effective radii of atoms and ions of the alkali metals and the halogens it is found that the space functions of the third powers of the radii are as follows: for halogen ions, φ_0 (ratio of cube of radii $\times$ 6.063 $\times$ 10^{23} to gram-ionic volume) = .44; for halogen atoms, φ_0 = .25 (agreeing with van der Waal's postulate); for alkali ions, φ_0 = .25; and for alkali atoms, φ_0 = .52. In other words the volume of the halogen ion is roughly 44-25 that of the atom, and the alkali ion 25-52 of the corresponding atom. Upon this simple basis the molecular volumes of the alkali halides are found to be dependent as $3.35 \times 10^{24}(r^3_{\text{hal·ion}} + 1.76r^3_{\text{alk·ion}})$.

Finally there are many linear relationships to be found among the other elements: *e. g.,* the molecular volumes of the cuprous, silver and thallous halides and the *stability of the triammines* of these halides, to the atomic volumes or ionic sizes of cuprous copper, silver and thallium; the atomic volumes of calcium, strontium and barium (in some cases also lead), to the molecular volumes of practically any alkaline earth salt, or the stability of the hexammines of the metals (*e. g.,* Ca. 6 NH_3) to the ionic sizes of the alkaline earths; the molecular volumes of various sulfides, selenides and tellurides to the size of sulfide, selenide and telluride ions; the molecular volumes of the oxides to the atomic volumes of titanium, zirconium and cerium; and numerous linear relationships between the molecular volumes, stability, percentage contraction and heats of dissociation of complex compounds and the molecular, atomic and ionic dimensions of the constituents of the whole complex molecule. These will be considered in a separate paper.

The general method of representing the properties of salts as functions of the dimensions of their constituent ions (or of the atomic volumes of the constituent elements) is of such fundamental importance that an extensive study of the characteristics of these surfaces is now being made in collaboration with Professor A. C. Lunn and Professor W. D. Harkins of this university. As has been stated some of these *surfaces* are *planes,* while most of the others are *doubly* ruled.

George L. Clark
University of Chicago,
February 3

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION L (1) HISTORY OF SCIENCE

The History of Science section was organized on a temporary basis at the Chicago meeting of the American Association for the Advancement of Science, December, 1920. At the Toronto meeting, December, 1921, it was formally organized, and recognized by the Council of the American Association for the Advancement of Science as a sub-section in Section L (Historical and Philological)

This step now assures the future of the History of Science movement in the United States. The movement has been growing steadily, not alone in active interest and research by various scholars, but by the fact that our colleges, universities and technical schools are taking cognizance of its place in the curriculum of science and technology.

If we are, at all, to enter a new epoch of science teaching, and give more emphasis to the humanistic element in our sciences, it is evidently time now to consider the matter. Science, that which we love to call pure science, has been too long dominated by the ulterior motive of materialism.

The fact that the American Association for the Advancement of Science has recognized the value and purpose of History of Science, and accorded it a place in its comprehensive activities, indicates a step forward, not alone in the "Association" progress, but in science, and in educational methods as well.

A movement that can be fostered by two large and widely different organizations, such as the American Historical Association and the American Association for the Advancement of Science, is doubly assured of success and future stability, in relation to other intellectual movements.

The Toronto meeting was in charge of a local committee, Dr. J. Playfair McMurrich and Dr. G. S. Brett, appointed by Dr. Burton E. Livingston, permanent secretary. To this committee great credit is due for the courtesies shown, in the matter of room selection and accommodations, lanterns, etc.

The program committee adhered to the policy adopted last year, by extending invitations to representative scholars to present papers, each paper illustrative of research in the field of some particular historical problem—technical and cultural.

The meeting was called to order by Dr. William A. Locy, chairman of the interim committee, Dr. Walter Libby acting as secretary *pro tempore*. The first paper on the program, "Leonardo da Vinci—Artist or Anatomist?" was given by Dr. J. Playfair McMurrich, of the department of anatomy, University of Toronto. Dr. McMurrich proved by reference to Leonardo's masters that Leonardo's initial interest in anatomy was that of the scientific artist. In discussing the address of Dr. McMurrich it was suggested that there was an analogy between the relation of Leonardo to the science of anatomy and the relation of Shakespeare to the science of psychology. In answer to a question, Dr. McMurrich expressed the view that Leonardo did not anticipate Harvey's discovery of the circulation of the blood. Continuing, Dr. McMurrich further remarked:

"Attention was called to the rapid improvement in anatomical illustration in the first half of the sixteenth century after a prolonged reign of crude conventionalism, and the attempt was made to connect this with the art renaissance which preceded that of science. The endeavors of the artists of the Renaissance to delineate accurately the human form led to better standards of observation, without which accurate drawing was impossible, and this reacted on the anatomists.

The great interest of the fifteenth century artists such as Pollajuolo, Verrocchio and Michelangelo in anatomy was noted and it was pointed out how great was the probability that Leonardo received his initiation into anatomical studies during his apprenticeship to Verrocchio. He approached anatomy from the standpoint of the artist, but his genius quickly led him to inquiries into the conditions underlying and determining surface form, and the artist became an anatomist.

The second paper was by Dr. Walter Libby, of the University of Pittsburgh, "History as the Record of Human Possessions." Dr. Libby pointed out the value of taking stock of the paraphernalia of civilization—such as metals, buildings, books, musical instruments, machines —in the succeeding historical epochs. A study of cultural equipment enables one to view the history of the race as a progressive development. The Greeks passed from barbarism to the highest civilization when they came in contact with the cultured accumulations of the Egyptians, Babylonians and Cretans. Similarly, the Arabs ceased to be a rude, uncivilized people only when they gained possession of the books, buildings, etc., of the Mediterranean basin and of Mesopotamia.

Dr. William A. Locy, Northwestern University, followed with the third paper entitled "The *Hortus Sanitatis* (1491) and Related Books." Dr. Locy's address was splendidly illustrated. He not only used the lantern to show pictures of plants and animals taken from the *Hortus Sanitatis* of 1491 and similar works, but he displayed photostat reproductions of selected pages of this famous work.

"The *Hortus Sanitatis* is a famous knowledge book on natural history and popular medicine, printed for the first time in 1491 and in many editions thereafter. It was widely circulated and of immense popularity. It appeared in that interesting period of intellectual development just preceding the full bloom of the Renaissance and it throws light upon the rebirth of the scientific attitude of mind. Representing a phase in the struggle of the human spirit to get away from the mystical and subjective method of thinking, which had prevailed for centuries, it is an important human document and is not to be looked on as merely a curiosity of antiquarian interest. A mental revolution was coming on, destined in the following half-century to establish observation in place of dependence on authority as a method of advancing knowledge, and books like the *Hortus Sanitatis* were harbingers of this revolution.

"Other related books such as the *Book of*

Nature, printed in 1475, and the *Garten der Gesundheit,* especially since the *Garten der Gesundheit* of 1485 is of higher quality, and some of its illustrations represent the earliest printed pictures of animals and plants drawn from nature. The publication of these sketches in 1485 'forms an important landmark in the history of botanical illustration, and marks perhaps the greatest single step ever made in that art.' They were unequaled until the publication of the herbals of Brunfels and of Fuchs half a century later. The *Hortus Sanitatis* was more widely distributed, and since it was a larger and later production, generally it has been assumed that it contained the best pictures of the period—but this is wrong. The much rarer *Garten der Gesundheit* of 1485 (often confused with the *Hortus Sanitatis*) is the only member of that family of books which has excellent pictures drawn from nature.

"As a publisher's venture in the early days of printing, the preface of the *Hortus Sanitatis* contains a clever appeal to the commercial instinct, saying, that by help of the information contained in the book, people 'with quite small expense to themselves will be able to compound helpful remedies and perfect medicines' without the necessity of doctors and apothecaries. Another feature of the book, however, had greater influence on the thought of the time: through its 1,066 pictures and descriptions attention was directed to the productions of nature and information was spread regarding plants, animals and minerals. Almost the whole structure of modern science rests on such humble beginnings."

Dr. G. S. Brett, of the department of philosophy, University of Toronto, presented an unusually interesting paper in that it gives the philosopher's point of view in the history of science, "The Theory of History in Relation to the History of Science." Dr. Brett also discussed the idea of the history of science and the difficulties that lie in the way of making history of science a branch of academic instruction.

This paper was presented as a contribution to the problems of method. Reference was made to the status of the Section and to recent discussions on the subject, especially to the paper by Professor E. H. Johnson, contributed to Science December 16, 1921. The writer argues that the difficulty of finding a place for history of science in a curriculum was partly due to a want of clear ideas on the nature of the subject. This point was further explained by a sketch of the development of historiography, which was shown to be dependent on a variety of interests. The early tendency to comprehensive records gave place to a more restricted aim which virtually made history equivalent to political annals. The idea of progress brought to light the idea of continuous historical development, and led to a philosophy of history which attempted to organize the facts as proof of the theory. This failed because the actual historical sequence did not conform to the theories, as for example the attempts of the Romantic school to demonstrate a rational solution. After tracing the tendency in modern historical work to break new ground in the history of literature, the history of general types, such as "federation" or "liberty," and even the "history of historians," the writer argued that a specified type of history was required for the history of science. In its essential feature, this would not be identical with biographical work on men of science, or with the type of work which naturally forms the background of any particular study. While monographs on these subjects are indispensable preliminaries, a good history of science must coordinate the achievements with the total conditions, social and intellectual, which culminate in them. It was argued that in this field there is a unique opportunity for studying the cumulative growth of culture, and for exhibiting the way in which ideas persist and are transformed. The lack of a sufficient literature, neither sporadic nor biased by national interests nor disproportionate in the treatment of topics, makes the subject difficult to teach. It was also the best proof that the nature of the subject was not properly understood.

In the absence of the next speaker and the secretary, the following paper was read by title only: "Historical Basis for the Scientific Stagnation of the Middle Ages," by Dr. Harry E. Barnes, of the department of the history of thought and culture, Clark University, Worcester, Massachusetts.

Dr. Louis C. Karpinski, University of Michigan, reminded the Historical Section of the centennial of Hermann von Helmholtz. He presented in brief, but most interestingly, the great German's place in the history of science.

"The history of science concerns itself with the historical and logical sequence of scientific concepts. The process of development by which man arrives at fundamental laws of the universe in which we live is a vital study, having great possibilities for furthering the advance of science. Studies in this field have shown that the part of particular individuals, even men of great genius, is much less than is commonly supposed. The genius is that fortunate individual who arrives upon the scene when the accumulation of observations enables the formulation of some general law for whose reception and acceptance the way has been prepared.

"Obviously only few men can be successful in attaching their names to fundamental laws. Prominent in the group is Hermann von Helmholtz, who in 1847 at the age of 26 gave a complete statement of the laws of the conservation of energy. Were one to attempt to characterize in a few words his extraordinary range of researches, one would say that Helmholtz brought biological and physical problems under the dominion of mathematical formulas and methods."

Dr. Karpinski further states, "In a centennial recognition of a life of such great significance for mankind, the purpose is both historical and inspirational," and shows further the historical contribution of Helmholtz to civilization by a detailed characterization of his life.

"Towards the end of his life in 1894, the great German was working upon the similar but more inclusive 'principle of least action' which he hoped to extend mathematically so as to apply to all forces of nature. Helmholtz, it should be noted, resolutely set himself against any commercialism or financial exploitation of his researches. His words on this subject are worthy of serious consideration to-day in every great American university, where in some departments a tendency exists to mix devotion to science and learning with devotion to private interest. Helmholtz says: 'Whoever, in the pursuit of science, seeks after immediate practical utility, may generally rest assured that he will seek in vain. We must rest satisfied with the consciousness that he too has contributed something to the increasing fund of knowledge in which the dominion of man over all forces hostile to intelligence reposes.'" (For the complete paper see *Scientific Monthly*, July, 1921).

Following Dr. Karpinski's paper, the election of officers was held, resulting in the selection as given:

For Vice-president: Dr. Wm. A. Locy, Northwestern University.

For Secretary: Frederick E. Brasch, James Jerome Hill Library, St. Paul.

For Sectional Committee: Dr. Walter Libby, University of Pittsburgh; Dr. Florian Cajori, University of California; Dr. George Sarton, Carnegie Institution; Dr. Louis C. Karpinski, University of Michigan.

In addition to the officers elected, the chairman (Dr. Locy) appointed a committee consisting of Dr. Lawrence J. Henderson, Harvard University, Dr. Walter Libby, University of Pittsburgh, and Dr. G. S. Brett, University of Toronto, to approach the representative of the *Encyclopedia Brittanica* with an offer of cooperation in revising the parts of that reference book that relate to the history of science. Dr. Libby is chairman of this committee.

The next meeting of the History of Science Section will be held in Boston, December, 1922. Plans are therefore being devised for a larger and more effective meeting. In fact, in view of the American Historical Association meeting in New Haven, December, 1922, there is every reason to suppose a joint session would prove most profitable. This occasion ought to prove unique, as it is extraordinary for a given subject to be considered by a scientific and a historical association at the same time.

For the splendid notes and the courtesy in acting as secretary *pro tempore*, the secretary wishes to acknowledge his indebtedness to Dr. Libby.

Frederick E. Brasch,
Secretary

James Jerome Hill Library,
St. Paul

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

REPORT OF THE SECRETARY OF THE COMMITTEE ON GRANTS FOR RESEARCH

To the Executive Committee of the Council, American Association for the Advancement of Science.

Gentlemen:

In accordance with your request I submit the following report of the Committee on Grants for Research, this being a summary of the activities of the committee during the five years since its organization.

By the settlement of the Colburn estate in 1916 the association received cash and securities valued at about $76,000, bequeathed by Richard T. Colburn, a fellow of the association, the income of which is to be devoted "to original research in the physical and psychic demonstrable sciences." The association had accumulated a fund of about $25,000, mainly from the fees of fellows, life members, and members. The income from these funds being available for grants for research, the sum of $4,000 was, at the New York meeting of the association, on the recommendation of the treasurer, set aside for this purpose by the council, to be expended during the year 1917.

At the same time a Committee on Grants for Research was appointed, consisting of seven members under the chairmanship of Edward C. Pickering. These members, as well as their successors, were chosen so as to represent as far as possible the different sections of the association. At the meeting of the association in December, 1918, the committee was enlarged to include nine members, while a year later, with the adoption of the new constitution of the association, the number was changed to eight, the term of each member to be four years, with the arrangement of rotation so that two members should be succeeded by new appointees each year. In 1920 the executive committee of the council voted that the Committee on Grants should thereafter elect its chairman and secretary.

Following is a list of persons who have served as members of the Committee on Grants, with the inclusive years of their respective terms:

Edward C. Pickering	1917-1918
E. C. Franklin	1917-1919
N. L. Britton	1917-1919
J. McKeen Cattell	1917-1919
W. B. Cannon	1917-1920
R. T. Chamberlin	1917-1920
Henry Crew	1917-1921
Louis I. Dublin	1919-1919
G. N. Lewis	1919-1921
G. H. Parker	1919-1921
Joel Stebbins	1919-1921
George T. Moore	1920-1923
Robert M. Yerkes	1920-1923
Arthur B. Lamb	1921-1922
C. Judson Herrick	1921-1924
David White	1921-1924

The chairmen of the Committee on Grants have been Edward C. Pickering (1917-1918), Henry Crew (1919-1920), and Robert M. Yerkes (1921-); and the secretaries, J. McKeen Cattell (1917-1918), and Joel Stebbins (1919-1921).

The committee has held its meetings annually, at first in Washington during the month of April, but recently in December in connection with the meetings of the association. Although the members are widely separated geographically, it has been possible to get enough of them together once a year to have an intelligent discussion of the business of the committee. Experience has shown that while a good deal of preparation can be carried on by correspondence, the final decisions and the apportionment of money for grants can be made satisfactorily only with the personal exchange of views at a meeting.

From the beginning it has been the policy of the committee to apportion the annually available amount as a number of small grants to individuals; in fact, with a total of about four thousand dollars each year, to cover all the sciences, there was no other choice than to apportion a number of small sums. Although other methods of procedure have been suggested, the council of the association has formally approved the policy of the committee in assigning miscellaneous grants to individuals, without undertaking to support specific lines of investigation which might stand as projects of the committee alone.

At the time of its organization the committee adopted a number of rules for its own guidance and for the information of those to whom grants are made. These rules, adopted in April, 1917, are as follows:

1. Application for grants may be made to the member of the committee representing the science in which the work falls, or to the chairman or secretary of the committee. The committee will not depend upon applications, but will make inquiry as to the way in which research funds can be best expended to promote the advance of science. In such inquiry, the committee hopes to have the cooperation of scientific men and especially of the sectional committees of the association.

2. The committee will meet at the time of the annual meeting of the association or on the call of the chairman. Business may be transacted and grants may be made by correspondence. In such cases the rules of procedure formulated by the late Professor Pickering and printed in the issue of Science for May 23, 1913, will be followed.

3. Grants may be made to residents of any country, but preference will be given to residents of America.

4. Grants of sums of $500 or less are favored, but larger appropriations may be made. In some cases appropriations may be guaranteed for several years in advance.

5. Grants as a rule will be made for work which could not be done or would be very difficult to do without the grant. A grant will not ordinarily be made to defray living expenses.

6. The committee will not undertake to supervise in any way the work done by those who receive the grants. Unless otherwise provided, any apparatus or materials purchased will be the property of the individual receiving the grant.

7. No restriction is made as to publication, but the recipient of the grant should in the publication of his work acknowledge the aid given by the fund.

8. The recipient of the grant is expected to make to the secretary of the committee a report

in December of each year while the work is in progress, and a final report when the work is completed and published. Each report should be accompanied by a financial statement of expenditures, with vouchers for the larger items when these can be supplied without difficulty.

9. The purposes for which grants are made and the grounds for making them will be published.

At least once each year announcement is made in Science inviting applications and suggestions for grants. Although this procedure naturally results in the receipt of a considerable number of requests for support of work which is trivial or scientifically unsound, it is also true that members of the committee have in this way learned of various places where small expenditures would produce valuable results, both by direct aid to struggling investigators and by bringing to the attention of authorities of institutions the importance of some of the work which is being carried on by members of their staffs.

Each person who accepts a grant signs an agreement to the following conditions:

(1) The work as outlined will be begun in the near future and efforts will be made to complete it at as early a date as possible.

(2) A report will be made to the secretary of the committee on the completion and publication of the work, and in December of each year until the work is completed. The reports will include a financial statement with vouchers for the larger items.

(3) In the publication of the results the grant from the research fund of the American Association for the Advancement of Science will be acknowledged.

Shortly before December 1 of each year the secretary of the committee sends out a reminder to each recipient of a grant that a report is due, and a list of these reports is kept in the files of the committee. By a vote of the committee the account of each grant is kept open until it is formally closed by action of the chairman, secretary, and member of the committee in whose field the grant lies. Every grant is thus followed up until the work is completed and published.

As the committee was organized just prior to the entrance of the United States into the war, there was considerable delay at first, during 1917 and 1918, in getting the work of the different grants started. In fact, some of the assignments were returned because the work was postponed on account of the war, and other investigations have not yet been brought to conclusion for the same reason.

In the following table is given a summary of the grants that have been made during the past five years together with a summary of the present state of the accounts, and there is given as an addendum to this report a detailed list of the different grants which have been made:

Year	Amount apportioned	Number of Grants	No. of Grants for Which Work is Completed	No. of Grants for Which Work is Completed and Published	No. of Papers Published
1917	$ 2,350	14	9	6	10
1918	2,900	9	6	5	12
1919	4,000	16	9	5	12
1920	4,500	19	9	4	3
1921	5,000	24	3	2	2
Totals	$18,750	82	36	22	39

Most scientific men will no doubt agree that the only test as to whether or not a given investigation is successful, is the actual publication of the results. The last column in the foregoing table shows how many papers have thus far been published as wholly or in part due to grants from the association for the corresponding year. In the second addendum to this report is given a bibliography of these papers. This list is growing rapidly, and as time goes on it will present a real measure of the success of the work of the committee and of the policy of the association.

Respectfully submitted,

Joel Stebbins,
Secretary, Committee on Grants
University of Illinois,
December, 22, 1921

First Addendum

List of Appropriations Made by the Committee on Grants, 1917-1921

1917

1. Ralph C. Benedict, Brooklyn, New York. Botany. For the continuation of the investigation on the Boston fern.......... $100
2. R. S. Woodworth, Columbia University. Psychology. For compiling anthropometric data.......... 100

3. F. C. Blake, Ohio State University, Physics. In aid of his work on electric waves 100
4. Richard C. Tolman, Fixed Nitrogen Research Laboratory, Washington, D. . Physics. For further testing and extending his work n the electromotive force produced in a conductor subjected to mechanical acceleration........ 300
5. H. L. Fairchild, University of Rochester. Geology. To defray traveling expenses in a study of the post-glacial land uplift in New England and the maritime provinces of Canada........ 300
6. S. W. Williston, University of Chicago, Geology. Toward the expenses of an artist to help draw the figures of the many new Permian fossil vertebrates which Dr. Williston discovered........ 100
7. Ralph W. Chaney, State University of Iowa. Geology. Toward field expenses of further studies upon the Eagle Creek flora of the Columbia River gorge........ 100
8. Frederick P. Gay, University of California. Pathology. For animals and materials to be used in the study of the specific treatment of tuberculosis in animals, especially in the use of taurine derived from the muscles of certain shell fish........ 500
9. John B. Watson, Johns Hopkins University. Psychology. Toward the study of the development of the reflexes and instincts of infants........ 100
10. Robert M. Yerkes, Harvard University. Psychology. Toward the cost of apparatus and care of animals in the study of ideational behavior. (Returned) 100
11. Ales Hrdlička, U. S. National Museum. Anthropology. For anthropometrical investigations on the tribe of Shawnee in Oklahoma........ 100
12 Bruno Oetteking, Museum of the American Indian, New York. Anthropology. For the purpose of completing the investigation of skeletal material from the Pacific coast of America 100
13. Herbert M. Richards, Barnard College. Botany. For the continuation of the investigation of the physiology of succulent plants........ 250
14. C. H. Kauffman, University of Michigan. Botany. To aid in his studies of the fungus genus *Cortinarius*........ 100

1918

15. American Association of Variable Star Observers. Astronomy. For the purchase of a telescope of 5-inch aperture 300
16. A. E. Douglass, University of Arizona. Botany. For determining the record of the Sequoias........ 250
17. C. H. Eigenmann, Indiana University, Zoology. For the study of the fresh water fishes of South America........ 500
18. Edwin B. Frost, Yerkes Observatory. Astronomy. For the measurement and reduction of stellar spectrograms........ 500
19. R. A. Porter, Syracuse University. Physics. For the explanation of the hysteresis which has been observed in the potential gradients of the calcium-cathode vacuum tube........ 200
20. E. W. Sinnott, Connecticut Agricultural College. Botany. For experiments to determine the ratio between root, stem, leaf and fruit in the bean plant 200
21. O. F. Stafford, University of Oregon. Chemistry. For research on the distillation of wood 500
22. Herman L. Fairchild, University of Rochester. Geology. For the continuation and completion of his studies on the post-glacial continental uplift in New England and the maritime provinces of Canada. (Additional)........ 200
23. Seismological Society of America. Geology. To enable the society to dispatch capable men to study the phenomena of earthquakes as promptly as possible after their occurrence........ 250

1919

24. Edwin B. Frost, Yerkes Observatory. Astronomy. For the measurement and reduction of stellar spectrograms. (Additional) 500
25. A. L. Foley, Indiana University. Physics. For experiments on the speed of sound very close to the source........ 150
26. Orin Tugman, University of Utah. Physics. To determine the change of conductivity in a thin metallic film when exposed to ultra-violet light........ 100

27. E. M. Terry, University of Wisconsin. Physics. For work on the modulation of radio-energy employed in wireless telephony........ 150
28. F. C. Blake, Ohio State University. Physics. In aid of his work on electric waves. (Additional)........ 100
29. Gerald L. Wendt, University of Chicago. Chemistry. For the investigation of the photo-chemical reactions of hydrogen and chlorine........ 350
30. Seismological Society of America. Geology. For the investigation of earthquake phenomena. (Additional)........ 250
31. Roy L. Moodie, College of Medicine, University of Illinois. Geology. For the preparation of sections of fossil bones which show lesions of ancient disease, and for the making of photomicrographs of these sections........ 200
32. C. H. Eigenmann, Indiana University, Zoology. To defray part of the expenses of the Irwin expedition to western South America. (Additional)........ 500
33. P. W. Whiting, St. Stephens College. Zoology. For investigations on the Mediterranean flour-moth and its hymenopterous parasite, *Hadrobracon* 200
34. *Botanical Abstracts*. Botany. For aid in establishing this new and important periodical 500
35. Gilbert M. Smith, University of Wisconsin. Botany. For aid in a study of the plankton of the lakes of southwestern Ontario........ 100
36. Ales Hrdlička U. S. National Museum. Anthropology. For *The Amerian Journal of Physical Anthropology*........ 200
37. Myra M. Hulst, Washington, D. C. Social Science. For investigations into the mortality of graduates from American colleges for women........ 200
38. Leslie B. Arey, Northwestern University Medical School. Medicine. In support of his study of the origin, growth and fate of the giant cells, or osteoclasts, usually held responsible for bone dissolution........ 400
39. S. A. Courtis, Detroit, Michigan. Education. Toward the expenses of securing a comparison based upon a survey of Boston schools in 1845 with present-day schools from Maine to California 100
40. Solomon Lefschetz, University of Kansas. Mathematics. To assist in the publication of his memoir on algebraic surfaces, which was awarded the Bordin prize of the Paris Academy of Sciences 300
41. Olive C. Hazlett, Mount Holyoke College. Mathematics. In support of her work on the theory of hypercomplex numbers and invariants........ 100
42. A. A. Knowlton, Reed College. Physics. In aid of a determination of the relation between chemical composition and magnetic properties in Heusler alloys 200
43. John C. Shedd, Occidental College. Physics. In aid of a further study of snow crystals, similar to that which he has already published........ 100
44. Philip Fox, Dearborn Observatory. Astronomy. In support of his work on the photographic determination of stellar parallaxes........ 600
45. Anne S. Young, Mount Holyoke College. Astronomy. For the determination of the positions and proper motions of stars from photographic plates already taken 100
46. Ferdinand Canu, Versailles, France. Geology. To carry forward completion his studies upon the classification of bryozoa 250
47. Frank B. Taylor, Fort Wayne, Indiana. Geology. For a field study of the moraines of recession in the St. Lawrence Valley 250
48. S. I. Kornhauser, Denison University. Zoology. For a continuation of his work on the sexual characteristics of the membracid insect *Thelia bimaculata* 250
49. P. W. Whiting, St. Stephens College. Zoology. For breeding outfit and temperature apparatus to be used for genetic and cytological researches on *Ephestia* and *Hadrobracon*........ 200
50. *Botanical Abstacts*. Botany. For editorial and office expenses in connection with the preparation of manuscripts. (Additional) 500
51. I. W. Bailey, Bussey Institution. Botany. For an investigation upon: (1) Myrmecophytism; (2) Relations between ants and fungi; (3) Cytology of the cambium 500

52. S. D. Robbins, Boston, Massachusetts. Psychology. For a study of a trephined stammerer 100
53. Daniel W. LaRue, Stroudsburg State Normal School, Pennsylvania. Education. In support of experimental work on a phonetic alphabet 200
54. Margaret F. Washburn, Vassar College. Psychology. For a study of emotional characteristics of certain racial groups in New York City 200
55. Joseph Peterson, George Peabody College for Teachers. Psychology. In support of a study of the qualitative differences in the mentality of whites and negroes 200
56. A. A. Schaeffer, University of Tennessee. Psychology. In support of an experimental study of orientation and the direction of movement of animals, and particularly of th ''spiral path'' in man 200
57. Theodore Hough, University of Virginia. Physiology. In support of his studies with Dr. J. A. Waddell on blood changes after severe hemorrhages. (Returned) 100
58. Carl J. Wiggers, Western Reserve University. Physiology. In support of his investigations of the cardiac function by optical registration 150

1921

59. Solomon Lefschetz, University of Kansas. Mathematics. In support of his work in algebraic geometry 150
60. Gerald L. Wendt, University of Chicago. Chemistry. For the purchase of apparatus for investigations at high temperatures. (Additional) 200
61. Graham Edgar, University of Virginia. Chemistry. For the purchase of a quartz mercury arc lamp for research in photo-chemistry 200
62. Sebastian Albrecht, Dudley Observatory. Astronomy. In support of his investigation of the variation of wave-length of lines in different types of stellar spectra 200
63. Caroline E. Furness, Vassar College Observatory. Astronomy. For assistance in the measurement and reduction of photographic plates 200
64. Frank B. Taylor, Fort Wayne, Indiana. Geology. For a field study of the moraines of recession in the St. Lawrence Valley. (Additional) 300
65. Seismological Society of America. Geology. For the investigation of earthquake phenomena. (Additional) 200
66. P. W. Whiting, St. Stephens College. Zoology. To add to his microscopic equipment for the study of genetics in insects. (Additional) 200
67. N. A. Cobb, Falls Church, Virginia. Zoology. For aid in a series of researches into the physiology of the cell, or to defray cost of publication of results already on hand 450
68. George B. Rigg, University of Washington. Botany. For work on the sphagnum bogs of the Puget Sound region 300
69. J. M. Greenman, Missouri Botanical Garden. Botany. In part payment of expenses of a collecting trip to Central America 500
70. T. R. Garth, University of Texas. Psychology. For a psychological study of Indian children in the United States schools at Chilocco, Oklahoma, and Albuquerque, New Mexico 150
71. E. G. Boring, Clark University. Psychology. For the preparation of a set of steel acoustic cylinders to be used in determining the nature of sensory response under conditions of normal psychometric situation 150
72. A. L. Kroeber, University of California. Anthropology. For bibliographical and clerical assistance in connection with an ethnological investigation to determine the culture areas of aboriginal South America 200
73. Helen H. Roberts, New York City. Anthropology. For a study of negro folk music in Jamaica 150
74. Frank A. Hartman, University of Buffalo. Physiology. To aid in the study of suprarenal insufficiency 150
75. W. E. Garrey, Tulane University, Physiology. For the puchase of apparatus for hydrogen-ion determinations 200
76. Frank P. Knowlton, Syracuse University. Physiology. To aid in the study of the blood flow and gaseous metabolism of the thyroid gland 150

77. Carl J. Wiggers, Western Reserve University. Physiology. In support of his investigations of the cardiac function by optical registration. (Additional) 150
78. W. F. G. Swann, University of Minnesota. Physics. For investigation of electric phenomena in the upper atmosphere 150
79. H. M. Randall, University of Michigan. Physics. In support of his study of rotational spectra of gases obtained by absorption........ 250
80. Walter G. Cady, Wesleyan University. Physics. In support of his study of electrical reactions by piezo-electric crystals in high frequency circuits........ 200
81. Paul F. Gaehr, Wells College. Physics. In support of his work on specific heat of tungsten at incandescent temperatures 100
82. A. L. Foley, Indiana University. Physics. For experiments on the speed of sound very close to the source. (Additional)........ 100

Second Addendum

LIST OF PAPERS REPORTING WORK SUPPORTED BY APPROPRIATIONS FROM THE COMMITTEE ON GRANTS

(To December 31, 1921)

American Association of Variable Star Observers. Observations by C. Y. McAteer in monthly reports. *Popular Astronomy,* Vols. 27-29, 1919-1921.

Arey, Leslie E. The origin, growth and fate of osteoclasts, and their relation to bone resorption. *American Journal of Anatomy,* 26: 315-346, 1920.

Benedict, Ralph C. The origin of new varieties of *Nephrolepsis* by orthogenetic saltation. Progressive variations. *Bulletin Torrey Club,* 43: 297-234, 1916.

Blake, F. C. On the effective capacity and resistance of a condenser for high frequency currents. *Physical Review,* 16: 540-557, 1920.

On electrostatic transformers and coupling coefficients. *Journal of the American Institute of Electrical Engineers,* 40: 23-29, 1921.

Chaney, Ralph W. The flora of the Eagle Creek formation. *Contributions from Walker Museum,* 2: No. 5, 115-181, 1920.

Cobb, N. A. *Contributions to a science of nematology,* IX: 217-343, 1921.

Douglass, A. E. Climatic cycles and tree growth. *Carnegie Institution of Washington, Publication* No. 289, pp. 127, 1919.

Eigenmann, Carl H. The Irwin Expedition to Peru, Bolivia and Chile. *Indiana University Alumni Quarterly,* January, 1920, pp. 20.

The fishes of Lake Valencia, Caracas, and of the Rio Tuy at El Concejo, Venezuela. *Indiana University Studies,* 7: No. 44, 1-13, 1920.

South America west of the Maracaibo, Orinoco, Amazon and Titicaca basins, and the horizontal distribution of its fresh water fishes. *Indiana University Studies,* 7: No. 45, 1-24, 1920.

The fishes of the rivers draining the western slope of the Cordillera Occidental of Colombia, Rios Atrato, San Juan, Dagua and Patia. *Indiana University Studies,* 7: No. 46, 1-19, 1920.

The fish fauna of the Cordillera of Bogota. *Journal of the Washington Academy of Sciences,* 10: No. 16, 1920.

The fresh water fishes of Panama east of longitude 80° W. The Magdalena basin and the horizontal and vertical distribution of its fishes. *Indiana University Studies,* 7: No. 47, 1-34, 1920.

The origin and distribution of the genera of the fishes of South America west of the Maracaibo, Orinoco, Amazon and Titicaca basins. *Proceedings of the American Philosophical Society,* 60: 1-6, 1920.

The American characidæ. *Memoirs of the Museum of Comparative Zoology, at Harvard College,* 48: Part 3, 209-319, 1921.

Fairchild, Herman L. Post-glacial continental uplift. SCIENCE, 47: 615-617, 1918.

Glacial depression and post-glacial uplift of northeastern America. *Proceedings of the National Academy of Sciences,* 4: 229-232, 1918.

Post-glacial uplift of northeastern America, *Geological Society of America Bulletin,* 29: 187-238, 1918.

Post-glacial sea-level waters in eastern Vermont. *Report of the Vermont State Geologist for 1917-1918,* 52-75, June, 1919.

Pleistocene marine submergence of the Hudson, Champlain and St. Lawrence valleys. *The New York State Museum Bulletin,* Nos. 209-210 (May-June, 1918), April, 1920.

Post-glacial uplift of southern New England. *Geological Society of America Bulletin,* 30: 597-636, 1920.

Foley, A. L. A photographic method of finding the instantaneous velocity of spark waves. *Physical Review*, 16: 449-463, 1920.

Garrey, W. E. The relation of respiration to rhythm in the cardian ganglion of *Limulus polyphemus*. *Journal of General Physiology*, 4: 149-156, 1921.

Gay, Frederick P. The treatment of experimental tuberculosis in guinea-pigs and rabbits by taurin, alone and in combination with gold chlorid and sodium oleate (by M. Takeoka). *Journal of Infectious Diseases*, 20: 442-456, 1917.

A method for the preparation of taurin in large quantities (by C. L. A. Schmidt and T. Watson). *Journal of Biological Chemistry*, 33: 499, 1918.

On the elimination of taurin administered to man (by C. L. A. Schmidt, E. von Adelung and T. Watson). *Journal of Biological Chemistry*, 33: 501, 1918.

Hrdlička, Ales. The vanishing Indian. Science, 46: 266-267, 1917.

Kornhauser, S. I. The cytology of the sea-side earwig, *Anisolabis maritima* Bon. *Denison University Bulletin, Journal of the Scientific Laboratories*, 19: 234-246, 1921.

Moodie, Roy L. Concerning the fossilization of blood corpuscles. *American Naturalist*, 54: 460-464, 1920.

Ancient bacteria and the beginnings of disease. *Scientific Monthly*, October, 1920.

Microscopic examination of a fossil fish brain. *Journal of Comparative Neurology*, 32: 329-333, 1920.

A variant of the sincipital T in Peru. *American Journal of Physical Anthropology*, 4: 219-222, 1921.

Porter, R. A. The relation of potential distribution to hysteresis effect in the Wehnelt tube. *Physical Review*, 13: 189-196, 1919.

Robbins, Samuel D. A plethysmographic study of shock and stammering in a trephined stammerer. *American Journal of Physiology*, 52: 1-24, 1920.

Seismological Society of America. The San Jacinto earthquake of April 21, 1918 (by S. D. Townley and others). *Bulletin Seismological Society of America*, 8: 45-73, 1917.

The Inglewood earthquake in southern California, 1920, June 21 (by Stephen Taber). *Bulletin Seismological Society of America*, 10: 129-143, 1920.

Watson, J. B. *Psychology from the standpoint of a behaviorist*, Lippincott, 1919. Summary of work in Chapters VI, VII and VIII.

Wendt, Gerald L. Triatomic hydrogen (with R. S. Landauer). *Journal of the American Chemical Society*, 42: 930-946, 1920.

Young, Anne S. Proper motions of certain long-period variable stars. *Astronomical Journal*, 33: 194, 1921.

THE ELEMENTARY COURSE IN GENETICS[1]

The elementary courses in botany and in zoology have recently been the subject of considerable discussion. One might think that subjects as old and as well established as these which have been taught for many years should long ago have become definitely organized upon the proper pedagogical basis. But these subjects with their various subdivisions have grown so large that it is becoming increasingly difficult to give adequate treatment even in an elementary manner to all phases of either of these two primary biological sciences in the time that is ordinarily available for the beginning course. Teachers of these subjects are, therefore, confronted with the choice of making the beginning course an elementary survey of the entire field of their subject or of bodily eliminating certain phases, leaving their consideration to later and more specialized courses.

Genetics may properly be regarded as one of these subdivisions or phases of biology—a phase of applied biology if you will. But it can not properly be regarded as a phase either of botany or zoology alone, nor can it be adequately treated in a course of instruction by confining one's attention exclusively to one or the other kingdom. The genetics instructor must be free to select his illustrative material from any source, plant or animal, economic or non-economic, as he sees fit. While the greater number of forms of animal life of economic importance are to be found among mammals, birds and fishes, and of plants among the

[1] Paper No. 95, Department of Plant Breeding, Cornell University, Ithaca, New York. Read before the Conference of Geneticists interested in agriculture at the Toronto meeting of the American Association for the Advancement of Science.

angiosperms, certainly much of our collateral evidence in genetics comes from the lower forms of both kingdoms. An adequate treatment of the subject of genetics can not be had under any system of administrative organization which insists upon the drawing of hard and fast departmental lines or in any environment which limits the instructor to the consideration of either wild or domesticated forms of life. In my judgment genetics falls in the same category as cytology and evolution in which the best instruction can not be given without the opportunity of free and unrestricted choice of illustrative material and evidence from both plant and animal life.

Although the science of genetics is by no means as old as that of botany or zoology, its growth and development has been and continues to be of such magnitude that we are rapidly approaching the same state of affairs that confronts the botanist and zoologist. The elements of genetics in all of their details are already extensive and numerous and it is becoming increasingly difficult adequately to treat all phases of the subject even in an elementary way in a single course without making it of unreasonable length. The genetic instructor must, therefore, decide what subject matter is relevant to the object of his course and what is irrelevant and of the former determine what phases may reasonably be left to courses in other biological sciences which may be made prerequisite to the elementary course in genetics and what may well be left for advanced courses in genetics. I confess that the problem of how far to go in the elementary course and what to leave for the advanced course is at times a most perplexing question.

In order to reach the proper decision, we must first define our objective. What is the purpose of the elementary course in genetics? What is its objective? Upon the answer to these questions must our method of procedure necessarily depend. It seems to me that any course worthy of collegiate recognition and standing must be primarily cultural in nature and secondarily informational. It is, however, not impossible to combine these two purposes in any course of instruction even in the professional school, but judging from the array of courses offered by some departments in some of our agricultural colleges one may wonder if the presentation of encyclopedic information rather than the training of students to do independent and original thinking is not the end attained even though it may not be the objective sought. I wonder if we instructors in agricultural colleges do not sometimes make the mistake of thinking that the agricultural student is not interested in anything that has no direct connection with agricultural phenomena and that it is necessary to sugar coat the pill by giving our courses an agricultural flavor. I admit that we have some students of this type but I believe that they constitute a small minority of the student body, at least at the beginning of their college course. If, however, many of the courses which students find in the agricultural college are largely informational in nature, it is not at all strange that some should regard a modern course in genetics as highly theoretical and of little practical application. When I recall that many of our most successful farmers representing our highest type of rural citizenship are not agricultural college graduates, I wonder if we have perhaps not over emphasized the value of an agricultural course as contrasted to courses in the so-called pure sciences, languages and the humanities even for the man who expects to spend his life and make his living on the farm. I do not underestimate the value of the information he gets in technical agricultural courses but I question if the time that the student is often required to spend in getting this information is proportional to the amount of real and useful information that he gets. One of my colleagues in one of our technical departments recently said to me, "We can give our students all that we know that will actually work on the farm in our field in a three-hour course." Yet I hazard the guess that if you will examine the announcements of courses of departments in this field in our various agricultural colleges, you will find in most of them a relatively large array of detailed courses offered. Where this situation prevails the student is forced to spend an excessive amount of time to get what I am firmly convinced in many cases could be consolidated into much fewer hours if the subject matter were more concentrated. Furthermore, better teaching would result if courses were designed for the purpose of real mental training rather than for the purpose of giving out a lot of half digested facts, some good, many bad, for absorption by the student to be handed back often in the same undigested form at examinations.

Granting that the primary object of the agricultural college is the training of men and women for farm life, I wonder if we would not be doing that better were we to give in our courses of instruction less consideration to the presentation of information and more to the development of the habit and desire for real thinking. We may well leave the acquisition of some of this information to the student himself if we will acquaint him with the literature of the subject and train him properly to appraise the value of such information as is available and how to use it after he has obtained it.

The teaching of genetics in the agricultural college affords an excellent opportunity for the accomplishment of these aims. If the course is properly organized and presented no student can successfully grasp and assimilate such a body of knowledge without some real mental effort on his part.

I would, therefore, define the objective of the elementary course in genetics as primarily cultural and secondarily informational. If proper consideration be given to its cultural value, it should be of like interest to the student of general biology who expects to go no farther into this field of human knowledge but who desires a general understanding of the phenomena of inheritance, to the student of eugenics and sociology who wants a genetic background for further studies in those fields, to the student who is beginning his special or professional training in genetics or to the student who is specializing in any of the plant or animal industry departments and who desires a genetic training as a basis for plant and animal improvement.

From the informational point of view the general student is not at all interested in a genetic analysis of aleurone color in maize or eye color in Drosophila. The same is probably true of the agronomist or animal husbandman. But an understanding of the phenomena involved in the inheritance of such characters and a knowledge of the mode of attack that has been used in the solution of such problems will be helpful and useful to all and will give to students of applied genetics a better appreciation of the complexity of the mode of inheritance of other characters that are of economic importance and with which as plant and animal breeders they are vitally concerned.

PREREQUISITES

In order to deal with the subject of genetics even in the elementary course in an adequate and satisfactory manner, it is essential that the student have the proper biological background. For the advanced student in genetics a thorough training in either botany or zoology and an elementary training in the other of these sciences is essential but this seems hardly necessary in the beginning course. A sufficient biological training as prerequisite for elementary genetics would seem to be had in a general course in botany or zoology and one in physiology. An elementary knowledge of cytology is, of course, important but the genetics instructor should be able to supplement by lecture or reference without difficulty or without much expense of time such instruction as the student ordinarily gets in cytology in the beginning courses in botany and zoology as may be necessary to an elementary knowledge of the mechanism of heredity.

Certain courses in mathematics are also advisable for the advanced student of genetics but are perhaps not essential for the beginner. The one thing that is essential in my judgment is that the student shall not have forgotten his high school mathematics nor have forgotten how to think and reason in mathematical terms —a condition which too often prevails among students in the agricultural college.

OF WHOM REQUIRED

Of what students in the agricultural college should genetics be required? When I think of my own course I am tempted to answer, of none. I am sure that we would all agree that it is much more satisfactory to work with a class of students all of whom are registered because they want that particular course than because the faculty has ruled that they must have it before they will be graduated or because some professor has said they must have it before they may take his course. Since I insist upon the privilege of saying that my own students shall have botany or zoology and physiology before they take genetics, I can not well quarrel with a colleague who makes similar requirements of my course as a prerequisite for his.

Perhaps we would all agree that an elementary knowledge of genetics is of value to all agricultural students. But so are courses in many other subjects. If a student were required to have even an elementary knowledge of every thing that is good for him there would be little time left for advanced or specialized courses in any subject. It does seem advisable, however, that as a rule students specializing in any phase of biology should have a course in genetics, though I doubt the advisability of making it a fixed requirement for all. If any group of students should be required to have genetics, it should be those who will later be engaged in the production of better plants and animals and then only in the sense of making it the basis for courses dealing with the application of genetic principles to plant and animal improvement. I am not at all in sympathy with making genetics a requirement for graduation of all students in the agricultural college any more than with making plant or animal breeding such a requirement.

RELATION TO COURSES IN TECHNICAL DEPARTMENTS

Notwithstanding my conviction that the genetics instructor will get better results on the whole if his course is not required, from the standpoint of instruction in the technical departments of plant and animal industry as well as from the standpoint of educational and administrative policy, it would seem important that at least an elementary knowledge of genetics should be made prerequisite to courses in plant and animal breeding if the latter are to be more than a presentation of empirical rules and methods or a consideration of superstitious practices and beliefs. If the genetics course is made prequisite to such courses the instructor of the latter will have a definite basis upon which to work and will not be forced to spend his time in a consideration of genetic principles as an introduction to the main part of his course—a tiresome review for those of his students who have previously taken the course in genetics and an inadequate consideration of genetics for those who have not. Time will thus be saved for both instructor and student and better work will be done.

I offer no apologies for the materials of the genetics instructor. Nevertheless, in an agricultural college at least one always encounters a few students of an intensely practical mind, to whom I have already referred, who seem to have little interest in matters not of immediate economic importance or application. Such students one of my colleagues has described as "those who desire information without knowledge." If left to their own inclinations and desires they are apt to fill up their schedule with what may be termed "informational" courses to the exclusion of courses that require real mental work. It is sometimes possible to command a greater interest on the part of such students by giving careful thought to the choice of illustrative material, by pointing out from time to time some applications of genetic principles in plant and animal improvement and by referring such students to literature illustrating the very practical use of genetic knowledge in the interpretation of phenomena with which they are quite familiar.

SCOPE AND CONTENTS

In my judgment, the elementary course in genetics should constitute a survey of the entire field of heredity. It should be organized and presented in such a manner as to acquaint the student not only with a knowledge of the principles and facts of heredity but of how the science of genetics has been and is being developed, and give him an elementary knowledge of the modes of genetic research. Genetics offers an excellent opportunity for the teacher to present his subject from the research point of view and to demonstrate how human knowledge is advanced. I am inclined to think agricultural students in general get too little of this type of instruction.

Perhaps I can best illustrate the scope and contents of such a course as I have attempted to describe by briefly outlining our own elementary course in genetics. In doing so, I have no exaggerated idea of the importance of its organization or contents. In fact, we are by no means satisfied with it ourselves and are continually changing it from year to year. Nevertheless, for our conditions, it seems to work fairly well as it now stands. It consists of three lectures and one laboratory period a week for a term of sixteen weeks.

PLANT BREEDING 1—GENETICS

1. The methods, problems, scope and relationships of genetics. Relation to evolution, to plant and animal breeding, and to eugenics.
2. Early theories of development and heredity.
   Preformation and predelineation.—Epigenesis.—Spencer's physiological units.—Darwin's pangenesis.—Naegeli's micellæ.—DeVries' intracellular pangenesis.—Weismann's theory of heredity.
3. The pioneer plant hybridizers.
   Camerarius' demonstration of sexuality in plants.—The first plant hybrid.—The first extensive series of plant hybridization experiments by Kölreuter, his results and conclusions.—Other early plant hybridizers and their contributions: Thomas Knight and John Goss—the "splitting" of hybrids; Wiegmann and Sageret—the existence of characters in contrasted pairs and the frequent suppression in the hybrid of one parental form by that of the other.—Von Gärtner and his classification of hybrids as intermediate, comingled and decided.—Naudin and his principle of the segregation of species potentialities.
4. Gregor Mendel—the greatest of plant hybridizers.
   Choice of material.—Methods used and characters studied.—Results in first and second generation hybrids with (*a*) one character pair, (*b*) two character pairs.
5. The essential features of Mendel's hypothesis.
   Independent inheritance of single characters.—Alternative forms of single characters (allelomorphism).—Dominance and recessiveness.—Segregation and the purity of the germ cells.—Recombination.
6. Mendel's methods of testing his hypothesis.
   Behavior in subsequent generations.—Backcrossing the hybrids to the parental forms.
7. Definition and illustration of Mendelian terms.
   Gamete, zygote, homozygote, heterozygote, genotype, phenotype, P_1, F_1, F_2, F_3, etc.
8. Further illustration of Mendelian inheritance and the calculation of Mendelian expectancies.
   Mono-, di- and trihybrids with and without dominance.—Backcrossing heterozygotes to simple, double and triple recessives.—Algebraic and checkerboard methods of calculation.
9. The mechanism of Mendelian heredity.
   Brief evidences for the chromosome theory of heredity.—Behavior of the chromosomes in mitosis.—Heterotypic and homotypic divisions.—Parallelism of Mendelian segregation and chromosome segregation.—Chance and probability in inheritance.—Points at which chance is operative.
10. Interaction of factors.
    Interaction of allelomorphic factors: heterozygous or "unfixable" characters—pink Mirabilis, double carnation; homozygous dominant lethal—the yellow mouse, yellow snapdragons, dichaete Drosophila, etc.—Interaction of non-allelomorphic factors: appearance of new or old characters with normal Mendelian ratios—comb form in fowls, plant color in maize; appearance of new or old characters with modified Mendelian ratios such as 9:3:4, 9:7, 13:3, 27:9:28, 27:37, 27:9:9:3:9:7, etc.—Duplicate and triplicate genes, 15:1 and 63:1 ratios.
11. Sex inheritance and sex determination.
    The chromosome theory of sex inheritance: cytological evidence; sex-linked inheritance; evidence from parthenogenesis; miscellaneous evidences; attempts at sex control.—Sex inheritance in plants: mosses, ferns and liverworts; diœcious forms among the spermatophytes.—Sex intergrades and gynandromorphs: Mercurialis; gypsy moth; Drosophila, etc.
12. The physiological basis of sex determination.
    Hormones of sex glands and their effect upon the development of secondary sexual characters.—Effects of castration and transplation of gonads.—Effects of nutrition.

13. The principle of associative inheritance—linkage.
    Discovery by Bateson in sweet peas.—Elaboration by Morgan and others in Drosophila.—Extension to other plants and animals by various workers.—The chiasmatype theory as an explanation of the mechanism of linkage and crossing over.—Illustrations of various linkage phenomena.
14. The inheritance of quantitative characters.
    The facts.—The interpretations that have been offered.—The multiple factor hypothesis.
15. The statistical study of variation.
    Calculation and uses of the ordinary biometrical constants.
16. Correlation.
    Calculation and uses of the coefficient of correlation.
17. The pure line concept.
    Johannsen's selection experiments and conclusions.—Confirmation and extension by other workers.
18. The role of selection in plant and animal breeding.
    Effect of selection in populations of self-fertilized and cross-fertilized plants and with animals under various systems of mating.—Selection from the point of view of the animal breeder.—Modifying factors.
19. Inbreeding and outbreeding.
    The conflict of views.—Experimental evidence in both plants and animals.—Interpretation of the results of inbreeding.—Heterosis and its utilization in plant and animal production.
20. Non-Mendelian inheritance.
    Cytoplasmic and maternal inheritance.—Chimeras.
21. The mutation concept.
    The DeVriesian view.—The modern view.—Point or factor mutations and multiple allelomorphs.—Regional mutations.—Chromosome aberrations.—Bud variations.—Attempts to induce mutations.
22. The mode of evolution from the mutation point of view.
23. Eugenics.
    The application of genetic principles to race improvement.—Limitations.

C. B. HUTCHISON

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LAMARCK, MIRBEL AND THE CELL THEORY

IT seems to have escaped the notice of writers of text books on biology and the history of science, even in France, that the cell theory in broad outlines was taught in Paris at the very opening of the nineteenth century, forty years before Schleiden and Schwann published their famous epoch-making work.

Lamarck stated clearly in his "Philosophie Zoologique," 1809, that all plants and animals are composed essentially of cellular tissue, without which "no living body would be able to exist nor could have been formed." "Since 1796," he says, "I have been accustomed to set forth these principles in the first lessons of my course."

Lamarck's clear and positive statement of the fundamental importance of cellular tissue, like his theory of evolution, unfortunately was not supported by an array of well authenticated published facts. Lamarck's conception was that cellular tissue (epidermal and connective), enclosing the organism and its parts, is the matrix in which the fluid living matter is shaped into organs, by physico-chemical forces acting upon it from without.

Mirbel, his younger colleague at the museum, adopted the cellular tissue theory, and brought to its support from the field of botany a splendid body of facts, to which long afterwards both Schleiden and Schwann allude. To Mirbel plants are made of a folded membranous cellular tissue, with slow circulation of fluid among the cells through intervening pores.

Dutrochet, in 1824, introduced into the theory the idea of the individuality of the cell, of which all plants and animals are composed, but unfortunately he had no standard by which to decide what is, or what is not, a cell in the animal. The universally present nucleus had not yet been discovered and the cell thus, so to speak, standardized. Hence in matters of detail, he went somewhat astray, but he was a most enthusiastic supporter of the cell theory as he knew it.

Robert Brown, as a by-product of a work on fertilization in Orchids and Milkweeds, described the universal occurrence of cell nuclei.

This made the cell theory of Schleiden and Schwann a possibility.

Without detracting at all from the epoch-making work of these two men, and with great admiration for that of Schwann, who accurately described for the first time many types of animal cells, the present writer finds himself unable to give them sole credit for a theory that had been taught forty years earlier in France.

Not one of these pioneers knew how new cells originate. It was the deep secret that most intrigued the active minds of the two Germans. They made their guess, and guessed wrongly, but their observations in confirmation of Robert Brown's important discovery, and Schwann's clear pictures of animal cells, have given them the distinguished place that they deserve among the founders of the cell theory. Whether they should be given exclusive credit for the theory that had been taught in Paris forty years earlier by Lamarck, and admirably supported by beautiful plates prepared by Mirbel showing plant structures, the reader may judge for himself by reading a review of the whole situation in the current number of *The Scientific Monthly*[1], and, better, by perusing the original books and papers to which reference is therein made.

Reviewed now, after the lapse of a century, the different methods and temperaments of the various writers are thrown into bold relief, and one is forcibly reminded of the folly of unchecked speculation and the wisdom of guarding the indispensable imagination by keen, untiring observation and experiment.

John H. Gerould

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[1] The Dawn of the Cell Theory, *Scientific Monthly*, Vol. XIV, No. 3, pp. 268-277, March, 1922.

SCIENTIFIC EVENTS

DISINTEGRATION OF ELEMENTS[1]

I have been asked to say a few words about a telegram in the *Times* of March 14 giving an account of a paper communicated to the American Chemical Society at Chicago by Dr. G. Wendt and Mr. C. E. Iron. It reported that, when a powerful condenser discharge at 100,000 volts was sent through a very fine tungsten wire, the filament exploded with a "deafening report," producing a flash estimated to correspond to a temperature of at least 50,000° F. The telegram states: "After the flash he (Dr. Wendt) found atoms of tungsten decomposed into simpler atoms and the result was the change of metallic tungsten into gaseous helium." The experiments were made to investigate whether any atomic disintegration can be effected by such high temperature discharges, and apparently the authors believe that they have obtained positive results.

We must await a much fuller account of the experiments before any definite judgment can be formed; but it may be of interest to direct attention to one or two general points. During the last ten years many experiments have been recorded in which small traces of helium have been liberated in vacuum tubes in intense electric discharges, and it has been generally assumed that this helium has been in some way occluded in the bombarded material. On modern views, we should anticipate that the disintegration of a heavy atom into lighter atoms, *e. g.*, into atoms of helium, would be accompanied by a large evolution of energy. Indeed, it is to be anticipated that the additional heating effect due to this liberated energy would be a much more definite and more delicate test of disintegration of heavy atoms into helium than the spectroscope.

Our common experience of the large effect of temperature in ordinary chemical reactions tends to make us take a rather exaggerated view of the probable effects of high temperatures on the stability of atoms. While it seems quite probable that momentary temperatures of 50,000° F. can be obtained under suitable conditions in condenser discharges, it should be borne in mind that the average energy of the electrons in temperature equilibrium with the atoms at this temperature corresponds to a fall of potential of only 6 volts. In many physical experiments we habitually employ streams of electrons of much higher energy and yet no certain trace of disintegration has been noted. In particular, in Coolidge tubes an intense stream of electrons of energy about 100,000 volts is

[1] Sir Ernest Rutherford, in *Nature*.

constantly employed to bombard a tungsten target for long intervals, but no evolution of helium has so far been observed.

A RESEARCH FELLOWSHIP IN BACTERIOLOGY

The Society of American Bacteriologists at its recent meeting in Philadelphia, appropriated a fund for the support of a research fellowship in pure bacteriology. While excellent work is being carried on in many places, nearly all the problems under investigation have as their aim a practical application and there are, therefore, many gaps in our knowledge of fundamental principles. The society, believing it to be the duty of bacteriologists to fill these *lacunæ,* requires that the line of work to be carried on under its fund must concern a purely scientific and fundamental phase of bacteriology, although a certain latitude of choice will be permitted, conditioned by the previous training and the desires of the research fellow himself.

Applicants for the fellowship must have the degree of B.S. or its equivalent. The successful candidate, through arrangements now being made, will receive academic credit for the work done from a university of recognized standing. One hundred dollars a month will be available for the living expenses of the fellow. Approximately half his time will be devoted to details connected with the society's collection of bacteria, deposited at the Army Medical Museum.

The selection of the research fellow will be in charge of a committee consisting of:

Dr. Victor C. Vaughan, chairman of the Medical Section, National Research Council, *Chairman.*

Captain C. S. Butler, Medical Corps, U. S. Navy, commandant, Naval Medical School.

Dr. Geo. W. McCoy, director of the Hygienic Laboratory, U. S. Public Health Service.

Dr. John R. Mohler, chief, Bureau of Animal Industry.

Mr. L. A. Rogers (president of the Society of American Bacteriologists), in charge of research laboratory, Dairy Division, Bureau of Animal Industry.

Colonel Joseph F. Siler, Medical Corps, U. S. Army, Division of Sanitation, Office of the Surgeon General of the Army.

Dr. Erwin F. Smith, pathologist in charge, Laboratory of Plant Pathology, Bureau of Plant Pathology.

This committee will have general supervision of the work, approve the problem selected and pass upon the thesis which the fellow will submit as the report of his research. Applications for and communications concerning the research fellowship should be addressed to the chairman of the committee, Dr. Victor C. Vaughan, National Research Council, Washington, D. C.

A. Parker Hitchens,
Secretary of the Committee

Army Medical School,
Washington, D. C.

THE CULTURE COLLECTION OF THE SOCIETY OF AMERICAN BACTERIOLOGISTS

The Society of American Bacteriologists has taken over the collection of cultures which for the past ten years has been maintained at the American Museum of Natural History by Professor C.-E. A. Winslow, and has deposited it at the Army Medical Museum, where facilities have been arranged for its housing and maintenance.

The following committee will be in charge:

Dr. J. M. Sherman, Dairy Division, Bureau of Animal Industry, *Chairman.*

Major G. R. Callender, curator of the Army Medical Museum.

Dr. Geo. W. McCoy, director of the Hygienic Laboratory, U. S. Public Health Service.

Major H. J. Nichols, Army Medical School.

The president of the society.

The secretary of the society.

These and other members of the society in and near Washington will do volunteer work and the research fellow will do part time work in maintaining the collection. No charge will be made for cultures. In making requests, the classification of the society should be followed as far as possible. Mail should be addressed to the Department of Bacteriology, Army Medical Museum, 7th and B Streets, S. W., Washington, D. C.

J. M. Sherman
Chairman of the Committee

STATION FOR THE STUDY OF DECIDUOUS FRUITS AT STANFORD UNIVERSITY

The United States Government has established an experiment station on the Stanford campus in cooperation with the university for scientific work on the breeding and improvement of deciduous fruits. The university has furnished 20 acres of land together with irrigation water free of charge, and on this plot the Bureau of Plant Industry of the Department of Agriculture, under the direction of W. F. Wight, is planting trees designed to be a basis of extensive experiments in the breeding, selection and domestication of various fruits for the purpose of developing varieties having greater disease resistance and better adapted for cultivation than those now grown.

Mr. Wight is in charge of the horticultural and pomological investigations of the Chico Experiment Station and cooperating with him as representative of the university is Professor Leroy Abrams of the department of botany of the university.

The Stanford campus was selected for an experiment station because the Santa Clara Valley supports a greater variety of deciduous fruits than any other place in the country, and also because Stanford will be the headquarters for the work in fruit classification studies for this part of the country, and perhaps ultimately for the Pacific Coast. The library facilities, as well as collections of the fruits to be studied, are necessary for the work.

The work carried on at Stanford will be of local value to the Santa Clara Valley on account of the attention that will be paid to the apricot and prune, but will be of wider scope. It is planned to make a study of the varieties of pears of high quality and resistance to pear blight. It is hoped that the work will be of value wherever deciduous fruits are grown in this country.

It is planned to carry on experiments through a period of at least ten years with the probability that they will be continued indefinitely. By the agreement between the government and the university, all plant material in the experiment station will be available to the department of botany of the university for study and investigation, provided such work does not interfere with the government's undertaking. The distribution of the material will probably be through state experiment stations, nurseries and to individual growers where the latter are in a position to grow a given variety on a commercial basis.

THE AMERICAN PHYSICAL SOCIETY

The one hundred and fifteenth regular meeting of the American Physical Society will be held in Washington, at the Bureau of Standards, on Friday and Saturday, April 21 and 22, 1922. The first session will begin at 10 o'clock on Friday morning.

The Association of Scientific Apparatus Makers will hold meetings at the Bureau of Standards on the same days as will the American Physical Society. Arrangements have been made for a joint informal dinner on the evening of Friday, April 21. It is expected that addresses will be made by Dr. S. W. Stratton in behalf of the Bureau of Standards, by Professor F. K. Richtmyer, representing the Association of Apparatus Manufacturers, and by Professor R. A. Millikan, representing the American Physical Society. Arrangements are being made for an exhibit of scientific apparatus at the Bureau of Standards.

The other meetings for the calendar year will be as follows: The Thanksgiving meeting, on November 25, 1922, will be held at the University of Chicago. The annual meeting, beginning on December 26, will be held in Boston, in affiliation with the American Association for the Advancement of Science.

The Pacific Coast Section will hold a meeting at Salt Lake City, at the time of the meeting of the Pacific Division, A. A. A. S., on June 22, 23 and 24, 1922. Correspondence relating to this meeting should be addressed to the secretary of the Pacific Coast Section, Professor E. P. Lewis, University of California, Berkeley, California.

Dayton C. Miller,
Secretary

SCIENTIFIC NOTES AND NEWS

A celebration was held at Bryn Mawr College on April 11, in honor of Professor Charlotte Angus Scott, who has been head of the department of mathematics since the college opened in 1885. Professor Albert N. Whitehead, of the University of London, came to America to make the principal address. Among those who planned to be present were: Professors George David Birkoff, Harvard; Ernest William Brown, Yale; Emilie Norton Martin, Mt. Holyoke; Helen Abbot Merrill, Wellesley; Roland George Dwight Richardson, Brown; Oswald Veblen, Princeton; Henry Seely White, Vassar, and Ruth Goulding Wood, Smith.

A testimonial dinner in honor of Dr. George E. de Schweinitz, president-elect of the American Medical Association, was held in Philadelphia, on April 4, under the auspices of the Philadelphia County Medical Society. Dr. Hobart A. Hare was toastmaster, and the speakers were: Dr. Hubert Work, president of the association and postmaster general of the United States; Dr. William C. Braisted, president of the Philadelphia College of Pharmacy; Dr. Ross V. Patterson, dean of the Jefferson Medical College, and Dr. John G. Clark, professor of gynecology in the Medical School of the University of Pennsylvania.

President Porras, of Panama, on April 7, tendered a reception to Dr. Richard P. Strong, professor of tropical medicine at Harvard University and director of the Gorgas Memorial Institute, recently founded there. Dr. Strong started on the following day on a tour of the interior.

The Royal Geographical Society will award its medals and grants as follows: *The Founder's Medal* to Lieutenant Colonel C. K. Howard-Bury for his distinguished services in command of the Mount Everest Expedition of 1921; *The Patron's Medal* to Mr. Ernest de K. Leffingwell for his surveys and investigations on the coast of northern Alaska; *The Victoria Medal* to Mr. J. F. Baddeley for his work on the Historical Geography of Central Asia; *The Murchison Grant* to Mr. Charles Camsell for his explorations and surveys in northern Canada; *The Back Grant* to Khan Bahadur Sher Jang for his surveys on the Indian frontier; *The Cuthbert Peek Grant* to Mr. F. H. Melland for his explorations in northern Rhodesia; and *The Gill Memorial* to Mr. A. A. R. Boyce for his triangulations in the Sudan.

We learn from *Nature* that the following were elected fellows of the Royal Society of Edinburgh at the meeting on March 6: Mr. C. L. Abernethy, Professor G. Barger, Sir Dugald Clerk, Dr. F. A. E. Crew, Dr. W. O. Greenwood, Mr. W. A. Guthrie, Professor R. K. Hannay, Professor E. Hindle, Dr. C. F. Juritz, Professor J. C. Meakins, Mr. M. Macgregor, Dr. Bijali Behari Sarkar, Professor H. W. Turnbull, Dr. J. Walker, Mr. J. Wilson, Mr. J. M. Wordie.

Dr. O. Stapf, who has been keeper of the herbarium and library at the Royal Botanic Gardens, Kew, since 1908, has retired on reaching the age limit. He is succeeded as keeper by Mr. A. D. Cotton, formerly a member of the herbarium staff and lately mycologist to the Ministry of Agriculture and Fisheries.

The *Engineering and Mining Journal* and *Mining and Scientific Press* were consolidated on April 1, to form the *Engineering and Mining Journal-Press,* with Josiah Edward Spurr as editor.

A new major subdivision has been created in the United States Geological Survey by raising the division of Alaskan mineral resources to the status of a branch. The work will continue under the immediate direction of Colonel A. H. Brooks, whose title under the rearrangement is chief Alaskan geologist.

R. T. Stull, who for several years has been superintendent of the Columbus (Ohio) Experiment Station of the Bureau of Mines, has been appointed assistant chief of the bureau's mineral technology division. In that position he will have technical supervision over the work in non-metallics and in ceramics.

During the absence of Director Frank Schlesinger, who is attending the meeting of the International Astronomical Union in Rome and will be absent until the latter part of May, Professor Ernest W. Brown is to serve as acting director of the Yale Observatory. Mr. Carl L. Stearns, assistant at the observatory, with the rank of instructor, has been granted leave of absence for a year beginning July 1, 1922.

Following the return of Dr. H. H. Rusby, the scientific men who were members of the Mulford Expedition to South America, arrived in New York last week. They include Dr. W. M. Mann, assistant entomologist of the U. S. Department of Agriculture; Dr. Orlando E. White, assistant botanist of the Brooklyn

Botanical Garden, and Dr. Everett Pearson, of the University of Indiana.

On April 4, Professor W. H. Hobbs, of the University of Michigan, completed his lectures at the Technical High School of Delft in exchange with Professor Brouwer. On May 4, he will sail for the Windward Islands and the west coast of South America, returning to Ann Arbor on September 1.

The National Research Council has appointed a committee to investigate the properties of ammonium nitrate. The personnel of the committee is as follows: C. E. Munroe, National Research Council, *Chairman;* S. P. Howell, representing the Bureau of Mines; R. C. Tolman, representing the Department of Agriculture; C. G. Storm, representing the Ordnance Department, United States Army; C. P. Beistle, representing the Bureau of Explosives of the American Railway Association; and C. A. Bigelow, representing the Institute of Makers of Explosives. It is expected that the Navy Department will also be represented on this committee.

The spring meeting of the American Electrochemical Society will be held in Baltimore, beginning on April 27. The morning will be devoted to a symposium on electric cast iron in charge of A. P. Hinckley and Bradley Stoughton. In the evening Professor R. W. Wood, of Johns Hopkins University, will speak on the subject of fluorescence. Acheson Smith, the retiring president, will deliver the presidential address.

Dr. Hendrik Anton Lorentz, of the University of Leiden, has given, in the Jefferson Physical Laboratory at Harvard University, three lectures on mathematical physics. It will be remembered that Dr. Lorentz has been lecturing at the California Institute of Technology, Pasadena, whose invitation to deliver a special series of lectures was the occasion of his present visit to the United States. Before returning to the Netherlands on or about the first of May, he is visiting a number of American universities.

Dr. E. W. Washburn, of the department of ceramics of the University of Illinois, lectured on April 6 before the Franklin Institute on "Physical chemistry and ceramics." On April 13 a lecture on "The physics of the three-electrode bulb" was given by Professor K. T. Compton, of Princeton University. On April 19, Professor William D. Harkins lectured before the institute on "The structure and building of atom nuclei."

Professor Charles R. Stockard, of the department of anatomy, Cornell University Medical College, delivered a lecture on heredity at the meeting of the Philadelphia Pediatric Society, on March 14.

Professor J. Paul Goode, of the University of Chicago, gave an address at the annual meeting of the Cleveland Chamber of Commerce on March 21 on the subject, "American opportunity in world trade." On March 22 he spoke at Georgetown University, Washington, on "America as a world power," and on March 24 he lectured on "Industrial Japan" for the National Geographic Society at Washington.

Dr. Charles W. Eliot, president emeritus of Harvard University, spoke on "Prevention of disease through animal experimentation," at a public health conference in Boston, on March 29, under the auspices of the Massachusetts State Federation of Women's Clubs.

The Bakerian lecture of the Royal Society will be delivered on March 9 by Professor T. R. Merton and Mr. S. Barratt on "The spectrum of hydrogen."

Dr. Harris Graham, for thirty years professor of pathology and practice of medicine in the American University of Beirut, died in his sixtieth year on February 27, at Beirut, Syria.

Sir Patrick Manson, distinguished for his work on malaria and tropical diseases, died on April 8 at the age of seventy-six years.

Dr. J. T. Merz, author of *The History of European Thought in the Nineteenth Century,* died on March 21 at the age of eighty-two years.

The death, on March 24, at fifty-eight years of age, is announced of Professor W. B. Bottomley, professor of botany at King's College, London, from 1893 to 1921.

THE John Macoun Memorial Committee of the Ottawa Field Naturalist's Club announces that, as the number of copies to be issued of the autobiography of the late Professor John Macoun, naturalist to the Geological Survey of Canada, is limited, orders, with or without the subscription price of $3, should be sent in by May 15, addressed to Mr. Arthur Gibson, treasurer, John Macoun Memorial Committee, Birks Building, Ottawa, Canada.

DR. GEZA HORVATH, director of the section of Zoology of the Hungarian National Museum in Budapest, writes that the price of the complete series of the *Annales historico-naturales Musei Nationalis Hungarici* (Volumes I to XVIII) has been reduced from $108 to $58. It is the hope of the administration of the museum that, through the sale of sets of these important *Annals*, they will be able to add to the funds needed to pay the present exorbitant charges for the publication of current and future volumes.

THE Royal Academy of Belgium announces that a triennial prize of 2,500 francs, to be known as the Prix Joseph Schepkens, for the best experimental work on plant genetics, has been established.

THE German Congress of Surgery will be held at Berlin, under the presidency of Professor Hildebrand, from April 19 to April 22, when the following subjects will be discussed: The experimental principles of wound injection, introduced by Professor Neufeld, of Berlin; general surgical infection, introduced by Professor Lesser, of Freiburg; operative transplantation of muscles, introduced by Professor Wullstein, of Essen, and the importance of histological examination of the blood, introduced by Professor Stahl, of Berlin.

UNIVERSITY AND EDUCATIONAL NOTES

THE University of Missouri, Columbia, Mo., will erect a new chemistry building to cost $125,000.

MISS KATE C. GARRICK, daughter of the late Sir James Francis Garrick, for ten years agent-general in London for Queensland, has by her will bequeathed £10,000 to the University of Queensland to found a James Francis Garrick professorship of either law or medicine, as may seem best to the university, in memory of her father.

DR. EDWIN B. WILSON, professor of mathematical physics in charge of the department of physics at the Massachusetts Institute of Technology and a member of the administrative committee of the institute, has been appointed professor of vital statistics at Harvard University. He has also been appointed a member of the administrative board of the School of Public Health, the other members being David L. Edsall, chairman, Milton J. Rosenau, Roger I. Lee and Cecil K. Drinker.

THE following promotions to associate professorships have been made at Yale University: Dr. Francis Kovarik and Horace Scudder Uhler, in physics; Herbert L. Seward, in mechanical engineering; Charles S. Farnham, in civil engineering, and Richard S. Kirby, in engineering drawing. Dr. Arthur J. Hill has been promoted to an associate professorship in organic chemistry, with assignment to the Sheffield Scientific School and the Graduate School. William L. Crum, Ph.D., has been advanced to an assistant professorship in mathematics. English Bagby, Ph.D., in psychology, and Archer E. Knowlton, E.E., in electrical engineering, have been advanced to assistant professorships.

DISCUSSION AND CORRESPONDENCE

DEVONIAN PLANTS

To the geologist, the invertebrate paleontologist, or the stratigrapher who turns to the map of North America, the Devonian system is one of a completeness and grandeur that must be satisfying in the extreme. The mapping has proceeded through nearly a century, and the horizons have been divided on accurate faunal data. To long lists of invertebrates are added remarkable fishes.

To the paleobotanist on the contrary, the Devonian is at once alluring and forbidding. While the algæ with a great record go back to the Precambrian, the recognizable land floras begin in the Devonian. But the great expanses of Devonian rock are for the main part beyond the reach, knowledge, and experience of the paleobotanist. Away to the Canadian Northwest and extending far into Alaska, the main Devonian mass stretches for 2,000 miles through the remotest region of the continent. Thence scarcely a plant has come. Far or near, no one goes into the Devonian field for plants, and the "finds" are apt to be neglected year after year. Although the world's first great forests appear in the Devonian, from all North America not 200 species of Devonian plants could be named, and those mostly of little satisfactory definition.

Inasmuch as Devonian plant materials must long fail to bulk up as a workable assemblage without some initial and better coordinated attention, I wish the invertebrate paleontologists and geologists who have data would supply them to me or to others interested, in the form of brief memoranda, or promptly publish the same. It should shortly be possible to see Devonian paleobotany on a better basis. Meanwhile it would be especially gratifying if some attention could be given to the following inquiries:

(1) Which are the main shale or other sections where Devonian plants have been seen?

(2) Are there good Psilophyton localities,—(*a*) where stems are petrified, (*b*) well carbonized?

(3) What North American localities of the lower Devonian yield silicified stems large or small? The British geologists cite the Cordaite, Paleopitys milleri of the old Red.

(4) Are there any North American Devonian cherts containing stems comparable to *Rhynia*, the most primitive of vascular plants, as occurring in the siliceous cherts of Aberdeenshire, Scotland?

(5) Are there any well marked seeds in the Indiana Black shale, the Genesee shale, the Waverleyan? Are there any typical pteridospermous, or gymnospermous seeds in the North American Devonian at all?

The enormous extent of parallelism in the lines of plant descent, and the exceedingly small percentage of known forms in pre-Carboniferous rocks, give to every discovery of plants in the Devonian a high value. It is to-day patent that better plant phylogenies much depend on the closest attention to chronology, and especially on new discoveries in the Devonian.

I should state that it is not my purpose to take up the subject of Devonian plants but to help others to do so, as I am persuaded that much material of value is being lost, or too long unnoted. Is it not grievous to admit that in the past twenty-five years, contributions to Devonian paleobotany have been so lacking from North America? There is for the Waverleyan at the close of Devonian time the very fine contribution of Scott and Jeffrey. And from the Indiana Black shale there is the fine Cordaite *Callixylon Oweni* of Elkins and Wieland. There the record of publication about closes.

But what possibilities of discovery there must be in the rocks that yield such a striking forest type as the "Naples tree," *Protolepidodendron*, interestingly restored at the State Hall at Albany! The great dearth of knowledge of the Devonian plant front is due to the failure to get the evidence in the field; although it is admitted that here discoveries and collection are difficult. It is possible to search given Devonian horizons for invertebrate material with success, because occurrences have been sought out and diligently described, the continent over, for the past three or four score years. The impression thus grows upon us that with attention in kind, the Devonian plant record for the continent would soon be augmented, and that relative importance of scientific subjects asks such a result. Is the investigation of the Devonian to be carried on only in other countries? Can we make no such brilliant discoveries as those from the Devonian cherts of Aberdeenshire?

G. R. WIELAND

YALE UNIVERSITY

THE EFFECT OF ALKALI ON THE DIGESTIBILITY OF CELLULOSIC MATERIALS

THE communication of Professor Lindsey on the above subject in your issue of February 3 is of considerable interest to students of cellulose chemistry inasmuch as it indicates the possibility of converting waste material into valuable food products.

In view of the interesting results obtained in Germany during the recent war, on the action of alkalis on chopped straw, this matter is well worthy of a thorough study. In a recent lecture by the writer to the Syracuse Section of the American Chemical Society on "The rôle of alkali in the future development of the cattle food, cellulose, paper-pulp and liquid fuel industries," attention was drawn to the fact that experiments carried out at the behest of the German War Office show that by the simple process of boiling chopped straw for three hours with a one per cent. solution of sodium carbonate a 75 per cent. yield of material is obtained, of which 75 per cent. is digestible, and this in spite of the relatively high lignin content. A full account of this work is to be found in the recent pamphlet by Hans Magnus entitled, "Theorie und Praxis der Strohaufschliessung," published by Paul Parey, Berlin, 1919. Further information and additional references are to be found in the recent work of Hans Pringsheim, "Die Polysaccharide," Berlin, 1919.

It would seem that the treatment with soda ash is peculiarly applicable to American conditions and offers to the individual farmer the possibility of obtaining a cheap cattle food from such waste materials as chopped straw, ground corn cobs, etc., by the use of a chemical product with which he is familiar and employing only the simplest type of machinery. The resulting material when mixed with molasses apparently yields a profitable and palatable cattle food of high nutritive value.

Lantern slides have been made of the various tables quoted in the pamphlet by Magnus, and the writer will be pleased to loan them to any one interested in lecturing on this subject.

HAROLD HIBBERT
YALE UNIVERSITY

BUTYL ALCOHOL AS A REAGENT IN HISTOLOGY

PROFESSOR GRIFFIN'S article in SCIENCE for March 10, recommending the use of isopropyl and methyl alcohols for histological work, impels the writer to call attention to the practicability of using butyl alcohol, as recently suggested by Larbaud,[1] for similar purposes. Among the advantages claimed for this reagent are that it obviates difficulties due to the presence of slight amounts of water in so-called "absolute" ethyl alcohol, and that it does away with the contraction and hardening due to xylol, since butyl alcohol is a solvent of paraffin and therefore takes the place of xylol or chloroform as well as of the higher alcohols. As butyl alcohol does not mix readily with water, Larbaud recommends a mixture of equal parts of butyl and 95 per cent. ethyl alcohols in appropriate dilutions for the lower grades in the dehydrating series. There seems to be no *a priori* reason why a mixture of butyl and methyl alcohols would not serve equally well. The writer has used Larbaud's methods, with slight modifications, for the dehydration and infiltration of fungus tissues for cytological study, with entirely satisfactory results.

GEORGE W. MARTIN
HULL BOTANICAL LABORATORY,
UNIVERSITY OF CHICAGO

GENETICS OF THE VIENNA WHITE RABBIT II.

IN SCIENCE for March 10, I described the genetics of a variety of white rabbit having colored eyes, which I supposed to be identical with the variety known in Europe as Vienna White. This variety I had synthesized by crossing albinos carrying the gene for yellow coat, with chinchillas, and I showed the white variety with colored eyes to be genetically a "yellow chinchilla." Since writing that article I have been able to obtain from Europe a pair of Vienna White rabbits and I find that, though they look like my synthetic white rabbits, they breed very differently. When crossed with yellow rabbits, they produce not *yellow* young, as my synthetic whites should do, but blue, black or gray young, according to the genetic constitution of the yellow parent, and these young are invariably *Dutch-marked,* pre-

[1] Larbaud, Mlle.: Nouvelle technique pour les inclusions et les préparations microscopiques des tissues végétaux et animaux. *Comptes. Rend. Ac. Aci. Paris,* 172: 1317-1319. 1921.

cisely as in the experiment of Baur. This result shows that the Vienna White rabbit is in reality a Dutch rabbit, with a completely white coat, as suggested by Punnett. Its eyes are blue as in blue rabbits regularly, but the choroid is white as in the whitest Dutch rabbits. The white rabbit which I have synthesized is a new type of white rabbit, entirely distinct from Vienna White.

W. E. Castle

Bussey Institution,
March 28, 1922

UNIVERSITY PROFESSORS AND MAJOR-GENERALS IN POLAND

A recent statement by the official Polish Bureau of Information in New York indicates the existence of an interesting condition in Poland regarding the status of university professors in that so-called backward country. The following is the statement, *verbatim:*

> University professors in Poland have equal ranking with major generals, and, being state officials, are accorded all the rights and privileges enjoyed by major generals. According to a recent announcement, there are at present 638 full professors in the Polish universities and higher academic schools. The salaries of professors are somewhat higher than that of the under-secretary of state.

Vernon Kellogg

Washington, D. C.

QUOTATIONS

"THE SCIENTIFIC SIDE"[1]

"Mme. Bisson assisted Mlle. Eva in a cabinet in which I was present with other observers," he said. "Mlle. Eva was wrapped in a heavy rubber coat in order to protect her body from the light as much as possible. She entered into a trance and after a short time an aperture was opened in the front of the rubber coat so that I could look within. I saw the ectoplasm in a thick slimy band encircling her body like some monstrous worm.

"'May I touch it?' I asked Mme. Bisson.

"She replied, 'Yes.'

"I reached within the aperture and firmly grasped between thumb and forefinger the belt-like mass, and as I held it I felt it writhe—a living, pulsing substance."

Sir Arthur stated his belief that the medium would have died from shock had any attempt been made to remove this reputed ectoplasm, but the observers finally managed to pinch off a small portion, and this was hurried into a laboratory where Professor Richet of the University of Paris made a microscopic and chemical examination.

"It was found to consist of mucoid cells, epithelial cells, a clear, slimy fluid, certain carbonates, and other compounds. It was a sort of etherealized matter, if such a term may be employed.

He cited the circumstances of a number of seances, and in one case read testimonies of other observers who were present.

"In one instance Mrs. Wriedt of Detroit, an American medium of great power, came to my house and we held a séance in the nursery, a room certainly devoid of suspicious surroundings. My wife and I, Mrs. Wriedt, and my secretary, Major Wood, held hands as we sat around a table, and having learned the value of singing in such experiments we all sang softly in chorus. We knew the words of the hymn, 'Onward, Christian Soldiers,' and by common consent took up this air. Suddenly there burst out overhead a clear joyous baritone voice, singing with us word for word. I stopped and heard the voices of my wife, of Mrs. Wriedt, and of Major Wood. And above them all was this ringing baritone voice.

"If that isn't a spiritual phenomenon, what is it?" he cried. "I have a right to ask that question."

He narrated details of numerous other séances, of one in which he declared he saw the face of his dead mother, "as plain as a Rembrandt portrait emerging from the dark," every wrinkle and line as he had seen her last.

"Again," he said, "I went to Southsea, where a Welsh miner was staying. This was the medium, Evan Powell.

"In this séance there were four other observers besides myself. Powell sat in my room

[1] Concluding part of a lecture with this title given by Sir Arthur Conan Doyle in Carnegie Hall, New York City, on April 12, as reported in the *Evening Post*.

in a chair and asked me to tie him in place. So well did I tie him that we had to cut him out afterwards. Then he fell into a trance, and suddenly I became aware of dazzling celestial lights over his head. Then my son's voice cried out: 'Father, father.' The voice was not a yard from my face.

"Yes, my boy," I answered. "Yes, what is it?"

"'Father! Pardon!' he said, and I felt his hand on the top of my head, bowing down my head, and then felt his lips touch my forehead.

"I knew what he meant immediately. Only I could have known. He had never subscribed to my belief while alive, and now he had come back to tell me that it had been as I said.

"'Yes, my son,' I called back to him, 'you had a right to your own belief while here with us.'"

Again the speaker, wrought up to a high pitch, cried:

"If that isn't spiritual communication, what is it?" And the audience, listening intently to every word, broke out in a clatter of applause.

SCIENTIFIC BOOKS

Studies of the Development and Larval Forms of Echinoderms. By Th. Mortensen. 266 pages, 33 plates and 102 text-figures. Published at the expense of the Carlsberg Fund. G. E. C. Gad, Copenhagen, 1921.

For some years, the well-known Danish zoologist, Dr. Th. Mortensen, has been gathering material in the embryological field to use in throwing light on the phylogeny of the echinoderms and on the interrelationships of families and genera in the most perplexing groups. A two year's journey around the world including stays of several weeks or more at Zamboanga and Jolo in the Philippines; Misaki, Japan; Sydney, N. S. W.; New Zealand; Hawaii; Nanaimo, British Columbia; La Jolla, California; Taboga Island, Panama; and Tobago, B. W. I., resulted in such an accumulation of material that the present noteworthy report has been prepared and published. Yet the indefatigable Danish investigator is again afield in search of more material and at the same time is hunting out the best place in the East Indies for the establishment of a permanent Scandinavian marine biological station!

As one turns the pages and studies the plates of this great contribution to embryology, it is hard to decide whether one should admire the more the industry, patience and skill of the investigator, or the ability to marshal his facts and set forth clearly his conclusions, revealed in the writing. Descriptions and figures alike leave nothing to be desired and even if one were not to accept all the suggested conclusions one can not question the care or the fairness with which they are expressed.

An introduction of 19 pages gives a brief but clear summary of what has so far been accomplished in acquiring knowledge of the embryology of those echinoderms which have free-living larval forms. Including Mortensen's own results we now have such knowledge, often very fragmentary it must be granted, of some 125 species. There is also much material accumulated concerning the life histories of many species which do not have free-living larvæ, but these are not included within the scope of the present report. The main purpose of Mortensen's research has been, to quote his own words, to throw light on "the interrelation between the larvæ and the adults in regard to a natural classification."

The second section of the report, designated "Special Part," deals with the larvæ of more than sixty identified species and nearly fifty additional larvæ, whose parent forms are unknown. No crinoids are discussed, as Dr. Mortensen has published his studies on crinoid development elsewhere. As experience demonstrated that the eggs of echini are more easily fertilized artificially than are those of other echinoderms, it is not surprising that nearly three fourths of Mortensen's work was done on members of that class, at least so far as results reveal. The early stages of no fewer than 43 species were studied and many species were carried along through weeks and sometimes months of larval life. One of the interesting results of this work was the demonstration of the hardiness of the larvæ of certain species. Thus some larvæ of the common West Indian rock-boring urchin (*Echinometra lucunter*), hatched from eggs fertilized the last week in March or early in April, were carried from Tobago to Copenhagen via New York, arriving in Denmark, June 1, still living, though not thriving! Besides the larvæ whose parentage was certain, Mortensen describes and discusses the relationships of nine echinoid larval forms taken in tow nets.

Among the sea-stars, artificial fertilization was successful with eleven species, and the larvæ resulting are described in ten of them, to a greater or less extent. Owing to unsatisfactory preservation no asteroid larvæ from tow-net collections are described. With the holothurians and ophiurans, particularly the latter, artificial fertilization is exceedingly difficult to obtain and with only two species of brittle-star (both at Tobago) was Mortensen able to study material derived from eggs fertilized in the laboratory. With holothurians, artificial fertilization was successful in three species, but with two of these the larvæ only lived two or three days. On the other hand, Mortensen describes three forms of a noteworthy Auricularia, one from Tobago, one from Misaki, and the third from New Zealand waters, and no fewer than 35 ophiuran larvæ, whose parentage is unknown. The most extraordinary fact recorded in this section is that certain Ophioplutei do not end their free-swimming existence by complete metamorphosis into miniature brittle-stars, but rather give off the new ophiuran as a sort of bud, and then apparently *regenerate a new larval body in place of the original one.* If this new body is capable of giving rise to a new ophiuran by a second metamorphosis, we have here, as Mortensen says, the only case of metagenesis known in the whole Echinoderm phylum. But the evidence is tantalizingly incomplete.

The last fourth of the volume, entitled "General Part," is divided into three sections, a short one on "Classification," a longer called "Morphology, Phylogeny, Biology," and a few pages on "Geographical Distribution." In the first section, Mortensen raises the question whether there is any correspondence between groups of larvæ arranged according to structure and the natural groups of the adults, and so far as the major groups of echini are concerned, he answers the question in the affirmative with little hesitation. He has further unquestionably demonstrated that no classification of echini can henceforth be accepted which does not give fair consideration to the characters of the larvæ so far as they are known. As for the ophiurans on the other hand, we are on much less sure ground, nor can we make very practical use of the ophioplutei in classification until a far larger number of them have been traced back to their parent forms. Among the Asteroidea, too, we still lack sufficient data, in spite of Mortensen's masterly efforts, but enough facts are known to warrant the hope that the various larval forms will prove of great value in tracing relationships within the class. The Crinoidea and Holothurioidea are still largely *terra incognita,* so far as larval forms are concerned. In the pages dealing with the morphology of the larvæ, a number of debatable points are discussed and one very important one is emphasized, namely, that there is no homology between the sucking-disk of a brachiolarian larva and the Pelmatozoan stalk. The remarkable animal described by Koehler and Vaney as *Stellosphæra mirabilis* is shown to be a larval form of a sea-star, probably *Pedicellaster sexradiatus.* After a detailed discussion of the various larval forms, Mortensen pays his respects to Grave's theory that the primitive echinoderm larval form had transverse rings of cilia, and then passes on to an interesting discussion of the proposals of Boas, Simroth and A. H. Clark regarding the phylogeny of the echinoderms, though the ideas of the last two are dismissed briefly, their refutation being designated "a superfluous task"! There then follow discussions of Giard's theory of *poicilogony,* as applied to echinoderms, of the rate of growth of larvæ, and of the relation of temperature to the production of matured reproductive cells. The pages devoted to geographical distribution deal mainly with the matter of the influence of currents in the distribution of echinoderm larvæ and the probable existence of vertical upward currents, which are important in bringing the larvæ of deep sea forms to the surface.

The volume closes with a brief appendix and a very full explanation of the admirable plates. There is no bibliography and no index, but the absence of the latter is atoned for by the presence of a table of contents just before the introduction. As in most of Dr. Mortensen's publications the illustrations are all that could be desired and are of the greatest service to the user of the book, while the text is entirely free from ambiguities and shows the customary positiveness of the writer. The whole appearance of text and plates is admirable and the Carlsberg Fund, no less than the author, is to be congratulated on this very important contribution to our knowledge of echinoderms.

Hubert Lyman Clark

SPECIAL ARTICLES

A BACTERIAL WILT OF THE BEAN CAUSED BY BACTERIUM FLACCUMFACIENS NOV. SP.

A new bacterial disease of navy beans has appeared in South Dakota. The grower on whose farm the disease was discovered reports that what he believes to be the same disease killed 90 per cent. of his 1920 crop. In 1921 he planted the seed harvested from the remainder and lost about 25 per cent. of his crop. Some of this 1920 Dakota seed planted at Arlington, Virginia, also produced a large proportion of diseased plants, many of which never survived the seedling stage. The disease is characterized by a wilting of the leaves of seedlings sometimes accompanied by a discoloration, and by dwarfing, reduction of yield and the death of some of the shoots, if the plant survives the early stages of growth.

Plants from South Dakota, received in the Laboratory of Plant Pathology, Bureau of Plant Industry, August 6, 1921, were found to contain bacteria in the vessels of the stem often accompanied by a browning of the vascular ring. The writer suspected the presence of *Bacterium solanacearum* Erw. Sm. but when petri dish poured-plates were made from the diseased stems a yellow organism was isolated. This, when pricked into vigorously growing King of the Mountain bean seedlings produced the wilt in every case. From these infected plants the yellow organism has been reisolated and has produced the wilt in Great Northern beans. King of the Garden lima and Ito San soy-beans have also become infected as the result of pure culture inoculations.

The same organism has been isolated from the Arlington, Virginia, plants and with it the writer has reproduced the disease.

The discoloration mentioned above may consist of a dull green or brownish green, greenish brown or reddish brown area sometimes bordered with yellow. The discolored area is flabby at first and later dry and papery. In many cases the whole leaf blade and petiole become flabby and droop without any discoloration at all, whereas in others a portion of the leaf becomes flabby and discolored while the rest of the blade and the petiole is turgid for a time at least. It is presumably a question of the number of vessels plugged by the bacteria. This same phenomenon has occasionally been observed in secondary infections of young leaves by *Bacterium phaseoli.*

The wilt of the seedlings in some respects suggests the "systemic disease" of beans ascribed by Burkholder to *Bacterium phaseoli* but the parasite under consideration is very different from *Bacterium phaseoli.* For example, its very moderate, often scanty growth on potato cylinders, due to its very slight diastasic action, is in marked contrast to the exceedingly copious prolonged growth and marked diastasic action of *Bacterium phaseoli* Erw. Sm. The color on potato is Ridgway's mustard or primuline yellow (Color Standards and Nomenclature, plate XVI, 2nd ed., 1912) and there is usually a marked graying of the potato. The difference in the colonies are less marked but plates of the two organisms when compared are easily distinguishable. The colonies of *Bacterium phaseoli* are much more wet-shining and of a much more syrupy consistency. Both *Bacterium phaseoli* and the South Dakota organism reduce the litmus in litmus milk in 4 to 7 days but the cultures of the latter finally become acid and the behavior of the two organisms is very different in regard to the manner and time of the other changes taking place in the milk. Cultures of *Bacterium phaseoli* begin to clear in 1 to 6 days, and a very soft mobile curd is formed, a partial peptonization of the casein preventing the formation of a solid coagulum. In cultures of the South Dakota organism, on the other hand, there is usually no visible change in plain milk for about three weeks, after which, in varying lengths of time, the fluid becomes solid. Some days after coagulation there is an extrusion of whey and finally peptonization begins, progressing very slowly however. *Bacterium phaseoli* produces tyrosin crystals in abundance in milk but none have been observed in cultures of the South Dakota organism. The latter produces a wide, deep yellow rim (Ridgway's primuline yellow loc. cit.) which is very striking.

Both organisms liquefy gelatin but *Bacterium phaseoli* does it rapidly whereas the South Dakota organism does it so slowly that for the first month there is little or no liquid gelatin present, evaporation taking place almost as rapidly as the liquefaction.

Another good medium for differentiating these two organisms is Congo Red agar. Both organisms take up the stain to a greater or less degree and finally change the agar to a purplish color but *Bacterium phaseoli* makes a very thick, smooth, wet-shining growth and the South Dakota organism only a very meager one. This medium is prepared as follows: 1000.00 c. c. distilled water; 10.00 g. saccharose; 1.00 g. dipotassium phosphate; 0.20 g. magnesium sulphate; 15.00 g. agar flour; 0.10 g. Congo red (Grübler's). Steam the water and salts one half hour, then add Congo red. Filter through cotton and tube. Autoclave tubes fifteen minutes at 115° C.

The bacterium causing the wilt is a polar flagellate rod 2-3 to 3μ by 1-3 to 1-2μ occurring singly or in pairs, and has been named *Bacterium flaccumfaciens* nov. sp.

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THE PERIPHERAL CIRCULATION IN MUSCLE INJURY SHOCK

THE following experiments were undertaken in an attempt to determine the influence of the peripheral tone in the production of the low blood pressure initiated by muscle injury. Evidence has been presented by a number of observers indicating that the vasomotor center is still active in shock produced by the exposure of the viscera or aortic occlusion, and that some peripheral tone is maintained.[1] A recent paper by Erlanger, Gesell and Gasser[2] presents results of a series of experiments in which, in these types of shock, the condition of peripheral constriction was directly determined by the rate of perfusion through the arterioles and capillaries. They show that during the development of shock the peripheral resistance is increased, and that only after the arterial pressure has fallen is there a loss of vasomotor tone, and consequently that a loss of tone is not the primary cause of shock. Our results are in accord with these findings and are presented as evidence indicating that the nervous factor is of minor importance in the causation of the low blood pressure following muscle injury, as in other forms of shock.

The method of determining the relative condition of vasomotor tone was that described by Bartlett,[3] and used by Erlanger, Gesell and Gasser. The rate of inflow of a fluid at constant pressure through the femoral artery of one hind limb was determined at intervals during the development of shock. The inflow cannula was placed in a side branch of the femoral artery or low down on the main branch directed towards the heart. With this arrangement, through the use of clips on the arteries, it was possible to shift quickly from the natural blood supply of the area supplied by the intact branches of the femoral artery to the perfusion fluid and *vice versa*. The perfusion fluid was

[1] Porter: *Am. Jour. Phys.*, 1907, XX: 399. Porter and Storey: *Ibid.*, 1907, XVIII: 181. Porter and Quinby: *Ibid.*, 1908, XX: 500. Seelig and Lyon: *Jour. A. M. A.*, 1909, LII: 45; also *Jour. Surg. Gynecol. and Obstet.*, 1910, 146. Seelig and Joseph: *Jour. Lab. and Clin. Medicine*, 1916, I: 283. Mann: *Johns Hopkins Hosp. Bull.*, 1914, XXV: 205. Morison and Hooker: *Am. Jour. of Phys.*, 1915, XXXVII: 86.

[2] Erlanger, Gesell and Gasser: *Am. Jour. of Phys.*, 1919, XLIX: 90.

[3] Bartlett: *Jour. Exp. Med.*, 1912, XV: 414.

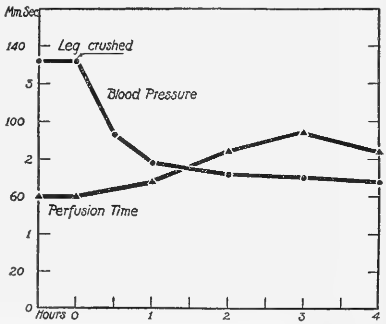
SUMMARY OF RESULTS SHOWING PERFUSION TIME FOR 1 C.C. OF PHYSIOLOGIC SODIUM CHLORID SOLUTION IN RELATION TO BLOOD PRESSURE IN MUSCLE INJURY SHOCK

Experiment	Control perfusion time, seconds	Maximal perfusion time, seconds	Period after injury, hours	Percentage increase	Perfusion time at end, seconds	Perfusion time after death, seconds	Original blood pressure, Mm.	Blood pressure at maximal constriction, mm.
8	5.2	12.9	0.75	144	4.7	----	140	90
9	2.3	3.3	1.0	43	2.9	1.8	130	16
10	1.4	2.4	4.0	71	----	1.2	140	74
12	1.2	2.7	4.5	125	1.1	0.8	130	68
14	0.8	1.5	1.5	87	1.0	0.5	130	60
15	1.3	3.7	1.25	185	----	1.3	120	72
16	1.6	4.0	3.5	150	----	----	135	78
18	2.7	4.0	4.5	48	----	----	125	65
19	1.5	2.5	6.0	66	----	1.1	135	42
20	1.4	2.5	----	78	----	----	130	92
21	1.0	1.7	3.0	70	0.9	0.6	130	60
Average	1.85	3.74	3.0	102	2.1	1.0	131	65

kept at a constant pressure by connecting the injection burette with a large bottle containing air at a constant pressure as indicated by a mercury manometer. A side tube on the burette connected with a bottle of normal saline solution served to refill the burette to the original level after each perfusion. In making a determination of the perfusion rate, about 3 c.c. of fluid was allowed to run into the artery while the time was being recorded with a stop watch. Such a determination required but a few seconds, and immediately after the clip on the main trunk was removed, thus allowing the part to receive its natural blood supply.

Cats, anesthetized with ethyl carbamate (urethane), were used. Shock was produced by the method described by Cannon.[4] The muscles of the right leg only were crushed, those of the left being left intact for the inflow measurements. In a few instances in which perfusion was interfered with by small clots forming in the vessels, the experiments were discarded. The condition of the vessels was tested by inflow determinations after death, when, if there is no obstruction, the rate of inflow is greatly increased. A blood pressure record was obtained from the right carotid by means of a mercury manometer.

A summary of the results is given in the table. The figures represent the time in seconds for the entrance of 1 c.c. of fluid, and in each case they are the average for at least three determinations. Frequently at the beginning of an experiment the readings indicated considerable variation in vascular tone, necessitating a number of observations to determine the control rate. Invariably there was a gradual increase in the time (*i. e.*, decrease in the rate) of inflow after muscle injury, usually starting within the first hour and reaching a maximum in from two to four hours. After this a dilation occurred which continued until the death of the animal and was accompanied by a further fall in blood pressure. As already stated, the perfusion rate was still further increased after death. A curve showing the general relation between the blood pressure and the tone of the blood vessels during the devel-



Curve plotted from the averages of six experiments showing the relationship between the perfusion rate and the blood pressure in muscle injury shock. As the blood pressure falls, there is a slowing of the perfusion rate, indicating an increased tone of the arterioles.

[4] Cannon: *Arch. of Surg.*, 1922, IV: 7.

opment of shock is given in the figure, which illustrates the averages of the six experiments which were carried out over a period of six hours or more.

From these results it is apparent that the low blood pressure initiated by muscle injury is not primarily due to a loss of vasomotor tone or to a dilation of the blood vessels. There is evidence[5] that a continued low blood pressure may ultimately result in an injury or depression of the vasomotor and other nerve centers, and it is probable that this explains the dilation of the peripheral vessels occurring some hours after the development of shock.

McKeen Cattell

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THE LOUISIANA ENTOMOLOGICAL SOCIETY

This society has completed its second year. Starting early in 1920 with about 25 members, it now has 36 members. Including others who have indicated their desire for membership, it will have in 1922 at least 40 members. The membership is distributed as follows: New Orleans, 14; Baton Rouge, 11; Mound, La., 2; Tallulah, La., 1; and others outside Louisiana at various places from New York City to a point in Mexico.

Meetings have been held bi-monthly, except during the summer, throughout the year. The average attendance has been about 18. The following papers and talks have been given:

Work on malarial mosquitoes at Mound Laboratory, D. L. Van Dine, U. S. Bureau of Entomology.

Beekeeping in Louisiana, E. C. Davis, Louisiana Experiment Stations.

Present status of cattle tick control in Louisiana, W. H. Dalrymple, Lousiana State University.

The plant lice or aphids, Thos. H. Jones, Louisiana Experiment Stations.

The camphor scale, E. R. Barber, U. S. Bureau of Entomology.

Plant quarantine at the port of New Orleans, Emile Kostal, Federal Horticultural Board.

The European corn borer and the sugar cane moth borer: A Comparison, T. E. Holloway, U. S. Bureau of Entomology.

Entomological practice in Hawaii a dozen years ago, Jacob Kotinsky, formerly of the Hawaiian Experiment Station.

The teaching of entomology, O. W. Rosewall, Louisiana State University.

Two moving picture films, "The Most Wonderful Insect in the World" and "Cotton's Worst Enemy—The Pink Boll Worm," were exhibited through courtesy of the U. S. Department of Agriculture.

The society is gradually acquiring an entomological library, which is housed at the Louisiana State Museum, Jackson Square, New Orleans. There are now about 40 books and about 500 pamphlets, largely the gift of Mr. D. L. Van Dine, of the U. S. Entomological Laboratory, Mound, La. Through the courtesy of Mr. Robert Glenk, curator, meetings are held at the museum and the moving picture projector is sometimes used. A very successful meeting was held at Baton Rouge in February, under the auspices of the members there.

Resolutions have been adopted during the year on the camphor scale in New Orleans, on financial assistance to the Division of Insects, U. S. National Museum, and on the campaign to control the Argentine ant in New Orleans.

At a recent annual business meeting the officers of 1921 were reelected for 1922. These are: *President,* Mr. Ed. Foster; *Vice-president,* Professor O. W. Rosewall; *Secretary-Treasurer,* Mr. T. E. Holloway; *Executive Committee,* the officers and Messrs. D. L. Van Dine, Chas. E. Smith and Thos. H. Jones.

The writer understands that certain members of the national societies look askance at the formation of local entomological societies, believing that these will draw members away from the larger organizations and result in a division of interest. This has not happened as a result of the organization of the Louisiana Entomological Society, and, on the contrary, the interest in entomology has been stimulated not only among entomologists but among other students of biology.

T. E. Holloway,
Secretary-Treasurer.

[5] See Cannon and Cattell. *Arch. of Surg.,* 1922, IV: 321.

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INDIVIDUALISM IN MEDICAL EDUCATION[1]

IN human progress there are two fundamental processes which sometimes proceed equally, but usually one or the other is dominant,—these two processes are extension and consolidation. In the birth and growth of nations, there is first settlement in colonies due to community of thought and action; this expansion is followed by a union; national expansion leads to international alliances; the expansion of alliances leads to consolidation into world leagues. In the growth of religions many beliefs are unified by the Christian religion; then extension of doctrines leads to innumerable sects, followed by attempts at consolidation. In the more specialized fields of activity the same processes are observed. In celestial physics the theory of gravitation coordinated the scattered and divergent views; then a period of differentiation, followed by attempts at coordination in the theory of relativity. In the field of medical science there are many illustrations of the same procedure. Scattered observations on variations in the blood, phlegm, and bile, during illness were brought together in the humoral theory of disease; in like manner studies on bacteria were unified in the germ theory. Studies on heredity and environment found common expression in the theory of evolution. In the past, medicine was largely restricted to the diseases of mankind. At present she recognizes the intimate relationships of the diseases of plants and animals to those of mankind. In the near future she must take into consideration the diseases of metals; ultimately her domain will extend widely over both the organic and inorganic world. In the growth of knowledge in all of

[1] An address delivered before the Association of American Medical Colleges March 7, 1922.

its special fields and great provinces, and as a whole, two processes stand forth, namely, extension and consolidation, specialization and generalization. The vitalizing factors in these are: individual thought, and collective thought.

Whether one follows the theory of evolution or accepts the teaching of the book of Genesis, he must contemplate the beginnings of intellectual growth in the individual. Individual thought precedes collective thought. Individualism, in the abstract, postulates that each human being may live to the fullest extent his own life as he wills. According to Biblical history it attained its greatest development with the first inhabitant of the earth but did not reach its ideal. The family embodies the first step in the growth of collective thought; and as the family grows individuality becomes restricted. Here and there it breaks away from the common modes of thought and action and asserts itself in differences so pronounced that one member becomes a genius while another becomes a black sheep—a Rocail and a Cain. Rocail erects a sepulchre adorned with statues of various metals, made by talismanic art, which move and speak and act like living men. Cain becomes jealous and envious of Abel and murders him.

Community life further accentuates common thought and is necessary for the preservation of mankind; but with its growth, individuality is again repressed. Through the ever increasing restrictions brought about by unity of purpose and organization, individuality is forced toward the average. Ideas either destructive or constructive must go up or down to the level of common thought. Great leaders,—philosophers, statesmen, and scientists,—have been those who have resisted these equalizing forces. Now and then a voice cries out: "Here am I lone wanderer in endless search of myself. For æons I have been searching from star to star down the ages until I chanced this way. . . I love the idea of equality, fraternity, democracy, but I must soon leave this crowd and wander on until I come to the kingdom of my solitary soul." He who explores ways of thought or action far ahead of his contemporaries must have an inner world in which he passes long and solitary hours. If he be engaged in scientific experimentation, in an unknown land with neither map nor sign post, he may lose his sight as did Bunsen, or his life as did Lazear.

If the development of individuality be ignored one of the greatest forces in the progress of mankind is lost to the world. On the other hand, the principle of collectivism underlies our entire social organization. It develops a general bond of likeness between the one and the many; it makes the individual a part of the whole; it leads to similarity, equality, fraternity, democracy. It enables us to move in companies, regiments, battalions, divisions, and armies. Without it, a nation sinks into oblivion and a world may be lost. Without individualism the same is true. A commander-in-chief, a great field marshal, is as necessary as the army. A million souls submerge their individuality for a common purpose, but each cries out, Where am I going? What am I doing? What I have in myself is moribund. I am physically an automaton, and intellectually boots, boots, boots.

The child accepts life as it is; it sails in a ship over seas that are calm; it knows naught of the larder, ballast or sails; the length of the voyage; the course or the destiny. Its life is in another's keeping; its own life is unknown; nothing stirs from within. The youth thinks of the ship; the voyage; the strange lands which bid him come. Self is beginning to assert itself; something stirs from within. Maturity builds a ship, carefully equips it, and sets forth on an uncharted ocean in quest of a new world. Something within takes possession of the heart and soul and guides every act.

Education is the bringing out of something from within; not the forcing of something in from without. Its emblem was written by an unknown hand on the walls of Delphi—"Know thyself." It is this something within; the personality, the essential self, the individual which must receive greater consideration in our schools. What I have in common with others is best developed by the school. What is mine and mine alone can not go to school with any one but it can be stimulated, intoxicated, liberated.

Let us proceed with the central thought; greater men in medicine through greater liberty in medical education. A medical school is built upon the same general foundation as any other institution. Purpose, products, materials, and methods form the corner stones.

The purpose of the medical school is to train men in the application of scientific methods to the prevention, alleviation, and cure of disease, and to advance medical knowledge in its broadest sense.

The products of medical schools may be considered as belonging to three principal groups: the practitioners, the investigators, and the teachers. A survey of the medical profession at large shows that its eminent men usually may be placed in one or the other of these groups; sometimes in two, but rarely in three. The group of practitioners comprises those whose primary interests are in the alleviation and cure of disease. The group of investigators includes those whose deepest interests are in the causation and prevention of disease. The group of teachers contains those whose principal aims are the dissemination of the methods adopted and the results achieved by the practitioners and the investigators. Lister, Pasteur, and Osler typify the groups.

A few decades ago, the country demanded and the schools furnished, for the most part, but one type of practitioner, and that type was the all-round practitioner. He was obliged to know something of medicine, surgery, and obstetrics, together with dentistry and pharmacy. In addition to these, he was expected to show proficiency as a veterinarian. The conditions of to-day are so different, that the all-round practitioner of to-day would have been a specialist fifty years ago. The cries from the country for general practitioners are heard far and wide but are less and less heeded by the young graduate. A doctor who has had modern training in laboratories and clinics with apparatus and libraries and contact with progressive men, is quite unwilling to leave all these. Moreover he can not come up to dear old Dr. Brown to whom physiognomy revealed more than modern laboratory methods; who did many a successful major operation on the kitchen table, and who thought nursing and a controlled environment entirely superfluous. The ambitious young doctor of yesterday, following the advice and example of his successful seniors, went forth to do an all-round practice for a number of years before entering upon the study of a specialty. Away from libraries, laboratories, clinics and stimulating colleagues, he found little growth or expansion, beyond that indicated by adipose tissue. The ambitious young doctor of to-day who contemplates a career as a specialist dispenses with this hibernating period of two or three years and seeks instead the live atmosphere of the hospital, an assistantship to the master, or a fellowship in some one of our great foundations. The rural districts and small towns will be obliged to adopt something of the same methods that they long ago adopted in securing churches, schools, and factories—they will be obliged to build and equip hospitals if they hope to obtain modern medical service. With the hospital comes the staff which, in turn, forms the basis of the group clinic. Instead of the general practitioner making a complete diagnosis, there is a group of collaborating clinicians, each of whom is an expert in his particular field. The rapid development of the group clinic is creating a situation which must be recognized both by the profession and the schools.

The practitioner of the future, either general or special, not only must measure up in self-reliance, responsibility, and judgment to the practitioner of the past, but also must be better trained and more thoroughly imbued with the investigative spirit.

Each patient presents a problem, the solution of which is more difficult than that in almost any other field of science. While every medical problem must be approached through the avenues of physics, chemistry, or biology, the physician is often baffled at the very beginning of his work by the fact that he is unable to determine which will aid him most. Often he finds that no one of these sciences will solve the problem but that all are involved. Physics may explain the mechanism of joints and muscles; it may aid us in the interpretation of the effects of light, heat, electricity, osmosis, pressure, on living tissues, but it does not explain, nerve impulses, sensations, memory, or thought. Chemistry may teach us the rates of protein, carbohydrate, and fat metabolism in health and disease; it may help us to know more of the precious vitamines and hormones but it does not tell us why one child resembles the father or mother physically and mentally, while another child does not. Biology may aid us in solving this problem but she, too, is extremely jealous of her secrets. She readily acknowledges that the process of fertilization is essentially the same throughout the animal kingdom, but she teaches us that the processes of regeneration are entirely different in different forms, and cautions us not to infer that a new leg will grow out from the stump of an old one in man as it does in some of the lower animals. She teaches that the organs of seeing, of hearing, of smelling, of tasting, of feeling, are the organs through which these sensations habitually are received. But she warns us not to infer that the loss of one of these special sense organs means an entire loss of that special sense. Our senses overlap to a degree which we little realize; light perception through the skin; sound perception through all parts of the body; color perception through both sound and smell; are a few of the many possibilities as revealed in the lives of Laura Bridgeman, Helen Kellar, Willetta Huggins and others. Deductions from the phenomena presented in these various fields are extremely hazardous and emphasize the necessity of working through the avenues of multiple hypotheses in the interpretation of disease. When this has been said, let us also recall that the names of diseases, of their courses, and of their processes are broad, generic terms, which signify physical, chemical, and biological complexes. Acuteness in observation; precision in experimentation and caution and judgment in deduction are the essentials for the interpretation of disease. They are the A.B.C. of the practitioner of the future.

One of the greatest needs in our medical schools of to-day is the encouragement of students to devote their lives to the study of the causation and prevention of disease. It becomes more and more apparent, as set forth last year by the committee on graduate work, that the medical schools must give opportunity and encouragement for men to develop as research workers. We need no longer argue that reproductive scholarship must be supplemented by productive scholarship. We accept the established fact that the investigative spirit must pervade the atmosphere of the medical school. Frequently a student stands where the roads fork and, as William James puts it, "one branch leads to material comfort, the flesh pots, but it seems a kind of selling of one's soul; the other to mental dignity and independence, combined, however, with physical penury. On one side is business, on the other science." It is not enough for the student to stand in deep perplexity outside the private door of his teacher and whisper that research work is going on inside. He must be invited in, and given time to accept the invitation. It is therefore necessary that some provision be made whereby any student may come more intimately in contact with research methods and ideals than is possible in our medical course of to-day. How far we can organize research is a question. There is no doubt but what to some extent we can create the investigative spirit. At any rate, we can help the young man who evinces this spirit; we can give him time; furnish him with apparatus and books; point the way to fields of investigation; discuss his problems and help him in his experiments. We can not dominate him nor restrain him. We can not force him to work independently or in cooperation; this must depend upon his bent, his personality, his individuality,—genius can not be organized nor can it go to school.

In every medical school there are those who are deeply interested in presenting summaries of the progress made in certain fields of medicine, or in the entire province of medicine. Their object is to sift out and correlate well established procedures. They may be neither practitioners nor investigators in the sense previously mentioned. They are so to speak the editors of medical facts and theories; the compilers; the writers of textbooks; the historians. This group we may designate as teachers or medical journalists. I am fully aware that this group is one created by American institutions and will doubtless become extinct in time for the simple reason that teaching must be accompanied by thinking; teaching and research are inseparable. The great teacher has always possessed the investigative spirit but may not have been a great investigator. We must, at present make provision for those who wish to prepare for teaching in its broadest sense.

These three types have been designated as they exist to-day. They are generic rather than specific. They possess many attributes in common and may sometimes form a trinity.

The materials to be converted by one method or another into the products set forth are students who enter the medical school with a high school and at least two years of college training. There are no two who have followed the same course of study with the same degree of interest or who have reached the same results. In the high school the student feels his way through a large range of group electives, and often before entering college he has decided that he will major in agriculture, engineering, law, theology, or medicine. In his college work, electives have enabled him to accentuate his choice or perchance to find that his decision was wrong. In both high school and college the student may have inclined toward subjects involving manual training and thereby have acquired keenness of touch and dexterity, or toward music, cultivating the sense of hearing. He may have elected biologic sciences, accentuating observation. He may have turned toward mathematics, physics and chemistry, emphasizing precision in deduction and experimentation. He may have laid special stress on history or languages thus acquiring an excellent memory and facility of expression; or perchance on philosophy thus developing the power of abstract thought. Those of us who come in contact with these men as they enter upon the study of medicine are impressed by their differences in concept, habit and training. He who comes from the land of mighty oceans, forests, and mountains, thinks in larger terms than he who comes from the truck farm. The boy brought up in the country better understands the thought and action of the country folk than the boy brought up in the city. The boy who is reared in the highly commercialized districts of a great city regards an education in quite a different light from the one who is reared in a college or university town. One student is always on time, another is always behind time; one works quickly, another slowly; one is deft, another clumsy; one student retains best what he sees—his memory is visual; another retains best what he hears—his memory is auditory; still another remembers best what he reads—his memory depends on word association. One mind stores up isolated impressions and facts—it is analytic; another arranges impressions and facts in groups—it is synthetic. Will the student who is slow and clumsy ever make as efficient a surgeon as the one who is quick and deft? Will the one whose memory is auditory, or depends on word association, ever succeed in surgery as well as another who is able to visualize the positions and relations of organs in the body? Will the student who has an untrained ear ever make as efficient an internist as the one whose keenness in sound perception and discrimination enables him to differentiate between normal and abnormal sounds in the lung or heart? Is the one which an analytic mind as capable of interpreting a syndrome as another whose mind is synthetic? It is beyond question that the men who enter the medical school at the age of 22 or 23 years are quite unlike in their mental equipment and this fact must be taken into account in the medical curriculum.

The method of the medical school is the curriculum; around it centers, to a large extent, the resources of the school, and through it are expressed the principles and concept of medical education. The curriculum of half a century ago was probably the best that could be devised to meet the needs of the profession and schools of that day. From an economic point of view, it was highly advantageous; one teacher could lecture to a large number of students and was entirely relieved of the time consuming instruction to small groups and individuals. It was an excellent mechanism for turning out one type of general practitioner. While it served in part as an intellectual pathway, it also functioned as a "straight jacket." It kept the students so busy that they could not destroy much property nor throw out many professors. To-day the conditions are entirely different. The financial situation has changed so that the school is no longer a recipient but a donor. The students are better trained both in behavior and intellect and are more eager for instruction. Many teachers are on a vocational basis and are able to give more time to instruction. Moreover, the medical school no longer looks to a single product, but to many products. The fixed curriculum of half a century ago will not meet the conditions of to-day, yet, in principle, it has remained unchanged. Our national organizations dealing with medical education have recognized and emphasized the need of a more liberal curriculum but have not adopted measures that materially assist the medical school in the development of such a curriculum. The fixed curriculum is so deeply rooted, so widely spread and so thoroughly fostered by standardizing bodies and educational institutions that state examining boards are rapidly adopting or creating such curriculums as the basis for medical licensure. "Eight months in each of four separate calendar years," devised for the improvement of medical education became a serious obstacle to patriotic service during the late war, and is no less an obstacle to education at the present time. A curriculum covering 4,000 prescribed hours is another mechanism to protect and advance medical education but it has defeated thinking. Medicine and medical specialties, 900 hours; surgery and surgical specialties, 648 hours; obstetrics and gynecology, 216 hours; are artificial divisions proposed by the medical educational bodies as a means of insuring better trained physicians and of eliminating bad medical schools, but these regulations have resulted in the state boards going one step further with the same good intent. But what a handicap has followed as a result of these measures. One state requires 170 hours of general pathology, another 240, another 250, and still another 270. Like variability is found in practically all the subjects in the state board curriculums. Certain peculiar requirements are exacted by some of the state boards. For example, one says in substance, either teach 60 hours of electro-therapeutics or your graduates can not practice in our state.

The day is not far distant when the schools must either incorporate in their curriculums the particular requirements of each state board curriculum or find that their graduates are not qualified to practice in these states. To incorporate these requirements means an enormous time expansion and this is impossible. The schools are thus approaching an impasse of their own creation and some remedy must be found. The one obvious solution is the creation of an elastic curriculum. The students in entering the medical school with a fixed curriculum are beginning a four-year program that requires all to do essentially the same kind and the same amount of work at the same time and in the same way. They are leashed together, made uniform in action and thought like the rowers in a great galley; shackled hand and foot, heart and soul, with chains of our own forging. It follows that the more uniform the special senses and intellectual processes, the more efficient becomes such a curriculum. To reach its maximal efficiency, we must revamp and equalize the special senses and intellectual processes,—but is this education?

The fixed and congested curriculum of to-day must give way to an elastic curriculum which is adjustable not only to these perplexities but also to instructional resources, clinical resources, and to the growth of medical science. It must provide for collective teaching; cooperative study and individual study.

Alexander Bain tells us that in the Scottish universities prior to the eighteenth century the quadrennial arts course was conducted by so-called regents, each of whom carried the same student through all the four years. In a rectorial address to the students of Aberdeen University, in 1882, he said: "You the students of arts, at the present day who encounter in your four years, seven faces, seven voices, seven repositories of knowledge, need an effort to understand how your predecessors could be cheerful and happy confined all through to one personality; sometimes juvenile, sometimes senile, often feeble at his best." Contrast this with the condition to-day, when seventy faces, seventy voices, and seventy personalities are encountered by the medical students in the four years of their course. To the single instructor the student could carry his entire intellectual possessions; to each of the seven, one seventh; to each of the seventy, he can carry but one seventieth. But what instructor realizes this and is willing to accept his proportion? Each demands more than the student can give, and the student under this tremendous pressure loosens his hold on the get-something idea, adopts the get-by methods, and revises his ethical principles accordingly.

Probably no field of science is undergoing a more active fermentation than medical science, with the splitting off of new segments; the discarding of certain subjects; and the addition of new subjects. Just as physiology and pathology split off from anatomy, so biochemistry is outgrowing physiology; bacteriology is asserting its independence of pathology; pediatrics and neurology, otolaryngology and ophthalmology are attaining independence from general medicine and surgery. Owing to the increase in entrance requirements, certain subjects like chemistry, embryology, histology and comparative anatomy are being shifted from the medical course to the premedical course, while other subjects like osteology, bone modeling, etc., have fallen by the wayside. Again, there is going on a continual importation of subjects from the outlying fields of investigation. Immunology, Roentgenology and parasitology have been brought into the curriculum from these outlying fields. The schools that are most actively engaged in the exploration and investigation of borderland subjects find greatest difficulty in holding to a fixed curriculum.

The clinical resources of one school may be quite unlike those of another. One is favorably situated for the study of tropical diseases, another is able to utilize a great tuberculosis sanatorium, another a great psychopathic institute. The school should be able to adjust its curriculum to these resources. If in South Africa, study sleeping sickness in the clinic, in the class room, and in the laboratory. If in Panama or Louisiana, emphasize, if you wish, malaria; if where cretanism abounds, study it, teach it and think it. While one school may thus emphasize this or that particular line of study, all are studying disease, and the underlying principles of disease prevention and control are not distributed geographically. Upon the proper certification that a student has had four or five years training in a good medical school should rest his qualification to practice. If it be expedient to protect the public by some form of state or national examination such examination should be directed solely toward determining the student's ability to work and think in terms of disease prevention and control.

The principle of collective teaching in all education is based upon the assumption that all human beings possess certain resemblances both physical and mental; otherwise we could not speak of them as a group. Each person possesses more or less of every ordinary human power. Our senses of feeling, tasting, smelling, hearing and seeing are similar; their actions and interactions upon an inherited substratum are reflected in thinking, and modes of thought run along fairly parallel lines. Collectivism stimulates a spirit of emulation; of comparative evaluation of mental assets both quantitative and qualitative. It arouses a sense of power which enables a member of a group to overcome obstacles which would defeat him if he were alone. This is forcibly illustrated by the heroic deeds of the soldier when inspired by the common purpose of the group. The status of the medical profession demands many elements of collectivism. There must be developed in the medical students a fraternal sympathy; a spirit of mutual consideration, and a basis for disciplined, or expert, cooperation. There is a fairly common substratum in each subject, in each great division, and in the curriculum as a whole, which can be presented collectively, and whether or not this be the method of the future, it must be the method of the present because it is an economic necessity. These are some of the considerations which justify class lectures, class demonstrations, class experiments and class examinations. It must not be inferred, however, that it likewise justifies the existence of the present division of students into freshman, sophomore, junior and senior classes. This grouping is a menace to education and should disappear as soon as possible, especially in the medical school.

The spirit of cooperation between faculty and students in medical training is one of greatest value to the student, not only for the school period, but throughout his entire life. In order to develop this spirit, we should determine as far as possible the special assets of each student at the time he enters the medical school, and ever keep in mind his adaptability for certain kinds of work. Much can be learned through contact afforded by laboratory work and through the seminar. This should be supplemented by a knowledge of his home life, his living conditions and his social habits. Through careful observation and inquiry, we must obtain as clear a picture of the student's individuality as is possible. With this as a guide we should help him to place his assets where they will yield the greatest returns. Experience teaches that most students, at the end of the second or third year of the medical course, have decided whether they wish to lay equal emphasis on medicine, surgery and obstetrics, fitting themselves for general practice, or to give some emphasis to one, fitting themselves for a special field. If, in the judgment of the faculty, the student's selection is wise, he should be permitted to accentuate his choice. In the fourth year the student should be allowed a further latitude which will permit him again to accentuate the all-round training in medicine, surgery and obstetrics, or to lay further emphasis on one of these. In the fifth year, he should be given the liberty to round himself out for general practice as an interne, or to add to his special training, or to do independent work in research. Collective teaching and cooperative study are both necessary but they both are drawn into a common vortex unless supplemented and invigorated by individual study.

Individual study alone starts the waves which roll on and on toward the unseen and unknown shore. Working in harness is most excellent for the development of the team, but the freedom of the fields is necessary for the growth of the individual. What an inspiration comes through the exploration of the limitless fields! What a thrill comes when the individual receives a new interpretation or new revelation of nature's laws! How hopeless to read a description of the country one is about to explore. It is known only by exploring it. Individuality derives strength from the history of science, its workers and their work; but no record or experience coincides with it. They are as guide posts which disappear at the frontiers of science and individuality must wander on alone. The light from the north star may direct its footsteps but the light which comes from the soul spurs it on. The traditional home of individuality is in the university, and here is the one place where it should be fostered and encouraged. It is fair to presume that in each of our medical schools there are to-day students of great potentiality who need but the stimulus and opportunity to become leaders in science. How shall they be given the opportunity. One of the simplest of the initial steps to be taken would be to grant them the privilege of electing a certain portion of their work both quantitatively and qualitatively. The privilege of adjusting study to capacity should be restored. It was distinctive of the earlier ages and each successive generation has lessened the privilege. The students of our day are expected to know more and must consequently attempt to learn more than the most brilliant intellectual leaders of the past, who would be content to-day with the schooling of Horace, of Shakespeare or Darwin. Where they learned one thing we are attempting to learn a half dozen. They acquired knowledge; we attempt to. We can not keep the medical students marching in the trodden paths of their predecessors until weary and heartsick they complete the march, only to find that they have also acquired mental debility on the way. We must encourage them to forsake the trodden paths, to break tradition when tradition is outgrown, and to explore the unknown fields. Individuality can never be limited to the mechanism of public order, either within or without the school. Life is bigger, it asks for more. There is only one way to develop strong men, and that is by helping them to become independent thinkers. Electives are the stepping stones to independent thought, and independent thought is the threshold of knowledge.

Throughout nature there are many beautiful pictures of collective and individual effort.

Who can but envy the ideal presented in the life of the wild honey bee that belongs to the swarm and works with her companions for a common purpose. Her coming and going are regulated by no schedule or master. She goes through the forests, along the streams, over the meadows, from flower to flower, gathering nectar from wherever it can be found. Ever going, ever returning, she not only increases her particular store, but enlarges that of the swarm. Beyond and above all these, and all unknown to her, she gives to mankind greater blessings in flowers and fruits.

Let us give to the student opportunity and encouragement to seek truth wherever it can be found. In bringing truths together he builds not only for himself but also increases the common fund of useful knowledge. Beyond and above these, he helps to build a great fund of knowledge which will illuminate life in the years to come.

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HYDRA IN LAKE ERIE

We seldom think of Hydra as of outstanding economic importance. However in this connection some interesting data were obtained by the writer during the summer of 1920 while staying at a pound-net fishery on the north shore of Lake Erie near Merlin, Ontario. The fishery is located about midway between Rondeau and Point Pelee, and from it are operated 20 pound-nets in four strings, 5 pound-nets in a string. The strings are approximately three miles apart and this would mean about nine miles from the most easterly string to the most westerly. In midsummer all the nets were taken out of the lake, some replaced from a reserve stock, the others simply reset after being washed, dried, mended and tarred. This midsummer cleaning is necessary because of the algal and other growths which accumulate on the nets making them heavy as well as putting considerable strain on the nets, especially in stormy weather, through the obstruction of the free flow of water through the meshes.

All of the nets when lifted in late July and early August were loaded with a very conspicuous brownish-orange growth in addition to the bright green algal growths. At first sight diatomaceous ooze or a bacterial production was suggested but microscopic examination showed it to be composed of innumerable living Hydras. The nets were lifted into the characteristic flat-bottomed pound-net boats and brought to the dock. The boats were anchored 100 to 150 yards from the dock and the nets dragged through the water to cars on the dock in order to wash off some of the loose material, especially mud. In addition to the mud many Hydras were washed off and these gave to the water a brownish-orange color quite distinct from the lighter color of the mud. The bottoms, seats, etc., of the boats were covered with Hydras to the depth of from ⅛ to ¼ inches and a quart jar was quickly filled by simply running a hand along the seats. A fisherman eight miles to the west and another seven miles to the east reported Hydra in apparently equal abundance. This means a distribution of at least fifteen miles along this part of the shore. The beach is sandy to gravelly with some large stones. Very little life was found on the bottom out as far as one could wade. However out beyond the region of strong wave action there must be places of attachment for the Hydras other than the nets in order to account for the existence of the species from one fishing season to another, since in 1920 they had not reached sexual maturity by the first week in Decemoer when the nets were removed for the season.

Specimens of this Hydra were submitted to Professor Frank Smith of the University of Illinois who kindly stated that they without doubt were *Hydra oligactis* Pallas although absolute determination could not be made in the absence of gonads. He stated that the large size and numerous buds indicated optimum conditions of food and temperature.

Fishermen had frequently spoken about a poisoning which often affected them while handling the nets during the process of cleaning and mending. They said this occurred chiefly after the nets had dried and were covered with a fine dust which they called tar dust. No poisoning was observed during this summer but the men stated that their hands and faces became inflamed and swollen especially if there were any cuts. The eyes were often affected also. Lack of time prevented carrying out any experiments but it seems quite probable that the poisoning could have been traced to the Hydras. The dust was composed of dried sediment and organic matter and certainly must have contained a high percentage of Hydra remains.

This account has been written to call attention to an economic problem in relation to the fishing industry, which awaits study. There would appear to be at least four points for investigation.

(1) The amount of interference and injury caused to the nets by these great growths.

(2) The question of the poisoning of the fishermen.

(3) Do these Hydra destroy young fish to any appreciable extent in open water? Beardsley in 1902 in Bull. U. S. Fish. Comm., vol. XXII, pp. 157-160, recorded the destruction of trout fry by Hydra in a hatchery at Leadville, Colo.

(4) To what extent do these immense numbers of Hydra reduce the entomostracan food supply of young fish and of mature fish such as the ciscoes? The latter in Lake Erie feed almost exclusively upon *Entomostraca* and if the Hydra are as abundant throughout the lake as they are along the fifteen miles of shore as described above they must be very serious competitors of these fish in the matter of food.

Since the above was written Professor Paul S. Welsh of the University of Michigan has informed me that he has been making a special study of Hydra in the Lakes of Northern Michigan.

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A MOSQUITO ATTRACTANT

Certain facts regarding the possibility of attracting mosquitoes were disclosed in the course of experiments made in 1919 which may have a bearing on mosquito control. Press of other work has prevented further development of this project and the following notes are offered for the consideration of those who may care to give the matter further attention.

A number of possible attractants were tested. Among these were crude mixtures of the components of perspiration and of blood which seemed to produce faint, erratic response from the mosquitoes, but it was found that a degree of warmth somewhat above that of the surrounding air was highly and consistently attractive to a certain percentage of these insects. Thus a joint of stove pipe placed in the woods and warmed somewhat by an alcohol lamp, attracted about as many mosquitoes as were attracted by persons in the vicinity. It must be said, however, that in all of our field tests of this attractant the mosquitoes were scarce.

In most of the laboratory experiments with heat *Culex pipiens* was the species used and the insects were liberated at will, as bred, into a cage about 20 x 20 x 15 inches square having the top and three sides of cheese-cloth, the bottom of wood, and the fourth side of glass for observation. The source of heat was water in a glass flask which was heated by an alcohol lamp. Air bubbled through this water through tubing by means of a pump in connection with a gas bag and was afterwards delivered to a funnel the open face of which, covered with cheese-cloth, was placed very near but not touching the side wall of the mosquito cage. A thermometer was inserted in this funnel.

As the temperature rose to a point where it exceeded somewhat that of the surrounding air a sinister beard-like growth would appear on that part of the cheese-cloth wall of the cage covered by the mouth of the funnel. This was produced by the beaks of the mosquitoes which were pushed through the cloth with great persistence as long as the current of warm, moist air was kept within certain limits of temperature. There seemed to be no specific optimum temperature but the maximum response occurred between 90 and 110 degrees Fahrenheit which represented temperatures from 15 to 30 degrees higher than that of the surrounding air. When the temperature reached 120 degrees less interest was displayed and at 140 degrees the mosquitoes were entirely dispersed.

At temperatures below 85 degrees there was very little response if any.

A comparatively small number of the mosquitoes reacted positively to heat at any one time; thus with 300 mosquitoes in the cage perhaps not more than fifteen or twenty would be attempting to feed at the height of the reaction. Whether the same individuals were concerned in each of a series of such responses or whether various individuals at different times took part, was not determined.

In nearly all of these experiments, which were made in an open insectary, no attempt was made to eliminate the odor of the observer but in some tests made in a closed room in an air-tight apparatus the mosquitoes responded in the usual manner when air was drawn from outdoors through a long tube. It is interesting to note, however, that when the breath was bubbled through the water instead of the usual current of air a decided increase of interest on the part of the mosquitoes was manifest. The admixture of various amounts of carbon dioxide with the air stream did not increase the interest over that shown for undiluted air.

In one series of experiments a hole about two inches square was cut in the lid of each of two pasteboard boxes which were exactly alike. These holes were covered with cheesecloth and a layer of absorbent cotton was supported immediately beneath this cloth. In one box the cotton was moistened with cool water while in the other it was moistened with hot water and was supported by a bottle containing hot water. When these two boxes were exposed in the mosquito cage considerable numbers of the mosquitoes would visit the warm box and attempt to feed while they paid no attention to the cool box.

Several types of traps in which heat was employed as an attractant were tested in the field and mosquitoes could be caught in even the crudest of these traps but the insects were also able to escape from all of them, displaying decidedly more ingenuity in this respect than is shown by the house fly. Experiments with more complicated traps were cut short owing to the entire disappearance of mosquitoes.

It was also found that mosquitoes in cages fed readily upon a solution of potassium arsenite in sweetened water and that this material was highly toxic to them. This suggested the use of such a poisoned bait in heat traps and traps were also devised in which the insects might be destroyed upon entering a chamber containing potassium cyanide. Neither of these agencies could be tested in the field.

S. E. CRUMB

BUREAU OF ENTOMOLOGY,
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SCIENTIFIC EVENTS

HEINRICH SUTER

ON March 17 there passed away Heinrich Suter, for many years gymnasialprofessor in Zurich, Switzerland, and a noted student of the history of Arabic mathematics and astronomy. For thirty years he was active as a translator and commentator of Arabic authors. The twenty years preceding 1892, when his first distinctly Arabic research was published, were years of preparation, during which he published a history of the mathematical sciences and a number of papers on mathematics during the Middle Ages in Europe. Most of his shorter articles appeared in the *Bibliotheca Mathematica* and in Schlömilch's *Zeitschrift für Mathematik und Physik*. As regards the quality of Suter's extensive studies of Arabic science it is enough to say that they are highly respected in an age when higher standards of historical accuracy are being established in Europe.

Suter was born on January 4, 1848, at Hedingen, near Zurich; he studied in Zurich and Berlin, and took his doctorate in 1872.

FLORIAN CAJORI

THE CALCUTTA SCHOOL OF TROPICAL MEDICINE

THE *British Medical Journal* states that the School of Tropical Medicine and Hygiene and the Carmichael Hospital for Tropical Diseases at Calcutta were opened by Lord Ronaldshay, governor of Bengal, on February 4. In the issue of December 3, 1921 (p. 957), it was noted that the School of Tropical Medicine and

Hygiene had begun work in the previous November, when a telegram of congratulation, announcing that the first lectures had been given, had been sent by the director, Lieutenant-Colonel J. W. D. Megaw, I.M.S., to Sir Leonard Rogers, who played the leading part in the inception and carrying through of this great enterprise. In the *Journal* of April 23, 1910 (p. 1010), the very great advantages which Calcutta offered for the establishment of a school of tropical medicine were pointed out; not only is the variety of clinical cases illustrating tropical diseases unsurpassed, but there is an excellent hospital and medical school, with a highly qualified staff accustomed to teaching, and for the greater part of the year the climate is no drawback. Some eleven years ago the general scheme for the school of tropical medicine was worked out by Sir Leonard Rogers, but its subsequent history has been marked by many delays, not a few of them to be traced to the war; the foundation stone was actually laid by Lord Carmichael, governor of Bengal, in February, 1914. The hospital has accommodation for about 100 patients, European and Indian, while the school has chairs of tropical medicine, pathology and bacteriology, protozoology, pharmacology, serology, public health, and chemistry, to which appointments have already been made; professors of hygiene, entomology, and biochemistry have still to be appointed. In addition, there are assistant professors of the chief subjects, and a number of special research appointments have been made. The nucleus of a reference library has been formed, mainly by gifts from Sir Leonard Rogers. In the report of the director for 1921 it is stated that classes will shortly be opened for the diploma in public health of Calcutta University; classes for the diploma in tropical medicine have already begun. The director considers that the result of the first year's working has entirely removed the doubts and fears which assailed him when he entered on his responsible duties. Considerable progress has also been made in the research laboratories, and reports have been published of work in connection with leprosy and kalazar and filariasis, and on the work of the hookworm laboratory.

FIELD WORK OF THE MUSEUM OF ZOOLOGY OF THE UNIVERSITY OF MICHIGAN

During the next fiscal year, which begins on July 1, the Museum of Zoology of the University of Michigan will carry on field work in Michigan, California, Washington, Oregon, North Dakota, Tennessee, Curacao, Panama, Mexico, Brazil and British Guiana.

Fifteen persons will be in the field: Carl L. Hubbs, Norman A. Wood, Lee R. Rice, Mina Winslow, Frederick M. Gaige, Helen T. Gage, Theodore H. Hubbell, and Alexander G. Ruthven, of the museum staff, and Crystal Thompson (Amherst College), Robert Hatt (University of Michigan), Rolland Hussey (Bussey Institution), Horace B. Baker (University of Pennsylvania), Thomas L. Hankinson (Michigan State Normal School), and Jesse Williamson and John Strohm of Bluffton, Indiana.

The work in North Dakota will be done in cooperation with the North Dakota Biological Station, of which Professor R. T. Young is director.

The work in western Brazil is under way and is being directed by Jesse Williamson. The party will remain in the field until sometime next year.

BRANCHES OF THE PSYCHOLOGICAL CORPORATION

Executive committees for branches of the Psychological Corporation have been organized in several states as follows:

Massachusetts: William McDougall, *chairman;* Herbert S. Langfeld (Harvard University), *secretary;* Edwin G. Boring, W. F. Dearborn, W. R. Miles, Daniel Starch, F. L. Wells.

Pennsylvania: W. V. Bingham, *chairman;* E. K. Strong, Jr. (Carnegie Institute of Technology), *secretary;* Clarence E. Ferree, Francis N. Maxfield, B. V. Moore, J. H. White, Lightner Witmer.

Ohio: George F. Arps, *chairman;* Harold E. Burtt, (Ohio State University), *secretary;* B. B. Breese, B. R. Buckingham, Henry H. Goddard, H. M. Johnson, Garry C. Myers.

Michigan: W. B. Pillsbury, *chairman;* H. F. Adams (University of Michigan), *secretary;*

S. A. Courtis, C. H. Griffitts, G. M. Whipple, Helen B. T. Wooley.

Illinois: Walter Dill Scott, *chairman;* Frank N. Freeman (University of Chicago), *secretary;* Madison Bentley, Elmer E. Jones, Charles H. Judd, E. S. Robinson.

In addition to the branches that have been definitely established by the psychologists of the states named and approved by the executive committee of the directors of the corporation, other branches are in course of organization.

All members of the American Psychological Association who are interested directly or indirectly in the applications of psychology, as well as other competent psychologists approved by the branches, may be members of the branches. Correspondence in regard to the Psychological Corporation in the states named should be addressed to the secretaries of the executive committees.

GEOGRAPHICAL MEETING IN NEW YORK CITY

The sixth joint meeting of the American Geographical Society and the Association of American Geographers will be held in New York, Friday and Saturday, April 28 and 29. The sessions will be held at the Exhibition Room of the American Geographical Society, Broadway at 156th Street. Professor Harlan H. Barrows, president of the association, will preside at the sessions. The joint meeting will be called to order on Friday morning by Mr. John Greenough, president of the American Geographical Society.

The Belleclaire Hotel, at the corner of Broadway and 77th Street, will be headquarters for association members. The American Geographical Society has against invited the members of the association and invited speakers to be their guests from Thursday afternoon to Saturday noon. Non-members, as always, will be cordially welcomed to all program sessions.

Space in the Exhibition Room has been reserved for an exhibit, by members of the association of new maps and diagrams. Members are urged to send any geographical material they desire to have displayed in advance of the meeting. The noon hour each day gives an opportunity to discuss materials on exhibit, an opportunity that has proved very helpful in the past.

The society's building can be reached by the uptown subway train marked Broadway and Seventh Avenue Express, Van Cortlandt Park, or Dyckman Street, or 215th Street, from any Broadway station. The 72nd Street subway express station is five blocks south of the hotel; the 79th Street local station is two blocks north. At certain hours change must be made from a local to an express train at 96th Street.

The program is as follows:

FRIDAY MORNING SESSION

Vilhjalmur Stefansson: Colonizing the lands beyond the treeline.

Alfred H. Brooks: The future of Alaska.

H. N. Whitford: Present and prospective use of tropical lands and tropical forests as illustrated by the Philippines.

FRIDAY AFTERNOON SESSION

Oliver E. Baker: The problem of land utilization and its geographic aspects.

Carl O. Sauer: The problem of the cut-over pine lands of Michigan.

Hugh H. Bennett: The soils of the Southeastern States and their utilization.

FRIDAY EVENING

Round Table Conference: Methods and problems in the study of land utilization.

SATURDAY MORNING SESSION

E. F. Gautier (University of Algiers): Native life in French North Africa.

H. A. Brouwer (Delft Technical Institute); Physical features of the Dutch East Indies.

C. W. Bishop: Geographical factors in the early culture development of Japan.

SIGMA XI AT McGILL UNIVERSITY

The thirty-sixth chapter of Sigma Xi was installed on April 13 at McGill University, Montreal. This event marks an epoch in the society's progress inasmuch as the McGill chapter is the first one to be established outside the United States. It is expected that there will soon be other petitions from the Dominion, and that Canadian institutions will take an active part in the society's affairs.

The charter membership of the new chapter comprises 41, including representatives of both pure and applied science and medicine. Four of the members are also fellows of the Royal

Society, a somewhat new distinction to come to Sigma Xi.

The installation ceremonies were conducted by Dr. Henry B. Ward, president of Sigma Xi, and Dr. Edward Ellery, secretary of the national organization. After the routine business had been transacted, Dr. Ellery delivered the charge to the new chapter, tracing the history of the society since its inception at Cornell in 1886, and outlining the gradual evolution of its ideals and methods of functioning.

The installation dinner was held in the evening at the Mount Royal Club. The chapter had as its guests Sir Arthur Currie, principal of the university; Dr. Gordon Laing, dean of arts and chairman of the Graduate School; Mr. W. M. Birks, of the board of governors; Dr. Georges Baril, of the Université de Montréal; Mr. E. J. Archibald, managing editor of the Montreal *Star*, and Mr. R. L. Hamilton, president of the Students' Council, as well as Dr. Ward and Dr. Ellery. The toast to McGill University was responded to by Sir Arthur Currie, that to Sigma Xi, by Dr. Ward in an inspiring address, and that to the new chapter, proposed by Dr. Ellery, by Dr. F. D. Adams, vice-principal and dean of applied science.

The officers of the McGill Chapter are:

President: Dr. W. W. Chipman.

Vice-presidents: Dr. A. S. Eve. F. R. S., Dr. J. Bonsall Porter.

Secretary-treasurer: Professor R. DeL. French.

Executive committee: Dr. H. G. Barbour, Professor F. E. Lloyd, Dr. D. A. Murray.

The secretary expresses the hope that no member of Sigma Xi may pass through Montreal without giving the McGill Chapter an opportunity of welcoming him to the city and of assisting him in every possible way.

THE SALT LAKE CITY MEETING

The summer session of the American Association for the Advancement of Science to be held in conjunction with the sixth annual meeting of the Pacific Division of the Association at Salt Lake City, June 22 to 24, 1922, promises to be a very successful meeting.

Salt Lake City offers many advantages as a meeting place. The center of a rich agricultural and mining section, it has large and important commercial and manufacturing interests. But it is perhaps chiefly famed for its scenic attractions drawing every year thousands of tourists by auto and railway from all parts of the country. The opportunity will be seized by many who will wish to combine a pleasure trip to one of the most interesting sections of the west with the advantages of a scientific meeting. Here will be met delegates from the educational centers of the Pacific Coast as well as from the middle western and eastern states. Many men active in science who have not found it possible to attend the eastern meetings will be at Salt Lake City. Contacts and relationships will be established that will widen the horizon of those attending and prove of lasting benefit.

The hosts of the Salt Lake City meeting will be the University of Utah, the Utah Academy of Sciences, the Utah Agricultural College and the Brigham Young University. Arrangements will be made for the comfort and entertainment of visitors. The meeting will be held under the auspices of the Pacific Division of the Association. Dr. Barton Warren Evermann, the president of the Pacific Division, American Association for the Advancement of Science, will preside at the general sessions and will deliver the presidential address at the opening session on Thursday evening, June 22. He will speak on "The conservation and proper utilization of our natural resources."

An outstanding feature of the meeting will be a symposium on "The Problems of the Colorado River." The great reclamation project which has for its object the utilization of the waters of the Colorado River has already attracted wide attention. It is proposed to consider in this symposium the scientific aspects of the problems involved. The arrangement of the symposium is as follows:

1. General description of the Colorado River: Mr. E. C. La Rue, hydraulic engineer, United States Geological Survey, Pasadena, California.

2. Archeology of the Colorado River Basin: Professor H. R. Fairclough, Stanford University, California.

3. Geology of the Colorado River Basin: Dr. Frederick J. Pack, Deseret professor, department

of geology, University of Utah, Salt Lake City, Utah.

4. The conservation of the waters of the Colorado River from the standpoint of the Reclamation Service: Mr. Frank E. Weymouth, chief of construction, United States Reclamation Service, Denver, Colorado.

5. The interstate and international aspects of the Colorado River problem: Dr. C. E. Grunsky, vice-president of the Pacific Division, American Association for the Advancement of Science, San Francisco, California.

The preliminary announcement of the meeting will be issued shortly to members with further details of the meeting.

While none of the sections of the national association will arrange to hold sessions at this summer meeting the various fields of science will be represented in the meetings of the affiliated societies of the Pacific Division. Those scheduled to hold meetings at Salt Lake City are:

The American Physical Society.

The American Meteorological Society.

The American Phytopathological Society, Pacific Division.

The Ecological Society of America.

The Society of American Foresters.

The Cooper Ornithological Club.

The Pacific Coast Entomological Society.

The Pacific Slope Branch, American Association of Economic Entomologists.

The Plant Physiologists.

The Utah Academy of Sciences.

The Western Psychological Association.

The Western Society of Naturalists.

SCIENTIFIC NOTES AND NEWS

The degree of doctor of science will be conferred in May by Liverpool University on Sir Charles Sherrington, Waynflete professor of physiology at the University of Oxford, president of the Royal Society and of the British Association for the Advancement of Science.

The honorary degree of doctor of science has been conferred on Sir Thomas Muir by the University of Cape Town, in recognition of his researches in mathematics and mathematical history. Sir Thomas Muir was superintendent-general of education for Cape Colony from 1892 to 1915.

The University of Dublin will confer the honorary degree of master of surgery upon Dr. George E. Armstrong, professor of surgery at McGill University, Montreal.

Professor Edwin G. Boring, of Clark University, gave a lecture at Wellesley College on April 18, on "The language of the emotions."

Dr. Max Planck, professor of mathematical physics at Berlin, has been elected a foreign member of the Swedish Academy of Sciences, Stockholm.

In order to secure scientific data on the value of moving pictures for use in teaching, the Commonwealth Fund, of New York, has given $10,000 for the use of Professor Frank N. Freeman, of the University of Chicago, in the systematic study of the educational value of various kinds of pictures.

At the recent meeting of the German Microbiologic Society, the annual prize from the Aronsohn Foundation, amounting to 25,000 marks, was awarded to Dr. J. Morgenroth, professor of bacteriology at the University of Berlin and chief of a department in the Koch Institute.

Dr. R. D. Carman, of the Mayo Foundation, has been elected an honorary member of the Roentgen Society of London.

Sir Gerald Edward Chadwyck-Healey, Bt., has been appointed a member of the Royal Commission on Awards to Inventors, to fill the vacancy caused by the resignation of Lord Rayleigh.

Dr. C. S. Myers has resigned from the directorship of the psychological laboratory of the University of Cambridge in order to devote his whole time to the work of the British National Institute of Industrial Psychology.

Frederick W. Sperr, Jr., chief chemist of the Koppers Company, Pittsburgh, Pa., has been awarded the Beal medal by the American Gas Association, in recognition of his work and paper, presented at the convention of the organization last November, entitled "The Seaboard Liquid Process of Gas Purification."

At a meeting held in Chicago on April 7, a Chicago Association for the Relief and Prevention of Heart Disease was formed to undertake the type of work carried on by similar organizations in New York and Philadelphia. The following officers were elected: *President,* Dr. James B. Herrick; *vice-president,* Dr. R. B. Preble; *secretary,* Dr. Sidney Strauss; *treasurer,* Frank O. Hibbard.

The sixth annual clinical session of the American Congress on Internal Medicine held in Rochester, Minn., April 3 to 6, was attended by about three hundred physicians. Dr. Sydney R. Miller, of Baltimore, was re-elected president, and Dr. H. S. Plummer, of Rochester, first vice-president of the organization.

Professor Harold E. Babcock, of Cornell University, has sailed for Bermuda at the request of the Colonial Government, and will remain there a month to assist the agricultural population of the islands to increase their efficiency in the production and distribution of their crops.

The Entomological Club of Madison (Wisconsin) arranged for a radio phone lecture on "Bugs and Antennæ" by Dr. E. P. Felt, state entomologist of New York, sent out by the broadcasting station of the General Electric Company at Schenectady on April 24. Madison is well within the range of this station with fair conditions and the lecture could therefore be heard over much of the eastern United States and Canada.

Dr. C. H. Mayo delivered the Joyce lecture in neurologic surgery before the Academy of Medicine at Portland, Oregon, and the Jerome Cochran lecture before a meeting of the Medical Association of the State of Alabama at Birmingham.

Sir Thomas Lewis will deliver the Noble Wiley Jones lectures under the auspices of the medical school of the University of Oregon between May 15 and 19. The lectures will deal with auricular fibrillation, quinidine and digitalis.

Dr. P. Chalmers Mitchell gave two lectures during March at the Royal Institution on "The cinema as a zoological method."

The Oxford Romanes lecture for 1922 will be delivered on May 24 by Professor A. S. Eddington, Plumian professor of astronomy at Cambridge and president of the Royal Astronomical Society. The subject will be "The theory of relativity and its influence on scientific thought."

Lingan Strother Randolph, consulting engineer and professor of mechanical engineering at the Virginia Polytechnic Institute for twenty-five years, died on March 7, at the age of sixty-three years.

George Ballard Mathews, F.R.S., who was lecturer in pure mathematics and then professor of mathematics at the University College of North Wales, Bangor, from 1884 to 1896, has died at the age of sixty-one years.

The death is announced, at the age of fifty-four years, of Professor Emil Heyn, director of the Kaiser Wilhelm Institut für Metallforschung, Berlin-Dahlem.

A fellowship at the University of Manchester for the encouragement of research in preventive medicine has been instituted in memory of the late Auguste Sheridan Delépine, professor of public health and bacteriology in the university from 1891 to 1921.

The John Macoun Memorial Committee of the Ottawa Field Naturalists' Club announces that, as the number of copies to be issued of the autobiography of the late Professor John Macoun, naturalist to the Geological Survey of Canada, is limited, orders, with or without the subscription price of $3.00, should be sent in by May 15, addressed to Mr. Arthur Gibson, treasurer, John Macoun Memorial Committee, Birks Building, Ottawa, Canada.

The *Journal of the American Medical Association* says in regard to the centennial of the birth of Pasteur, who was professor of chemistry at Strasbourg from 1852 to 1854, that two celebrations are planned in that city, one on the exact date, and another, with great ceremony, on June 1, 1923, when an exhibition will be opened to demonstrate the progress that has been realized in consequence of Pasteur's discoveries, and the Pasteur monument will be unveiled. Professor Borrel, 3 rue Koeberlé, Strasbourg, is in charge of the exposition. The Academy of Medicine has decided to devote one of its sessions in honor of the work of Pasteur. As the Pasteur Institute intends to commemorate this anniversary on the exact date, December 27, 1922, the Academy of Medicine has chosen December 26, the eve of the Pasteur Institute's celebration, in order that the same guests may participate in the two ceremonies. At the session will be presented data showing the progress accomplished since Pasteur's days in general biology, medicine, surgery, obstetrics, veterinary medicine and hygiene. Members of the academy who have been chosen to deliver addresses are: Widal, medicine; Delbet, surgery, Wallich, obstetrics; Barrier, veterinary medicine, and Calmette, hygiene.

The United States National Museum has recently secured by purchase, through the cooperation of the United States Department of Agriculture, the large private herbarium of Dr. Otto Buchtien, formerly director of the Museo Nacional, La Paz, Bolivia, built up by him through many years of botanical exploration in South America and through exchanges with institutions in many parts of the world. The herbarium consists of approximately 45,000 specimens, and is notable for its large proportion of tropical American species, particularly of the floras of Bolivia, Chile, Argentina and Paraguay.

The thirty-fourth meeting of the German Society of Internal Medicine will be held at Wiesbaden from April 24 to April 27, under the presidency of Professor L. Brauer. The chief subjects for discussion will be jaundice, introduced by Professor Eppinger, of Vienna, and the hypophysis, introduced by Professor Biedl, of Prague.

The American Medical Association announces that the committee on therapeutic research of the Council on Pharmacy and Chemistry will consider applications for grants to assist research in subjects which, in the opinion of the committee, are of practical interest to the medical profession, and which research might not otherwise be carried out because of lack of funds. Requests should state the specific problem which is to be studied, the qualifications of the investigator, the facilities available to him, and, if work is to be undertaken in an established research institution, the name of the individual who will have general supervision. The committee will also appreciate offers from research workers to undertake investigations of questions which may be suggested by the council. Applications should be addressed to Chairman, Therapeutic Research Committee, Council on Pharmacy and Chemistry, 535 North Dearborn Street, Chicago, Illinois.

It is announced in *La Géographie* for November 1921 that an attempt to cross the Sahara with twelve motor vehicles will shortly be made. The starting-point will be Tuggurt, the terminus of the Algerian railway, and the proposed route leads by Insalah, the Hogger region, and Adar of the Iforas, to Bureni on the Niger, 200 kilometers east of Timbuktu. The leader of the expedition will be Commandant Lafargue, and it will include a dozen members representing various government departments and other interests, among them being a cinema operator. It is hoped that the difficulty caused by the evaporation of the motor spirit in so torrid a climate has been overcome, but it is pointed out that there is a vast difference between the exceptional use of motor traction in this region for a special purpose, which may be feasible, and its regular commercial use.

Dr. Walter Libby, the historian of science, is delivering a novel series of lectures to the Industrial Fellows of the Mellon Institute of Industrial Research, the faculty members of the University of Pittsburgh, and the students of the graduate school of the university. The aim of this series of discourses is to discover the mental conditions of successful research. Dr. Libby takes account of certain phases of individual (or differential) psychology, deals with some of the more fruitful logical processes, and considers the means of stimulating the spirit of scientific discovery. The illustrative material is drawn from the records of the progress of chemistry and other sciences. The following is an outline of the course of lectures: (1) The Scientific Imagination; (2) The Hypothesis; (3) Conceptual Thinking; (4) Induction (contrasted with Deduction); (5) Reasoning by Analogy; (6) The Nature of Cause; (7) Experiment and Observation; (8) Scientific Laws; (9) Social Stimulation of Investigation; (10) The Suggestive Value of the Industries; (11) The Classification of the Sciences; (12) The Genetic Method. Dr.

Libby devotes a part of each period, say, twenty minutes of the hour, to a colloquium or critical discussion of the nature and application of the subject under consideration. In this way scientific technic is deliberated upon in all its aspects. These lectures are being delivered from 8:30 to 9:30 a.m. on Tuesday of each week of the present university semester, in the Fellows' Room of the Mellon Institute.

UNIVERSITY AND EDUCATIONAL NOTES

The will of the late Miss Janet Williams, of Frederick, Md., contains a bequest of $30,000 to Hood College, to create and maintain an astronomical building in memory of her father, John H. Williams, to be known as the Williams Observatory.

Festivities are being planned for this spring in honor of the founding of the University of Padua in 1222. Professor Lucatello, the rector of the university, is in charge of the arrangements.

The Japanese ambassador at Vienna has presented the sum of 6,500,000 crowns to the university as a personal donation in tribute to the scientific work being done there in spite of the unfavorable circumstances.

Dr. Clarence C. Little was elected president of the University of Maine on April 7. Dr. Little graduated from Harvard in 1910 and received the doctor's degree in 1914. In 1916 he became an assistant dean of Harvard College and research fellow in genetics for the Cancer Commission of Harvard University. Since his discharge from the army as major he has been research associate in the Station for Experimental Evolution of the Carnegie Institution.

Dr. D. S. Robinson, assistant professor of philosophy at University of Wisconsin, has accepted the professorship of philosophy at Miami University. Dr. E. E. Powell has held the chair of philosophy since 1905 and resigns the chair at the close of this year to devote his time to writing.

John Arthur Randall, secretary of the Advisory Board of the General Staff of the War Department, has been appointed president of Rochester Mechanics Institute. Mr. Randall was selected by the trustees to continue the development of a technical educational program containing liberal components.

Dr. George Thomas, formerly professor of economics in the University of Utah and since 1921 superintendent of public education in Utah, has been installed as president of the university.

DISCUSSION AND CORRESPONDENCE

POPULAR SCIENCE

To the Editor of Science: I am very much interested in Dr. Slosson's letter about popular science writing which appears in Science for March 3, just received. Since some of my own information and experience is along this line it may be worth while for me to make some additional comment.

I think that I can see a large number of conditions involved in the fact mentioned by Dr. Slosson that there is a dearth of popular science writers in this country, but I shall only discuss one or two of them. First and foremost is the malodorous condition of the popular science field which for some time has been so largely and so conspicuously occupied by fabricators, exaggeraters, emotionalists, ignoramuses and exploiters that many people of training and ability hesitate to enter. Furthermore if an entrance is attempted by use of an informative article of clarity and real merit the author may have the humiliation of seeing his work rejected for that of some irresponsible clown or gaudy sentimentalist who is successful in assembling a group of highly stimulating words ("lots of pep") which may or may not have some relation to fact.

Even more important than such discouragement to potential writers is the effect of lax, inaccurate and falsified statement of scientific material upon the reading public. I am sure that for a period of fifty years more hoaxes have been perpetrated by newspapers in the name of science than in any other way. As much as thirty years ago most intelligent people were suspicious of material presented by the public press as science. In the last twenty years this suspicion has been more than justified and many intelligent readers say they either do not read or do not believe the stuff peddled as science by most newspapers. Under such conditions why should the reading public take any interest in popular science writing? For killing this interest the press services, feature syndicates and syndicated newspapers (aided and abetted by renegade scientists and pseudo-scientists) are to blame rather than individual newspapers. This is partly because of commercialized ideas of service, partly because of the mass of material handled and partly because of remoteness from contact with the reading public.

The lack of interest in scientific matter is also probably increased to some extent by the fact which Dr. Slosson mentions as making it appear strange, *i. e.,* the increased teaching of science in our schools. The well informed student is thereby made more critical of the material presented. At the same time his parents become more cautious in reading or referring to it because they fear his ridicule when some point is raised involving inaccurate or garbled press reports.

In my own case I admit very freely that I am fully in sympathy with the man who hesitates to try popular science writing because of its unsavory reputation. I sometimes have a very distinct feeling of disgust when I find an article which I have tried to compose accurately and which I have taken especial pains to verify, printed in close proximity to one of the florid, vacuous, or untruthful type. On the other hand there is a lot of satisfaction when it gets on the editorial page in dignified company, as sometimes occurs.

For nearly three years our institution has been sending out to a number of California newspapers (our present mailing list is fifty-three) biological feature articles written by myself. These have been sent at intervals of one or two weeks free of charge, partly as a matter of experiment but mainly as a sort of university extension activity. We are convinced that the service has educational value and that it is helping to popularize true science. I have myself been surprised at times by the interest expressed in certain articles by people whom I would not have expected to read them, much less express appreciation of them. I have personally interviewed about sixty editors and have had interesting correspondence with others. A large number have shown such interest in my material that I am convinced that the general public is interested in good stuff if properly presented. If eight or nine out of every ten editors express interest in carefully verified scientific material written in popular (non technical and simple and direct) style I am inclined to think that a similar percentage of intelligent readers will do so if one will take time to gain their confidence.

I appreciate the difficulties confronting Dr. Slosson and Science Service and, like him, I am impatient at delay but when I think about how badly the American public has been served in regard to scientific news I realize that it will take long and hard work by a lot of people to get popular science writing on a basis to inspire confidence. There is always the risk that one who finds he can write in popular style will become more interested in the popular side of it than in the science (truth telling) side of writing and will become unreliable, as has often occurred in the past. Hence it is quite evident that the great need is not only for writers of popular style, of scientific training and ability, but also of high ideals of service which can not be broken down under the stress of temptation.

W. E. Allen

Scripps Institution for
Biological Research

TWO NEW WESTERN WEEDS

During the past year two plants, which threaten to become weeds of some importance in the arid and alkaline regions of the West, have been received from the western states. One of these is *Bassia hyssopifolia* (Pall.) Kuntze, a member of the family Chenopodiaceæ, originally described from the region of the Caspian Sea. It apparently has never been recorded as occurring in this country. The first collection was made at Fallon, Nevada, July 28, 1919, by Ivar Tidestrom (No. 10755), and a considerable amount of material for distribution has recently been sent me by F. B. Headley, superintendent of the Newlands Experiment Farm, Fallon, Nevada, which he collected at that place in August, 1921. Mr. Headley reports that the plant is becoming very abundant in that section, but that it has not yet invaded fields of growing crops on good soil, so that it may not prove to be a serious pest. It makes a rank growth on soil which is too alkaline for the usual cultivated crops, and is found in fields which have received no irrigation as well as in those which have been frequently irrigated. Additional specimens have recently been received at the U. S. National Herbarium collected by Professor H. M. Hall (No. 11751) at Los Baños, Merced County, California, October 10, 1921, and by Elias Nelson (No. 1002) at Yakima, Washington, October 3, 1921. Mr. Nelson reports that this plant has appeared during the past five years in the Yakima Valley, where it is spreading, and that it is eaten greedily by stock.

Bassia hyssopifolia is an annual, with much the habit of *Chenopodium album.* The flowers are glomerulate in the axils of small bracts, and are borne in short or elongate slender paniculately arranged woolly spikes, at first usually dense, later elongate and interrupted. Each of the five perianth segments at maturity bears on its back a spine incurved into a hook.

A second weed which apparently has not been reported from this country is *Centaurea picris* Pall., also a native of the Caucasus. Specimens were first recived in May, 1921, from Mr. C. O. Townsend, who reported that the plant was said to be a bad weed in the vicinity of Salt Lake City. Specimens from Idaho Falls, Idaho, collected by Miss Ayres of the Idaho Seed Laboratory, have been forwarded during the past year to Mr. E. Brown of the United States Department of Agriculture by Miss Anna M. Lute of the Colorado Seed Laboratory. Miss Ayres reports that the plant is becoming a serious pest in some parts of Idaho. The species has also been collected during the past year at Clifton, Kansas, by Mr. J. W. Head. Mrs. E. P. Harling of the Kansas State Agricultural College, who has investigated this occurrence, believes that the species may have been introduced in Turkestan alfalfa seed. The only North American specimen in the National Herbarium is one collected at Courtney, Missouri, in 1914, by B. F. Bush (No. 7152).

Centaurea picris is one of the knapweeds or star-thistles of the Old World, numbering several hundred species, some of which have become weeds in this country, while a few others are cultivated for their flowers or foliage. It is a several-stemmed perennial, somewhat tomentose or glabrate, with pinnatifid or dentate lower leaves, smaller and entire upper ones, and rosy or pink medium-sized discoid heads, and is especially characterized among the species known from this country by its involucral characters. The phyllaries are roundish to oblong, with greenish bases and scarious whitish obtuse to acuminate entire or subentire appendages, those of the inner phyllaries somewhat pilose.

It is evident that both of these plants find in the arid alkaline regions of the West a habitat similar to that of their Old World home, and unless measures are taken for their destruction, they may become serious pests, as has been the case in recent years with such plants as the "Russian thistle" (*Salsola pestifer*) and the prickly lettuce (*Lactuca scariola integrata*).

S. F. Blake

Bureau of Plant Industry,
Washington, D. C.

CAT-TAIL (TYPHA LATIFOLIA) AS A FEED

Experiments conducted on the writer's farm demonstrate the practical value of cat-tail as a feed for hogs. Sixty head were turned into a three-acre cat-tail swamp, and obtained sufficient nutriment from the rhizomes to keep them in good flesh for three months. No illness or digestive disturbance was noted.

The following table compares yellow (raw) corn with cat-tail flour, as analyzed by J. A. Le Clerc:

	Corn	Cat-tail
Moisture	6.96	7.35
Ash	0.82	2.84
Fat	2.82	0.65
Protein	7.88	7.75
Carbohydrate	80.83	81.41

The large amount of food material contained in the starchy central core of the typha rhizome was shown by A. P. Claassen, who estimated that one acre would yield a total dry weight of 10,792 pounds of cat-tail rhizomes, or more than two tons of flour, made from the central core.

Typha may be used as a substitute for high-priced corn. It would seem that the best time for feeding would be in the fall and winter, as the starchy content is likely to be highest then.

L. E. Freudenthal

Rosalie Farm,
Las Cruces, New Mexico

SOIL SHIFTING AND DEPOSITS

Mr. Peterson's article on deposition of soil in the Palouse area of eastern Washington and Idaho, which appeared in Science, January 27, 1922, should prove of interest and value to foresters as well as agriculturists in this region. The questions naturally arise: How far is this soil carried into the Bitterroot mountains, and how does it influence the character of the soil and vegetation within the forest areas? The writer's observations in this respect may be of interest in this connection.

Dust storms, commonly referred to as "Palousers," are of comparatively frequent occurrence throughout northern Idaho and northwestern Montana. They accompany high winds from the west and southwest; they are well known and despised by housekeepers in Kalispell, Missoula, Thompson Falls, Libby and all surrounding towns. The dust penetrates into every house and office. When accompanied by rain the window panes and buildings are besmirched with streaks of red soil. One of these storms in March, 1917, laid down on the snow within the timbered region of northern Idaho about 600 pounds of dust per acre. The dust from that storm hung on the trees, even at 6,000 feet elevation, along the Kootenai-Priest Divide throughout the summer of 1917. Settlers say that dust storms are common along the Cœur d'Alene, St. Joe and Clearwater rivers.

The writer has noted the billowy soil surface, unmistakably due to surface shifting of the soil, as far east as Pierce, Idaho, about eighty miles east of Moscow. The soil is unusually deep and fertile and the vegetation is more profuse, with better growth of timber, over the larger portion of the Clearwater Forest in Idaho than occurs on the forests farther north or on the forests of western Montana. It is of interest to note that the Clearwater forest lies directly in the path of the strong west winds from the arid parts along the Columbia River, and that Lewis and Clark, as early as 1806, called attention to the unusually deep and seemingly fertile soil in the Clearwater basin.

These observations lead to the supposition that the accumulation and shifting of soil on the Palouse area have been effective in preventing natural establishment of the forest here in the past, though climatic records indicate that the area should grow western yellow pine; and they strengthen the belief that the unusually good growth of timber, profuse vegetation, and deep soils on certain parts of the western slopes of the Bitterroot mountains in Idaho, are due partly to the fact that soil is carried in by the westerly winds from lava plateaus along the Snake and Columbia rivers.

J. A. Larsen

Missoula, Montana

QUOTATIONS

AN INTERNATIONAL LANGUAGE

There is an increasing demand among scientific men for international agreement as to the choice of a universal auxiliary language. After a long struggle, many of the fundamental tools of thought have been unified. All nations now use the same system of numbers, Arabic numerals, measurements of latitude and longitude, mathematical symbols, chemical formulæ, and, at least in science, the metric system.

But language, the master-key to thought and the vehicle of communication, remains under the curse of Babel. Were it possible by acquiring a second language in addition to the natal language to convey ideas to fellow-workers in every part of the world and to receive their ideas, one of the greatest barriers to the progress of science would be broken down. Time and money would be saved, overlapping of effort prevented, and precision of ideas would be assisted.

For many years there have been efforts towards the establishment of an international language, but chiefly by private persons or by associations formed directly for that purpose. Since 1919, however, governmental, scientific, and international bodies have given serious attention to the practical possibilities. At the meeting of the International Research Council, held in Brussels in the first summer after the war, a committee was appointed to investigate and report on the general problem of an international auxiliary language, and to cooperate with similar bodies established or that might be established for the same purpose.

The Section for Education of the British Association at the Bournemouth meeting appointed a committee which reported to the Edinburgh meeting last autumn. The American Association soon afterwards took a similar step, and its report was presented to the meeting at Toronto last December. The French and Italian Associations have also appointed committees, but as yet these have not issued reports. The delegates representing 12 states presented a resolution in the Assembly of the League of Nations last September taking the definite step of recommending Esperanto, and hoping that the teaching of that language would be made more general in the whole world, so that children of all countries might know at least two languages.

In accordance with the procedure of the league, this motion was referred to a committee under the chairmanship of Lord Robert Cecil. The committee was of the opinion that the question, in which "an ever-increasing number of great states" was interested, should be studied attentively before being dealt with by the Assembly. Accordingly, it is being studied by the secretariat. The British Association committee went further, and definitely recommended the choice of an artificial language, but hesitated to decide between those which have been invented. The American Association recognized the "need and timeliness of fundamental research on the scientific principles which must underlie the formation, standardization, and introduction of an international auxiliary language," and recommended further study.

These various bodies are free from the suspicion of advocating serious study of what might be regarded as a "fad." It is fair to accept their action as witness to the urgency of the problem. There is also evidence of their agreement that an auxiliary language, if it is to serve its purpose, must receive almost universal adoption.

The only suggestions which have received sufficient support to be ranked as serious candidates are Latin, English, Esperanto, and Ido. Latin was at one time the common medium of many nations and has retained a wide currency, directly in religion, less directly in some branches of science, and as the basis of the Romance languages. It is elegant and concise, has a definite system of forming new compounds and derivatives, and, as a dead language, its roots have unchanging significance. But its grammar is difficult; it has many exceptions and irregularities. The revival of Latin would require the coining of a very large number of new words.

English is widely used and is spreading rapidly; its grammar is relatively simple and its vocabulary is rich. But the choice of one among many widespread living tongues would excite a just jealousy. Its spelling is chaotic, and its pronunciation difficult and various. Moreover, a living language reflects the changing activities and emotions of the people who use it in literature and in daily speech, and is therefore unsuited as a vehicle for the cold and precise exchange of international knowledge.

The invented language Esperanto has already made great progress as an international auxiliary tongue; it has held 12 international congresses in different countries; it is taught in schools in Geneva, Breslau, Milan, Czecho-Slovakia, and Bulgaria. Its grammar, pronunciation, and method of word-building are simple, scientific, and easy to acquire, and its root-words have been carefully selected. Ido claims to be a later and improved form of Esperanto; hitherto it has had a smaller vogue, but in appearance and sound it is more attractive.

The balance of advantages seems to lie with the selection of either Esperanto or Ido or some modification of them recommended by experts on language. The vital requirement is that the auxiliary language should be kept auxiliary, the vehicle of formal statement. If it should become a language of common speech, of emotion, or of literature it will at once fail of its purpose and be only an additional linguistic burden.—London *Times.*

SPECIAL ARTICLES

ATOMIC STRUCTURE

There has been considerable discussion in the literature, during the past few months, of the Lewis theory of atomic structure[1] and Langmuir's extension of it to the heavy elements.[2] In 1919 and 1920 the writer worked out a somewhat different extension of this theory. For various reasons its publication has been delayed, but in a few months a paper describing it in some detail is to appear. Because of this delay, a short outline of the theory may not be out of place here.

The *number* of electrons in each shell of the lighter atoms is the same as in the original Lewis theory. It is assumed, however, that the fifth, sixth, seventh and eighth electrons in the second and third shells pair off with the first four, the distance between the electrons in each of these pairs, and also in each pair formed by bonding between atoms, being much less than the distance between pairs. These shells are therefore tetrahedra of pairs instead of cubes of single electrons.[3] The electrons in each shell (after the second) tend to be placed opposite the centers of the faces of the imaginary polyhedron formed by the electron groups in the underlying shell. If a certain shell is a tetrahedron, the next shell out will also be a tetrahedron; if the inner shell is a cube, the outer shell will be an octahedron (six points, eight faces); and if the smaller shell is an octahedron, it will be surrounded by a tetrahedron—four of its eight faces then being occupied—or by a cube.

[1] *J. Am. Chem. Soc.*, 38: 762 (1916).

[2] *Ibid.*, 41: 868 (1919).

[3] *Cf.* Lewis, *loc. cit.*, p. 779.

When the nuclear charge becomes sufficiently great, the same forces which cause pairing of electrons in nitrogen result in the formation of triplets in the inner shells of the heavier atoms. The type of force between electrons necessary to account for these phenomena is discussed in my longer paper and will not be considered here. As one after another of the outer electrons are drawn into an inner shell to form triplets, the remaining pairs are pushed further and further from the nucleus. This may result in rearrangement of the kernel structure, as indicated in the examples of atomic structure given below. Often, in different environments, different kernel structures are stable, some having more valence electrons and fewer triplets than others, etc.

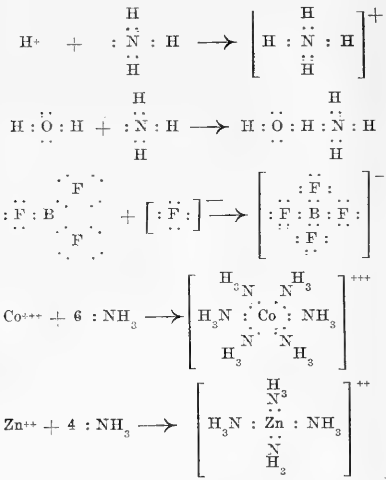
The structures resulting from the application of the foregoing ideas I shall represent by means of formulæ, in which the first parenthesis represents the nucleus and indicates its charge, the remaining parentheses each representing a shell of electrons, in order from the nucleus out. The number of electron-groups and the number of electrons in each group are indicated for every shell, except (in some cases) the valence shell. Formulæ for atoms and ions of some of the elements follow:

H	(+1)(1)
He	(+2)(2x1)
C	(+6)(2x1)(4)
Ne	(+10)(2x1)(4x2)
Cl^-	[(+17)(2x1)(4x2)(4x2)]$^-$ or
	[(+17)(2x1)(8x2)]$^-$
A	(+18)(2x1)(4x2)(4x2) or
	(+18)(2x1)(8x2)
Co^{+++}	[(+27)(2x1)(6x3 + 2x2)]$^{+++}$
Cu^{++}	[(+29)(2x1)(5x3 + 1x2)(4x2)]$^{++}$
Cu^{+}	[(+29)(2x1)(6x3)(4x2)]$^{+}$
Zn^{++}	[(+30)(2x1)(6x3)(4x2)]$^{++}$
Br^-	[(+35)(2x1)(6x3)(8x2)]$^-$
Kr	(+36)(2x1)(6x3)(8x2)
Ag^+	[(+47)(2x1)(8x3)(6x2)(4x2)]$^+$
Sn	(+50)(2x1)(8x3)(6x2)(4x2)(4) and
	(+50)(2x1)(6x3)(8x2)(6x2)(2)
I^-	[(+53)(2x1)(8x3)(6x2)(8x2)]$^-$
Xe	(+54)(2x1)(8x3)(6x2)(8x2)
Ce	(+58)(2x1)(8x3)(6x2)(8x2)(4) and
	(+58)(2x1)(8x3)(1x3 + 5x2)(8x2)(3)
Lu	(+71)(2x1)(8x3)(6x3)(8x3)(3)
Ta	(+73)(2x1)(8x3)(6x3)(8x3)(5)
Au^+	[(+79)(2x1)(8x3)(6x3)(8x2)(6x3)]$^+$

Hg (+80)(2x1)(8x3)(6x3)(8x2)(6x3)(2)
and (+80)(2x1)(8x3)(6x3)(8x3)(6x2)
Nt (+86)(2x1)(8x3)(6x3)(8x3)(6x3) or
(+86)(2x1)(8x3)(6x3)(8x2)(6x3)(4x2)

These and similar formulæ for the other elements express very satisfactorily their known chemical, physical and crystallographic properties. By applying this theory to crystal structures, it has been found possible to determine the arrangements of electrons in nearly all crystals for which the arrangements of atomic centers were already known, and also the atomic and electronic structures *in many cases in which even the atomic marshalling was previously unknown.* These structures furnish incontrovertible proof that this theory of atomic structure, fundamentally and in many of its details, is correct.

An important part of the theory is the idea that a single bond may be formed not only by the attraction between two atoms, each of which contains an unpaired electron in its valence shell, the two single electrons forming a pair, but also by the attraction of an atom containing a "lone electronpair"—one not acting as a bond—for another capable of holding on to this lone pair. The following are typical reactions of this type:



In the last two cases the lone pairs of the nitrogen atoms become bond pairs, assuming positions at octahedron corners opposite the six faces of the distorted cube of the cobalt kernel and at tetrahedron corners opposite the four previously unoccupied faces of the zinc kernel octahedron (or, what is the same thing, opposite the four faces of the zinc kernel tetrahedron). We thus have an entirely satisfactory picture of Werner's "auxiliary valencies" and "coordination numbers." In some cases (*e. g.*, in $Ag(NH_3)_2^+$) all the faces of the kernel polyhedron are not occupied. (In the silver iodide crystal, each silver kernel is surrounded by four electronpairs at tetrahedron corners, showing its true coordination number to be *four.*)

This theory has not yet been applied to the explanation of spectra; nor is it possible to give the *exact* positions of the electrons in each atom. These positions may in fact be merely the centers or foci of electronic orbits. In these and other respects the theory is still incomplete.

MAURICE L. HUGGINS
UNIVERSITY OF CALIFORNIA

A SIMPLE BUBBLING HYDROGEN ELECTRODE

THE electrode described in this paper is the result of an attempt by the writer to combine the principles of the bubbling type of electrode with simplicity of construction and the necessity for only a small amount of solution. That this has been accomplished, seems to be apparent from a study of the accompanying diagram and the behavior of the electrode in numerous tests.

Four models similar to the one shown in the diagram were constructed by the writer and compared with each other and a Bailey electrode. Various standard buffer solutions were tested and it was found that all electrodes gave results that agreed within .3 of a millivolt, which was the limit of accuracy of the galvanometer in the set up.

While the models constructed by the writer require only about 1.5 c.c. of solution, there seems to be no good reason why, with proper precautions, they can not be constructed for smaller amounts of solution. This can be accomplished, not by a smaller model of the same shape, but by making the bottom of the electrode vessel more conical in shape and taking particular precautions in sealing the electrode as near the base of the vessel as is conveniently possible. It is not desirable to materially decrease the diameter of the upper portion of the electrode vessel, because in so doing, the bubbling process is seriously interfered with.

CONSTRUCTION AND OPERATION

The electrode vessel *E* was made by sealing a short piece of glass tubing to an ordinary three inch soda-lime tube. The glass tube was then bent into position to make the side arm, *A*. The electrode proper, which consists of a piece of platinum foil, was sealed as near the base of the main vessel as possible. The protruding end of the foil was bent into a loop and partially embedded in sealing wax to give added mechanical strength. The rubber stopper, *D*, is used to prevent the rapid diffusion of air into the electrode vessel. The support, *S*, shown in the diagram by means of dotted lines, was made from a No. 12, two-holed rubber stopper by cutting out the portion between the holes.

After platinization of the electrode, about 1.5 c.c. of the solution to be tested are put into the electrode vessel, *E*. Purified hydrogen is bubbled through the solution by way of the side arm, *A*. Usually, about three minutes of bubbling are required for saturation.

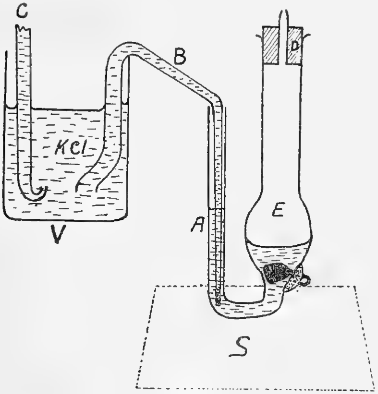


FIG. 1

The diagram shows the electrode in position for a measurement. *C* represents the side arm of the calomel electrode, *V*, a vessel containing a saturated KCl solution, and *B*, a tube filled with saturated KCl and plugged at the smaller end with filter paper to prevent the too rapid siphoning of KCl from *V*.

When properly constructed, this electrode possesses the following features, which should make it applicable for quite general use:

1. Simplicity of construction.
2. Ease of operation.
3. Requires only a very small amount of solution for a determination.

J. ROY HAAG
PENNSYLVANIA STATE COLLEGE

THE OKLAHOMA ACADEMY OF SCIENCE

THE tenth annual meeting was held in Oklahoma City, on February 10, and at the University of Oklahoma, Norman, on February 11, 1922. The following papers were read:

FEBRUARY 10

Presidential address: *The possibility of the redemption of the Great Plains from its semi-arid condition*: J. B. THOBURN.

Some notes on the Bois Fort Chippewa of Minnesota: ALBERT B. REAGAN.

Identification of Anthoceros in the Oklahoma cryptogamic flora: M. M. WICKHAM.

Notes on the migration of Macrochelys lacertine: M. M. WICKHAM.

Further notes on migration of Terrapene carolina in Oklahoma: M. M. WICKHAM.

Identification of fresh water sponges in the Oklahoma fauna: M. M. WICKHAM.

Red and white blood corpuscles and catalase in the blood of non-complement guinea pigs: L. B. NICE, A. J. NEILL and H. D. MOORE.

The regular tetrahedron in relation to its cube and other solids: OSCAR INGOLD.

Oklahoma geography in the high schools: C. J. BOLLINGER.

The poisonous substance in cotton seed: PAUL MENAUL.

The chemistry of the pecan: W. G. FRIEDEMANN.

FEBRUARY 11

Zoology Lecture Room, State University.

Biology Section

The egg-laying habits and early development of Haminea virescens (Sby.): A. RICHARDS.

The acceleration of the cleavage rate of Haminea virescens (Sby.): A. RICHARDS.

A third Christmas bird Census: MARGARET M. NICE.

Fate of leucocytes in the placental circulation: I. What prevents leucocytes of the maternal circulation from migrating into the fœtal circulation? II. The rôle of the syncytial layer of the chorionic villi. III. Importance of this investigation relative to inheritance of disease or immunity from disease: JOS. M. THURINGER.

A new differential staining method for connective tissue combined with the ordinary hematoxylin-eosin stain (Demonstration): JOS. M. THURINGER.

Effect of lime and organic matter on the root development and the yield of alfalfa on the so-called hard-pan subsoils of Oklahoma: M. A. BEESON.

Notes on the parasite fauna: JOHN E. GUBERLET.

A preliminary note on the optic tract of eyeless flies: MILDRED H. RICHARDS and ESTHER Y. FURROW.

Mitotic index of the chick: AUDREY FLITCH SHULTZ.

Somatic mutations and elytral mosaics in Bruchus: J. K. BREITENBECKER.

A preliminary report on the genetics of a red spotted sex limited mutation in Bruchus: C. LEE FURROW.

A preliminary note on the chromosome number in the spermatacite of Bruchus: FRANK G. BROOKS.

The grand period of growth of root-hairs (Lantern): R. E. JEFFS.

Continuous culture of oats versus rotation: H. S. MURPHY.

Multiple adenomata of the kidney cortex with special reference to histogenesis: JULIA STEELE ELEY.

SATURDAY, FEBRUARY 11, 9:30 A.M.

Geology Section

Physiographic history of the Arbuckle Mountains: S. WEIDMAN.

Some observations of erosion and transportation in the Wichita Mountain area: OREN F. EVANS.

Subsurface studies: R. D. REED.

An Oklahoma meteorite: A. C. SHEAD.

Robberson oil field: LEON ENGLISH. Discussion by ROGER DENNISON and ARTHUR MEYER.

Percentage of square mile of oil production in Oklahoma: BESS M. MILLS.

Oklahoma oil resources: C. W. SHANNON.

A new variant of the hidden treasure myth: C. H. GOULD.

The Webber's Falls limestone: J. B. THOBURN.

AFTERNOON SESSION, 1:15 P.M., SATURDAY, FEBRUARY 11

Room 308, Geology Building.

Sykes Alaskan expedition of the University of Oklahoma of 1921: ED. CRABB.

A note on the economic status of the bald eagle in Alaska: ED. CRABB.

On the intensity of the sound as measured by Rayleigh disc or a Webster phonometer: J. H. CLOUD (Read by title).

The simple rigidity of a drawn tungsten wire at incandescent temperature: WM. SCHRIEVER.

Economics and Government

International exchange: A. B. ADAMS.

Responsibility in state government: F. F. BLACHLY.

Public health administration in Oklahoma: MIRIAM OATMAN-BLACHLY.

Psychology

Self-taught arithmetic from the age of five to seven and a half: SOPHIE R. A. COURT.

Further notes on eighteen-months vocabularies: MIRIAM OATMAN-BLACHLY.

A child that would not talk: MARGARET M. NICE.

The following resolutions were adopted:

1. WHEREAS, It is to the best interest of the American people to have research in all branches of science proceed unhampered, the Oklahoma Academy of Science places itself on record against the provision in the Fordney tariff bill now pending in the United States Senate which puts a tariff on books, magazines and scientific apparatus.

2. WHEREAS, It is highly desirable to conserve the natural resources of our state, the Oklahoma Academy of Science places itself on record favoring the work of the Oklahoma State Forestry Association.

The following officers were elected for the ensuing year:

President: R. O. Whitenton, Stillwater.

First Vice-president: S. Weidman, Norman.

Second Vice-president: W. G. Friedemann, Stillwater.

Secretary: L. B. Nice, Norman.

Treasurer: H. C. Roys, Norman.

Curator: Fred Bullard, Norman.

L. B. NICE,
Secretary.

NORMAN, OKLAHOMA

SCIENCE

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Vol. LV, No. 1427

Friday, May 5, 1922

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VOL. LV MAY 5, 1922 No. 1427

HESPEROPITHECUS, THE FIRST ANTHROPOID PRIMATE FOUND IN AMERICA

IT is hard to believe that a single small water-worn tooth, 10.5 mm. by 11 mm. in crown diameter, can signalize the arrival of the anthropoid Primates in North America in Pliocene time. We have been eagerly anticipating some discovery of this kind, but were not prepared for such convincing evidence of the close faunal relationship between eastern Asia and western North America as is revealed by this diminutive specimen. The entire credit for the discovery belongs to Mr. Harold J. Cook, consulting geologist, of Agate, Nebraska, who has been contributing for many years to our knowledge of the extinct fauna of Nebraska through both his discoveries and his writings. He wrote to the present author (February 25, 1922):

I have had here, for some little time, a molar tooth from the Upper, or Hipparion phase of the Snake Creek beds, that very closely approaches the human type. It was found associated with the other typical fossils of the Snake Creek, and is mineralized in the same fashion as they are. I sent a brief description of this to Professor Loomis a short time before the Amherst meeting of this year, with a request that it be read at that time, if opportunity offered. The manuscript was returned to me here immediately after the meetings, but with no notation as to whether it was read or not, or presented at that time in any fashion.

Inasmuch as you are particularly interested in this problem and, in collaboration with Dr. Gregory and others, are in the best position of any one to accurately determine the relationships of this tooth, if it can be done, I will be glad to send it on to you, should you care to examine and study it. Whatever it is, it is certainly a contemporary fossil of the Upper Snake Creek horizon, and it agrees far more closely with the anthropoid-human molar, than that of any other mammal known.

On receiving the tooth, the author telegraphed (March 14, 1922): "Tooth just arrived safely. Looks very promising. Will report immediately." A letter followed the same day:

The instant your package arrived, I sat down with the tooth, in my window, and I said to myself: "It looks one hundred per cent. anthropoid." I then took the tooth into Dr. Matthew's room and we have been comparing it with all the books, all the casts and all the drawings, with the conclusion that it is the last right upper molar tooth of some higher Primate, but distinct from anything hitherto described. We await, however, Dr. Gregory's verdict to-morrow morning; he certainly has an eagle eye on Primate teeth. . . . We may cool down to-morrow, but it looks to me as if the *first anthropoid ape of America* had been found by the one man entitled to find it, namely, Harold J. Cook!

On March 22, 1922, the author wrote:

We believe we have found another one of the teeth, very much worn, of the same animal, which, so far as it goes, is confirmatory. The animal is certainly a new genus of anthropoid ape, probably an animal which wandered over here from Asia with the large south Asiatic element which has recently been discovered in our fauna by Merriam, Gidley and others. It is one of the greatest surprises in the history of American paleontology and I am delighted that you are the man who found it. Our specimen is unrecognizable, it is so much worn.

The tooth arrived with the following label:

One Molar Tooth, ?Anthropoid, No. HC425, Collection of Harold J. Cook, Agate, Nebraska. Found in Upper Phase of Snake Creek Beds, Typical Locality, in position in gravels with other fossils.

Following the examination by Dr. William D. Matthew and the author, who determined the tooth as a second or third upper molar of the right side of a new genus and species of anthropoid, the tooth was submitted to Curator William K. Gregory and Dr. Milo Hellman, both of whom have made a special study of the collections of human and anthropoid teeth in the American Museum and the United States National Museum. They reported (March 23, 1922) as follows:

1. Such a degree of wear is very rarely seen on m^3, and in view also of the marked difference in form of m^3, we rather incline to the opinion that it is an m^2. 2. The kind of wear shown in this tooth, which has an evenly concave surface (without humps representing the para- and metacones), has never been seen in an anthropoid tooth, and we are of the opinion that even in very old chimpanzees the outer half of the crown will be unevenly worn. 3. The nearest in point of wearing surface is the supposed m^2 attributed to *Pithecanthropus,* also in form of roots. The strong hypocone in "*Pithecanthropus*" and the absence of hypocone in the new specimen is not positively diagnostic, in view of the immense differences in the hypocone, both in apes and man. 4. On the whole, we think its nearest resemblances are with "*Pithecanthropus*" and with men rather than with apes.

On the basis of these very careful studies, the author decided to make this tooth the type of the following new genus and species:

Hesperopithecus haroldcookii,[1] new species

This second upper molar tooth is very distant from the gorilla type, from the gibbon type, from the orang type; among existing anthropoid apes it is nearest to m^2 of the chimpanzee, but the resemblance is still very remote. It is excluded from close affinity to the fossil Asiatic anthropoid apes, such as *Dryopithecus punjabicus, Palæopithecus sivalensis,* and *Sivapithecus,* recently related to the human stem by Pilgrim. Its transverse diameter of 11 mm. is greater than its anteroposterior diameter of 10.5 mm. In the corresponding human tooth, m^2, of an American Indian, with which it is compared in Fig. 2, the transverse diameter is 12.5 mm., the anteroposterior diameter is 11 mm. Thus the proportions of the molar crown of the *Hesperopithecus* type are about the same as those in the *Homo sapiens mongoloideus* type. There is also a distant human resemblance in the molar pattern of *Hesperopithecus,* as very skilfully portrayed (Fig. 1)[2] by the artist, Mrs. L. M. Sterling, to the low, basin-shaped, channeled crown in certain examples of *Homo sapiens.* But the *Hesperopithecus* molar cannot be said to resemble any known type of human molar very closely. The author agrees with Mr. Cook, with Dr. Hellman, and with Dr. Gregory, that it resembles the human type more closely than it does any known anthropoid ape

[1] The names signify an anthropoid of the Western World discovered by Mr. Harold J. Cook.

[2] The illustrations will be published by the American Museum of Natural History.

type; consequently it would be misleading to speak of this *Hesperopithecus* at present as an anthropoid ape; it is a new and independent type of Primate, and we must seek more material before we can determine its relationships. It is certainly not closely related to *Pithecanthropus erectus* in the structure of the crown, for *Pithecanthropus* has a single, contracted crown in which the superior grinding surface has a limited crenulated basin, whereas *Hesperopithecus* has a widely open crown with broadly channeled or furrowed margins, and a postero-internal crest suggesting the hypocone of a higher Primate form. The disposition of the roots in *Hesperopithecus*, in *Homo*, in *Pithecanthropus*, is shown to be very broadly similar in comparative Fig. 2. The *Hesperopithecus* molar is three-fanged, the postero-external fang having been broken off in the type; the internal fang shows a median internal groove and a tendency to a deep external groove on the outer side.

Since 1908 there has been in the American Museum collection from this same horizon another small water-worn tooth, discovererd by Dr. William D. Matthew. The specimen belonged to an aged animal and is so water-worn that Dr. Matthew, while inclined to regard it as a Primate, did not venture to describe it. It now appears, from close comparison with the type of *Hesperopithecus*, to be closely related generically, even if it is not related specifically. The greatly enlarged drawing (Fig. 3), reproduced to the same scale as that of the type above described, shows that the molar pattern is fundamentally similar. The crown differs in its much more triangular form and, were it not for its extremely worn surface, we should unhesitatingly pronounce it as a third superior molar; it has, therefore, been given this position provisionally in the diagram; it seems to confirm the opinion of Gregory and Hellman that the type of *Hesperopithecus* is a second superior molar.

The geologic age of these two specimens is now believed to be the same as that of Thousand Creek, Nevada, and Rattlesnake, Oregon, among the fauna of which *Pliohippus* is very abundant and varied; it also contains *Ilingoceras* and other strepsicerine antelopes of Asiatic affinity; it is the last American fauna in which occurred the rhinoceros, preceding the Blanco fauna in which the Asiatic brevirostrine *M. mirificus* first occurs.

HENRY FAIRFIELD OSBORN
AMERICAN MUSEUM
OF NATURAL HISTORY,
NEW YORK, N. Y.

MEDALS AND DINNER OF THE NATIONAL ACADEMY OF SCIENCES

AT the annual dinner of the National Academy of Sciences, held at the Hotel Powhatan on Tuesday evening, April 25, 1922, two medals were awarded.

The J. Lawrence Smith Medal was bestowed upon Dr. George P. Merrill, curator of geology at the United States National Museum. This is a gold medal of the value of $200, from a fund established in 1884, as a reward for "original investigation of meteoric bodies." But because investigators in this field are so rare it has not been given since 1888. Dr. Whitman Cross, in his speech presenting the medal, pointed out that Dr. Merrill had continued to carry on the work of his predecessor, J. Lawrence Smith, on meteorites by the application of modern methods of analysis. The earlier analyses of meteorites were not always to be relied upon, and Dr. Merrill in his long years of research has been able to show that some of the elements previously reported as having occurred in meteorites are absent and, at the same time, he has extended the list of elements and compounds that do exist in these bodies. Among other minerals he has found a calcium phosphate similar to apatite, which has been named in his honor Merrillite. Dr. Merrill also has discovered evidences of metamorphism in meteorites, cases where a mineral structure has been broken up and the fragments later fused together like the conglomerates found in igneous rocks in the earth's crust.

Dr. Merrill in receiving the medal said that meteorites had in all ages attracted a great deal of popular interest. In the earliest times they were worshipped as divine and nowadays the newspapers give great attention to any meteoric fall. Yet few scientists have made them the subject of concentrated and long-continued study. In his work, Dr. Merrill said he had tried to keep his feet upon the earth as though his shoes had leaden soles and to leave to others premature speculation as to the origin of these bodies. It is evident from their composition that they come from regions where there was no air, for they contain iron, both in a free state and in compounds that are not stable in the presence of oxygen. From their structure it is evident that some have undergone secondary igneous changes. In conclusion, Dr. Merrill quoted the verse, "All my dreams come true to other men," and said that he would leave the developments and deductions from his work to future investigators and "may all my dreams come true to other men."

The address bestowing the Daniel Giraud Elliot Medal for the year 1920 was made by Dr. Henry Fairfield Osborn, of the American Museum of Natural History, New York City. This medal is intended to be awarded every year for contemporary contributions to zoology. Previous awards were made to F. M. Chapman, C. W. Beebe and Robert Ridgway. Dr. Osborn sketched the history of paleontology from the time when Cuvier first announced the law of correlation. But the ability of the biologists to restore an extinct animal from a single bone was exaggerated and for a time such general theoretical work fell into disrepute. The great American paleontologists, Leidy, Cope and Marsh, limited themselves mostly to description. But now again the time has come when general principles and relationships may be founded upon a more substantial basis. Among the young investigators who are taking up this work is Professor Othenio Abel, of Vienna, who has undertaken a general study of the causes of evolution. His guiding thought is that morphology depends upon physiology and that to understand a form we must know its function. Professor Abel pursued his studies even during the war when his family was in such distress that he had to send out his children to friends for food, and in 1920 he produced an inspiring work, entitled *Methoden der Paleobiologischen Forschung.*

In the absence of Professor Abel the medal was received by Edgar L. G. Prochnik, Austrian chargé d'affaires, who said that all Austria would rejoice over this honor done to one of her citizens. Conditions in Austria are exceedingly hard at present on account of the curtailment of Austria's resources and it is felt that the future of Austria lies in the mental power of her sons. The Austrian scientists are determined to bring their country to the rank which she occupied in science and art previous to the war. The disposal of this medal was another proof that science was not limited in its scope to creed or nationality. Professor Abel serves in the ranks of science, the peace maker.

President Walcott, in handing over the medal to the representative of the Austrian Legation, said that the award would carry with it an honorarium which was to be forwarded to Professor Abel.

Next, Dr. Vernon Kellogg, permanent secretary of the National Research Council, was called upon to tell something of the work and plans of that institution. The National Research Council, he said, was the child of the National Academy of Sciences, born in the tempestuous times of the war. The child had grown with amazing rapidity and had manifested the characteristic virtues and defects of lusty youth. Some of its parents—the use of this unconventional plural is justified by the collective parenthood—do not know whether to be proud of it or uncomfortably disturbed by it. The motto of the National Research Council is "cooperation and organization." The latter word was looked upon with disfavor and even suspicion by some scientists, but, rightly understood, as the council interprets it, there was nothing to fear from it. He had recently been reading the reports of the visits that had been paid by members of the council to 150 universities, colleges and other laboratories. In all these were found men earnestly engaged in research, often under disheartening conditions and in isolation. The National Research Council can aid and encourage these scattered and ill-equipped scientists to work out their plans in a concerted way. Nothing shall interfere with the individual freedom and initiative which are the main strength of scientific endeavor. Apart from the endowment and building fund, the National Research Council had raised over a million and a half dollars, which was being expended in promoting research work in various lines. Plans for the new building had been exhibited at this session of the academy. This building will cost about $1,300,000, this money being provided by the Carnegie Corporation, and $200,000 had been provided by a score of private donors for the purchase of the ground. The edifice will be worthy of standing in the group of patriotic, philanthropic, international and memorial structures, and here the National Academy of Sciences and her daughter, the National Research Council, may live together in peace and happiness.

The president then asked Dr. William H. Welch to speak on the new School of Hygiene and Public Health founded at Johns Hopkins University and endowed with six millions from the Rockefeller Foundation. Dr. Welch said that the prevention of disease in communities as distinct from the cure of disease individually was comparatively a new profession. The beginning of the public health work may be traced back to the seventeenth century, when three great discoveries were made. One was Captain Cook's success in preventing scurvy in his long voyage in the Pacific by the use of vegetable vitamines. The second was the discovery of the cause of "Devonshire colic," which was found to be due to lead poisoning from the drawing of cider through lead pipes. The third was the introduction of vaccination for smallpox. The Napoleonic wars set back work in this direction as in others, but in the great reform year of 1848 the English Parliament passed the Public Health Act. Then began a campaign directed against filth and for sanitation, water supply and sewage disposal. Now with our new knowledge of the causes of infection and epidemics, public health can be guarded as never before. Yellow fever has been swept from its old haunts, malarial fever can be controlled and typhoid has become so rare that it is difficult to teach it for want of cases. In Baltimore last year a single death from typhoid aroused great excitement among the students who were eager to attend the autopsy as the only opportunity they had to become acquainted with this disease. The new school is to be composed of men and women who are to make the prevention of disease the primary aim of their life work. There are four members of the National Academy of Sciences in the faculty of the School of Hygiene and Public Health.

At the close of the evening Dr. Hendrik Anton Lorentz, of the University of Leiden, was asked to speak and responded with characteristic geniality. He recalled his visit to the United States sixteen years ago and told how glad he was to accept the invitation of the Carnegie Institution of Washington and the California Institute of Technology, Pasadena, where he has been lecturing. Now on the eve of departure he expressed his gratitude for the kindness that had been showered upon him in various parts of the United States which was, he felt, more than he deserved and was, as he had discovered in some cases, due to the fact that he was taken for the Viennese surgeon, Dr. Lorenz. Everywhere he found earnest young men engaged in research which promised great things for the future of science in America. He found nothing to criticize, but took the opportunity of suggesting that perhaps the strenuous life and feverish activity of Americans might be benefited by somewhat of the Dutch restfulness of his own land.

Edwin E. Slosson

THE EDWARD C. PICKERING MEMORIAL

The wonders of the sky present such a fascinating appeal to the general public that large numbers of telescopes are sold each year to the amateur who with keen delight views the marvels of Saturn's rings, the everchanging appearance of Jupiter and his satellites, and the glories of the nebula of Orion. These and many other objects are observed with the greatest of eagerness, and books on descriptive astronomy are bought and are read with great avidity. The pleasures brought by the new telescope are all the more enjoyed if the instrument arrives during the summer season. Then it may be taken out into the garden or on to the roof top and the pleasure is unalloyed by biting winds, cold hands or freezing feet. With the coming of autumn and winter the telescope is used less frequently, and the warmer weather of spring and summer is looked forward to with anticipation. (The writer of this article looks back with anything but the keenest of joy to working for thirteen hours at night at the Yerkes Observatory with the thermometer at twenty-six degrees Fahrenheit below zero). Very frequently the keenness of the astronomical thrills becomes gradually dulled, the small telescope has not sufficient power to show the more remarkable objects in the sky, clouds and cold weather interfere with observing—and soon the telescope is brought out but seldom, and finally is offered for sale.

Many of these amateur star-gazers might have had their interest continued if only their work at night could have had some object other than personal pleasure. The American Association of Variable Star Observers has been of very great value to astronomy by organizing the owners of two-, three-, four- or five-inch telescopes and showing them how they can cooperate with the professional astronomer using larger telescopes to observe the class of objects in the sky known as variable stars. As their name signifies, these stars vary in brightness, sometimes being bright, sometimes much fainter. There are more than three thousand of such stars known in the the sky. The variations of some stars like Betelgeuse, β Lyræ or δ Cephei can be followed by the naked eye, some of the stars at minimum brightness can be seen with a five-inch telescope, while others become so faint at minimum that they are almost or quite invisible in the largest telescope in existence. Some of these variables have a period from maximum to minimum which is quite short, measured by an interval of a few hours or a few days in length, some of the periods are measured in hundreds of days. Some of the periods are quite regular, some are very irregular. The well-known Algol changes in brightness by one component eclipsing the other. There are other stars like SS Cygni, V. Geminorum, and SS Aurigæ that are normally faint, and suddenly and for some reason for which as yet we have no adequate explanation greatly augment their brilliancy, the last of the three stars named above may increase its brightness one hundredfold in twenty-four hours. There are thus many varieties of variable stars most of which need careful and systematic observation, and consequently an observing program can be chosen which can be adapted to the aperture of the telescope used.

Largely through the enthusiastic efforts of Wm. Tyler Olcott of Norwich, Conn., the American Association of Variable Star Observers (or the A. A. V. S. O.) was organized in 1911 with seven observers. In ten years the membership has grown to three hundred, and the total observations made has the amazing number of 120,000. The present plan of the A. A. V. S. O. is that its members are observing systematically the changes in brightness of more than three hundred stars of long period. The stars under observation can be followed until with diminishing brightness they become invisible with the small apertures employed. These stars, however, can still be seen with telescopes of larger size in the hands of the professional astronomer. By a plan of cooperation, therefore, the members of the A. A. V. S. O. can observe the variables when bright while Harvard with its twelve or fifteen-inch telescope and the McCormick Observatory with its still larger aperture of twenty-six inches can observe when faint, and thus the stars can be kept under almost continual observation, except when the stars are too near the sun. Each month each observer sends his observations to Harvard College Observatory where the observations are collected together and are then published in *Popular Astronomy*. This immediate publication is of great value in keeping alive the interest of the amateur for each observer can see that his observations are of value in fixing the brightness of the stars and even the beginner can experience the thrill of finding that his observations perhaps fit in beautifully with the magnitudes determined by observers of greater skill.

Professor Edward C. Pickering, the late director of Harvard College Observatory, was keenly enthusiastic about the work of the A. A. V. S. O. for he recognized the very great value of this organization. And now to perpetuate its work and to increase its value to astronomy the Association of Variable Star Observers is asking for an endowment to bear the name, the Edward C. Pickering Memorial.

The income from this fund is to be entirely devoted to variable star research, none of it being required for "overhead" or for equipment. Through an arrangement with Professor Pickering's successor, Dr. Harlow Shapley, Harvard College Observatory is to put the second floor of its library building at the disposal of the A. A. V. S. O. for its offices, and is to allow the use of one of the domes on the observatory grounds to house the largest telescope owned by the association, that recently acquired through the generous gift of Mrs. C. A. Post of Bayport, L. I.

Professor Pickering was so well known to members of the A. A. A. S. and to readers of SCIENCE that it is felt that many will wish to contribute to such a worthy cause as the Edward C. Pickering Memorial. Contributions should be sent to Wm. Tyler Olcott, Norwich, Conn., or to Leon Campbell, Harvard College Observatory, Cambridge, Mass.

S. A. MITCHELL

J. D. MITCHELL

MR. J. D. MITCHELL died at Victoria, Texas, on February 27, 1922.

Some years ago when the writer was about to go to Texas for the first time, he made the rounds of a number of scientific offices at Washington to obtain such information as he could about the natural history of Texas. Wherever he went, whether to entomologists, ornithologists, ichthyologists or botanists, the same advice was given. That was to go to Victoria and see Mr. J. D. Mitchell. A man whose knowledge had made such a deep impression upon the leaders in several departments of science must certainly have been in some degree remarkable.

At Mr. Mitchell's house in Victoria he had large collections of animals of all classes. From day to day the house was visited by ranchmen, doctors, school children and others to ask about various points connected with natural history. Thus, technical men as well as persons from the ordinary walks of life were alike influenced by the learning of the man.

Mr. Mitchell lived for a good portion of his life on a cattle ranch on the coast of Texas. His love of natural history was inherited from his mother, who had extensive knowledge of the plants of Texas and their practical uses. Later he moved to Victoria where circumstances gave him an opportunity to devote most of his time to work on natural history. In 1904 he became connected with the Bureau of Entomology and made important contributions to several of the larger southern problems like those of the cotton boll weevil and the cattle tick. In fact, his pioneer work on the cattle tick was an important factor in the notable project of eradication which has now permanently removed the pest from more than three fourths of its original range in the United States.

Mr. Mitchell had no technical training. He was an example of the vanishing type of devoted naturalists who pursue the subject out of pure love for nature. He never described a new species. Although he collaborated on many publications of the Bureau of Entomology, he published only one paper, dealing with the poisonous snakes of Texas. Nevertheless, it is fitting that this note about his career should be published in this journal. He was a fountain of accurate information for technical men and was a modest, patient and painstaking imparter of knowledge. His life showed the enjoyment which comes from the contact with nature and was thus an inspiration to others.

W. D. HUNTER

HOUSTON, TEXAS

SCIENTIFIC EVENTS

ANNUAL TABLES OF CONSTANTS

THE confederation of French scientific societies has renewed for the year 1922 its contribution of 40,000 francs in support of Annual Tables. The total subscription in France to this project during the year 1921 was 80,000 francs.

At the approaching meeting of the International Union of Pure and Applied Chemistry which is to be held at Lyons in June, the matter of organizing the work of Annual Tables upon a solid financial basis will come up for consideration. This important international project has had a very precarious existence since 1914 and the fact that the work has been continued at all has been due to the efforts of the general secretary, Dr. Charles Marie.

Plans for providing a certain and sufficient budget for the work during the next five years are in preparation, based upon definite annual contributions from the various countries in the International Union.

It is announced that the National Research Council of Japan has appointed the following advisory committee for Annual Tables: Yasuhiko Asahina, Eiji Aoyagi, Kotaro Honda, Katsuji Inouye, Gen-itsu Kita, Koichi Matsubara, Tsuruzo Matsumura, Seiji Nakamura, Kyoji Suyehiro, Umetaro Suzuki, Takuro Tamaru, Mitsumaru Tsujimoto, Nobuji Yamaga, Noboru Yamaguti. The chairman of the committee is Professor Yukichi Osaka, Japanese member of the International Commission in charge of Annual Tables.

ALASKA PENINSULA FISHERIES RESERVATION

Under date of February 17, 1922, an Executive order was promulgated creating the Alaska Peninsula Fisheries Reservation, extending eastward from the Aleutian Islands Reservation to a line from Foggy Cape, on the eastern end of Sutwik Island, to Cape Menshikof, on the northern shore of the Alaska Peninsula, and including the Shumagin Islands and the territorial waters adjacent to these lands and also the lands of the Aleutian Islands Reservation. The Secretary of Commerce is given power to make regulations for the proper administration of the newly created reservation and the waters covered by the executive order. The text of the order follows:

EXECUTIVE ORDER

In addition to the islands of the Aleutian Chain, Alaska, withdrawn and made a preserve and breeding ground for native birds, for the propagation of reindeer and fur-bearing animals, and for the encouragement and development of fisheries, by the executive order of March 3, 1913 (No. 1733), as modified by the executive order of August 11, 1916 (No. 2442), a reservation comprising the islands, peninsulas, and lands adjoining the eastern end of the reservation established by the said executive order of March 3, 1913, and extending in an easterly and northerly direction from Isanotski Strait to a line extending from low-water mark at Foggy Cape, on the eastern end of Sutwik Island, to low-water mark at Cape Menshikof, on the northern shore of the Alaska Peninsula, including the Shumagin Islands and all other islands, peninsulas, or parts thereof within the described area, is hereby set apart as a preserve to more effectively insure the protection of the fisheries and for their encouragement and development. This latter reservation is to be known as the Alaska Peninsula Fisheries Reservation.

It is hereby further ordered that all straits, bays, and other waters over which the United States has jurisdiction by reason of their relation and proximity to the islands, peninsulas, and other lands to which this order, as well as the said order of March 3, 1913, applies, be and the same are hereby reserved and set apart also as a preserve to more effectively insure the protection of the fisheries and for their encouragement and development.

The secretary of commerce shall have power to make regulations for the proper administration of the said Alaska Peninsula Fisheries Reservation, and the straits, bays, and other waters reserved by this executive order.

The establishment of the reservation under this executive order shall not interfere with the use of the waters, islands, or other lands for lighthouse, military, naval, or other public purposes, nor with the use of any of said islands or other lands under the laws of the United States for town-site purposes, mining purposes, or grazing of animals thereupon, under rules and regulations to be established by the secretary of the interior.

(Signed) Warren G. Harding

The White House, February 17, 1922.

A hearing was called for April 4 at the bureau's office in Seattle, when statements were received from those interested and information secured as a basis for regulations for the control of fishing in the Alaska Peninsula Fisheries Reservation.

THE FLORA OF PORTO RICO

Dr. N. L. Britton, director in chief of the New York Botanical Garden, has returned from Porto Rico, after three months spent in an intensive study of the Porto Rican flora. Dr. Britton reports a very successful trip and the collection of some 4,000 specimens. In addition to collecting plants and specimens for the garden, the object of the expedition was the obtaining of data for a flora of Porto Rico and the adjacent islands for publication by the New York Academy of Sciences, as parts of the scientific survey of Porto Rico and the Virgin Islands.

This survey was commenced in 1913 by the New York Academy of Sciences in cooperation with the insular Government of Porto Rico, the American Museum of Natural History, the New York Botanical Garden, the department of geology and of anthropology of Columbia University and with other American institutions. The work has been prosecuted since whenever practicable, but was much interrupted by the World War. In his report to the scientific directors of the garden, Dr. Britton says of the accomplishments to date in connection with the survey:

> The materials brought together already have formed the basis of numerous noteworthy contributions to knowledge, published by learned societies and by the cooperating institutions. Publication of the final reports was begun by the Academy in 1919, and three parts of the geological volumes and two of paleontology have now been issued, under the editorship of Professor R. W. Tower of the American Museum of Natural History. Additional parts of the geological volumes are now ready for the press, to be followed by those dealing with the botany and vegetable resources, the zoology, archeology and anthropology of the islands, as rapidly as funds for printing become available. The completion of the work will make the geology and natural history of Porto Rico and the Virgin Islands, insular possessions of the United States, the key to natural science knowledge of the West Indies.

The objects of the trip as detailed by Dr. Britton on his return were to supplement information about the vegetation obtained during several previous visits to the region and from the study of many specimens obtained by other collectors in former years; to ascertain now that the geological field work in Porto Rico has been completed, such distribution of species as may be governed by soils of different mineral composition, and to increase the representation of Porto Rican plants in the collections of the garden, with duplicates for exchange with other botanical institutions. These objects were satisfactorily accomplished, he says, over considerable areas of the island, special attention being given to the Northern and Southern Coastal Plains and to the higher mountain summits of the central districts.

EXPEDITION TO THE FIJI ISLANDS

A British government launch may be placed at the disposal of a party of scientific men from the University of Iowa who will be in the Fiji Islands on a collecting expedition during June according to a letter to Professor C. C. Nutting from Mr. T. E. Fell, acting governor of Fiji. Professor Nutting is head of the expedition which will sail from Vancouver on May 19 to the Fijis and New Zealand to gather laboratory and museum material for the university. Members of the party are: Professor R. B. Wylie, head of the department of botany; Professor A. O. Thomas, geologist; Professor Dayton Stoner, entomologist and ornithologist; Mrs. Dayton Stoner, who will assist in entomology; Waldo S. Glock, photographer and assistant geologist; and Professor C. C. Nutting, director of the expedition, whose specialty is marine invertebrates.

Arriving at Suva, Fiji Islands, about June 3, the party will be personally greeted by Governor Fell, who, as acting governor of Barbados at the time of the university's Barbados-Antigua expedition in 1918, extended many courtesies to the members of that party, which was also in charge of Professor Nutting.

The entire island of Makaluva, near Suva, has been placed at the disposal of the visitors, and the necessary buildings and equipment are conveniently at hand there. In addition to the launch the governor expresses his hope of having a small boat at hand for use in exploring the neighboring reefs, and arrangements are being made in advance for divers and reef experts to aid the party. All scientific equipment is to be admitted free of duty.

After remaining at Suva until early in July to make a study of Marine and tropical life, the party will go to New Zealand, where animal and plant life and geological formations are of peculiar interest. The official secretary of New Zealand has written to say that everything possible will be done to make their stay in that country a success. It is expected that the return voyage will end in Vancouver about September 9 in time for the opening of the university.

THE SECTION OF MEDICAL SCIENCES OF THE AMERICAN ASSOCIATION

It may be of some interest, in this period of co-ordination, to know that at the Toronto meeting a group of parasitologists, medical entomologists and medical workers met and decided upon the following policy for Section N, Medical Sciences:

1. That it was extremely desirable and necessary that a closer co-ordination between parasitologists, entomologists and medical workers be worked out.

2. That the secretary of Section N (Medical Science), after consulation with the secretaries of the related societies, arrange for a program which will avoid conflicts with related groups.

3. That the secretaries of the allied societies, co-operating with the secretary of Section N (Medical Sciences), suggest those of its members who might be invited to take part in a symposium at which the significant researches are reported that are of interest to the allied groups of workers.

4. It was deemed undesirable to attempt for the present any formal co-operation between these related societies.

5. That the time has come when there is a definite need for the discussion of such papers as affect the interests in the allied groups, both for stimulation and for information.

6. That each secretary so arrange the papers of its society's program that it may be possible for its members to meet with Section N (Medical Sciences) without too serious a loss.

7. That the joint meeting be held under the auspices of Section N (Medical Sciences).

Section N (Medical Sciences) is proceeding with this policy on the assumption that such arrangements will in no way conflict with any program that may be adopted at the Washington conference, held under the auspices of the National Research Council.

A. J. Goldfarb,
Secretary.

THE BOCHER MEMORIAL PRIZE OF THE AMERICAN MATHEMATICAL SOCIETY

The American Mathematical Society announces the foundation of a prize in memory of the late Professor Maxime Bôcher, of Harvard University. Soon after the death of Professor Bôcher, in 1918, a fund was raised in his memory through the efforts of Professor T. S. Fiske, of Columbia University, which was turned over to the American Mathematical Society. On recommendation of a committee of which Professor E. B. Van Vleck, of the University of Wisconsin, was chairman, the council of the society has decided to devote the interest of this fund to the establishment of a prize, to be called the Bôcher Memorial Prize, and to be awarded at five year intervals, for a notable research memoir published in the *Transactions of the American Mathematical Society* during the preceding five years by a resident of the United States or Canada. The age of the recipient shall not be over forty years, and the prize shall not be awarded twice to the same person. The first award (of $100) is to be made for a memoir published during the period 1918-1922, and will be conferred at some meeting of the society in 1923.

This prize, which is believed to be the first mathematical prize to be given in this country at regular intervals for research in pure mathematics, is an especially appropriate memorial for Professor Bôcher, not only because of his achievements in research, but also because of his great services to mathematics in this country as one of the founders and for many years one of the editors of the *Transactions of the American Mathematical Society;* for this latter reason the provision that the prize must be awarded for a memoir published in the *Transactions* seems particularly appropriate.

SCIENTIFIC NOTES AND NEWS

At the meeting of the National Academy of Sciences, held in Washington on April 26, members were elected as follows: Edward W. Berry, professor of paleontology, the Johns Hopkins University; George K. Burgess, Bureau of Standards; Rufus Cole, director of the hospital of the Rockefeller Institute for Medical Research; Luther P. Eisenhart, professor of mathematics, Princeton University; Joseph Erlanger, professor of physiology, Washington University Medical School; Herbert Hoover, secretary of commerce; George A. Hulett, professor of physical chemistry, Princeton University; Charles A. Kofoid, professor of zoology, University of California; George P. Merrill, curator of geology, U. S. National Museum; C. E. Seashore, professor of psychology, State University of Iowa; Charles R. Stockard, professor of anatomy, Cornell Medical College; Ambrose Swasey, president of the Warner and Swasey Company; W. H. Wright, astronomer, the Lick Observatory, University of California. Dr. Albert Einstein, of the University of Berlin, was elected a foreign associate.

At the meeting of the American Philosophical Society, held in the city of Philadelphia, on April 23 and 24, the following officers were elected: *President,* William B. Scott; *vice-presidents,* Arthur A. Noyes, Hampton L. Carson, Henry Fairfield Osborn; *secretaries,* Arthur W. Goodspeed, Harry F. Keller, John A. Miller; *curators,* William P. Wilson, Henry H. Donaldson; *treasurer,* Eli Kirk Price; *councillors,* Lafayette B. Mendel, Herbert S. Jennings, William W. Campbell, Robert A. Millikan, Felix E. Schelling. Members were elected as follows: Charles Elmer Allen, Madison, Wis.; Rollins Adams Emerson, Ithaca; Worthington C. Ford, Cambridge, Mass; Frederick E. Ives, Philadelphia; Irving Langmuir, Schenectady; Roland S. Morris, Philadelphia; George William Norris, Philadelphia; Charles Lee Reese, Wilmington; Harlow Shapley, Cambridge, Mass.; Henry Skinner, Philadelphia; James Perrin Smith, Palo Alto; Charles Cutler Torrey, New Haven; Robert De Courcy Ward, Cambridge; Henry Stephens Washington, Washington; David Locke Webster, Stanford University.

Dr. William F. Osgood and Dr. George D. Birkhoff, professors of mathematics at Harvard University, have been elected corresponding members of the Göttingen Academy of Sciences.

At the anniversary meeting of the Royal Irish Academy held in March, Professor T. H. Morgan, of Columbia University, and Professor Jules Bordet, of the University of Brussels, were elected honorary members in the section of science.

The Entomological Society of Brazil, on March 9, elected Dr. W. J. Holland, director of the Carnegie Museum of Pittsburgh, as one of its honorary members "in token of their appreciation of the services he has rendered to the science of entomology."

Professor W. Nernst will take over on April 1 the duties of director of the Physikalisch-Technische Reichsanstalt, but will continue to act as rector of the University of Berlin until October 15.

Professor Dugald C. Jackson, head of the department of electrical engineering, Massachusetts Institute of Technology, was elected president of the Boston Society of Civil Engineers at the annual meeting of the society on March 15.

Dr. T. Wayland Vaughan has at his request been relieved of administrative duties as chief of the Coastal Plain section in the Geological Survey, and L. W. Stephenson has been assigned these duties. W. P. Woodring has been appointed chief of the section of West Indian geologic surveys in the Coastal Plain section.

F. J. Katz, who has been with the Census Bureau for several years, has returned to the Geological Survey and will be assistant chief of the Mineral Resources section.

Herbert Popenoe, of Stanford University, has been appointed psychologist for the California State Bureau of Juvenile Research, to be stationed at the Preston School of Industry.

F. H. Read, formerly assistant engineer of tests of the Pittsburgh Testing Laboratory, has resigned to accept the position as research engineer of the Office of Public Roads, with headquarters at Harrisburg, Pa.

The Smith's Prizes at the University of Cambridge have been awarded to E. A. Milne, Trinity College, for an Essay on "Studies in the theory of radiative equilibrium," and to G. C. Steward, Gonville and Caius College, for an Essay on "The Aberration-diffraction problem." J. A. Carroll, Sidney Sussex College, has been elected to an Isaac Newton Studentship, and the studentship of W. M. H. Greaves, St. John's College, has been prolonged for a year.

The American Medical Association has granted to Dr. Reynold A. Spaeth, of the Department of Physiology, School of Hygiene and Public Health, Johns Hopkins University, the sum of $200 to further his researches on the relation between susceptibility and fatigue.

Dr. W. A. Cannon, of the Department of Botanical Research of the Carnegie Institution of Washington, has returned to this country from South Africa where for several months he was engaged in making observations on the plants and on the conditions of plant life in certain of the more arid portions of that country.

Professor Lazarus Barlow, who holds the chair of experimental pathology at the Middlesex Hospital Medical School, is visiting the United States to investigate methods of cancer research and radium treatment.

Professor Alexander Maximoff, formerly professor of histology and embryology at the Imperial Academy, Petrograd, has arrived in Chicago from Russia to accept an appointment in the department of anatomy at the University of Chicago.

On February 19 Dr. Francis W. Simonds completed thirty-two years of continuous service as head of the department of geology in the University of Texas. Dr. Simonds is now the senior professor in the faculty of the College of Arts and Sciences, and for the past five years he has been secretary of the general faculty.

The University of Buffalo recently combined with Canisius College and the Buffalo Society of Natural Sciences in bringing Professor M. M. Metcalf, formerly of Oberlin College, to Buffalo for a series of three lectures on "Animal Distribution; Man's Origin; Man's Future: can he control it?" The lectures were given on April 26, 27 and 28, and the course was attended by about 3,500 people.

Professor C. J. Keyser gave, on April 20, a lecture before the Detroit Mathematics Club on the mathematical obligations of philosophy and education.

Frederick V. Coville, botanist of the Bureau of Plant Industry, delivered the annual address before the Gamma Sigma Delta fraternity of the Kansas State Agricultural College on April 26. His subject was the "Influence of cold in stimulating the growth of plants." While in Manhattan, Mr. Coville visited the station projects and lectured before the staff members on "Acid tolerant plants" and related subjects.

Sir Ernest Rutherford delivered a Royal Institution lecture on April 7, on "The evolution of the elements."

George Bruce Halsted, professor of mathematics at the University of Texas from 1882 to 1903 and subsequently at the State Teachers College, Greeley, Colorado, died in New York City on March 19, at the age of sixty-nine years.

Dr. Ansel A. Tyler, professor of biology in James Millikin University, died of pneumonia on Friday, March 31. Dr. Tyler was born in East Bridgewater, Pa., in 1869. He did his undergraduate work in Lafayette College and received his Ph.D. from Columbia University. He had served on the faculties of Union College, Syracuse University; University of Arizona; and Bellevue College, Omaha.

Henry Newton Dixon, formerly lecturer in the Oxford School of Geography and professor of geography in University College, Reading, has died at the age of fifty-six years.

Philippe Auguste Guye, professor of physics at Geneva, died on March 27, at the age of sixty years.

Professor Heyn, whose work at the Materialprüfungsamt, first under Martens and later as co-director, has made his name known to engineers and metallurgists, has died at Berlin at the age of sixty-eight years.

The death is announced of Professor Robert Wenger, director of the Geophysical Institute of the University of Leipzig.

BY the will of the late Professor E. C. Hansen, of Copenhagen, a prize has been founded to consist of a gold medal and a sum of at least 2,000 crowns, to be awarded every two or three years for distinguished work in microbiology, published within the preceding years in Denmark or elsewhere. It is proposed in 1922 to confer the medal on some worker in general not medical microbiology. The foundation is in charge of the chiefs of the Carlsberg Laboratory at Copenhagen. Professor C. O. Jensen and Professor S. P. L. Sörensen, Professor Calmette of Paris and Professor Theobald Smith of Princeton are also on the committee of awards.

A CONFERENCE of those who teach physiology in the women's colleges of the northeast was held at Mount Holyoke College on April 21 and 22. The conference had to do almost entirely with teaching problems, since there have been very few opportunities for such discussions at the usual scientific meetings. Among the topics were the aims of the courses given at the various institutions, the prerequisites and content of the courses, the choice of material for experimental purposes, the affiliations of physiology with chemistry, physics, zoology and hygiene, and the type of research possible with undergraduates. The institutions represented were Barnard, Bryn Mawr, Connecticut, Goucher, Mount Holyoke, Simmons, Smith, Vassar and Wellesley.

WILLIAM WOOD & Co. have transferred publication of the New York *Medical Record* to the A. R. Elliott Advertising Agency, which publishes the *New York Medical Journal* and the *American Druggist*. The *Medical Record* was first issued in March, 1866. Dr. George F. Schrady was editor of the journal from its inception until his death in November, 1907, since which time it has been under the editorial management of Dr. Thomas L. Stedman.

THE publication of the *Behavior Monographs* will be discontinued upon the completion of the current volume (Volume 4) and a new series of Comparative Psychology Monographs will be initiated under the editorship of Professor Walter S. Hunter, of the University of Kansas, with the cooperation of Professor H. A. Carr, of the University of Chicago, Professor S. J. Holmes of the University of California, Professor K. S. Lashley, of the University of Minnesota and Dr. R. M. Yerkes, of the National Research Council. The new monograph series will be broader in scope than the old and, in addition to studies in animal behaviour, will publish work in human psychology conducted from the comparative point of view.

THE Permanent Bureau of All-Russian Entomo-Phytopathological Congresses, Petrograd, desires: (1) To exchange printed matter (published since 1914) on entomology, phytopathology, mycology and zoology, with American colleagues, scientific societies, agricultural experiment stations, museums of natural history, periodicals, etc.; (2) To receive from American publishers catalogues and specimen numbers of various publications on the above mentioned subjects; (3) to receive catalogues and price lists from American firms dealing in apparatus and chemicals used in combating plant enemies. Mr. D. N. Borodin will forward packages of books, bulletins, etc. for Russia, addressed to him at No. 110 West 40th Street, New York City.

THE Kelp-Potash Plant of the Bureau of Soils, U. S. Department of Agriculture, at Summerland, California, was sold and transferred on April 1 to Mr. Rodney Benson of Santa Barbara. This plant was constructed in 1917 and operated for four years as an experimental and demonstrational plant with a view to the development of processes for extracting potash and by-products from the giant kelps of the Pacific. It was closed through Congressional action in 1921. The plant will be enlarged and put back into operation at once for the manufacture of "Kelpchar" (a decolorizing carbon of very high activity), potash salts, and iodine. Dr. J. W. Turrentine, who was in charge of the plant throughout the period of the experimentation, after turning over to the Government's successors the manufacturing data established there, will return to Washington, D. C.

THE *Journal* of the Washington Academy of Sciences reports that Dr. T. T. Waterman, lately appointed ethnologist of the Bureau of American Ethnology, has left for field-work in Alaska, Oregon and Washington. He will first proceed to the Kasaan National Monument, Alaska, to study the architecture, totem poles and other objects at this village and will be accompanied by a half-breed Haida, related by marriage to Chief Skoul. It is expected that considerable legendary data bearing on history and sociology of the former inhabitants of Kasaan will also be collected. Should the results justify further work it is planned to continue field-work on place names and aboriginal village sites of Alaska to be followed later by work on stratigraphic archeology in more northern latitudes in order to discover if possible traces of the oldest Indians in this supposed prehistoric gateway of the migration of man into North America.

According to the correspondent of the Associated Press, boring into the crater of Kilauea, the active volcano on the Island of Hawaii, will be started May 1 in an effort to ascertain the heat underground and to discover whether it can be turned into industrial channels. A contract has been signed and the work, which will consume approximately six months, will be under the direction of Professor T. A. Jagger, volcanologist, in charge of the Kilauea observatory. Holes will be bored to various depths on all sides of the Kilauea crater, the great Kau desert to the south and at accessible spots on the floor of the crater. It is planned to bore into the lava flows of 1921, 1919, 1918, 1894, and in some more ancient flows, to ascertain whether any of the heat generated by those disturbances remains underground.

The Collins collection of algæ, covering both the seaweeds and their fresh-water relatives, has recently been acquired for the herbarium of the New York Botanical Garden in Bronx Park through the generosity of its director-in-chief, Dr. N. L. Britton. The new accession includes more than 40,000 specimens from nearly all parts of the world, New England, Bermuda, Florida, California, Alaska, the Philippine Islands, Japan, the Dutch East Indies, South Africa, Australia and the South Sea Islands being especially well represented. Frank Shipley Collins of Malden and later of North Eastham, Mass., was a business man who devoted his leisure to the advancement of scientific knowledge. The Collins collection is the latest of an importnt series of large collections which have been purchased to facilitate the scientific researches that are carried on in the Bronx Park institution. Among these are the J. B. Ellis collection of fungi, numbering about 80,000 specimens; the Mitten collection of mosses and hepatics, including about 50,000 specimens; the Underwood fern collection, with 16,000 specimens; the Otto Kuntze herbarium of more than 30,000 miscellaneous specimens, presented to the Garden by the late Andrew Carnegie; the Vigener herbarium of more than 20,000 specimens, also presented by Mr. Carnegie; the A. Henry collection of Chinese plants, including nearly 8,000 specimens, and the Jenman collection of West Indian and South American ferns, comprising about 4,000 specimens and given by the late D. O. Mills, the first president of the Board of Managers of the New York Botanical Garden. The number of specimens in the entire herbarium of the garden is now approaching 2,000,000 .

The ninth annual Faculty Research Lecture at the University of California by election by the Academic Senate was given by Dr. Charles A. Kofoid, professor of zoology in the university who spoke on Charter Day, March 22, on "Amœba and man." The discovery was announced of the detection of amœba in the bone marrow in cases of Ely's second type of arthritis deformans in man. The amœbic nature of the parasites in the bone lesions was demonstrated by their mode of cell division and the number of chromosomes which differ from those of human cells.

The correspondent of the London *Times* at Paris, under date of February 15, writes that the solemn reception of Mme. Curie by the Academy of Medicine is a *fait accompli.* The secretary-general read the terms of the decree by which the president of the republic approved the election of Mme. Curie. As an unprecedented mark of honor, M. Béhal made a speech to welcome the first *Académicienne.* He reminded her that it was about twenty years ago that, in response to his request, she gave a lecture at the Sorbonne on radium, which she had discovered, and was studying with her husband, Pierre Curie. He rapidly reviewed the ground traveled since then, and continued: "All these discoveries which result from yours are as nothing compared with the fundamental fact which you found—I mean the formidable energy contained in the atomic system. If we are to succeed in being able to release it methodically it would relieve the world from the dread of seeing disappear, at short notice, reckoning time in relation to the age of the world, the fuel accumulated in former centuries which is at present our principal source of energy." Mme. Curie bowed low and took her seat simply and without a word among her eminent colleagues.

Dr. Lynds Jones, from the department of animal ecology of Oberlin College, is arranging a special field expedition to leave Oberlin on June 23, going west through Illinois, across the Mississippi to Iowa and on toward MacGregor, through Southern Dakota, across the Big Horn Mountains in Wyoming into Yellowstone Park. The itinerary will then take the party to Pocatelo, Idaho, on to Salt Lake City and southern Utah, visiting the National Mountains and Bryce's Canyon. Leaving Utah, the group will strike across the northern part of Arizona and the southern tip of Nevada into southern California. Proceeding to the coast a week's camp will be made near San Diego. Sixteen students will make up the party, traveling with automobiles with complete camping outfit. Special attention will be given to the study of bird and animal life and field maps and topographical surveys will be prepared covering all parts of the route.

The Department of Commerce will send a party, headed by Assistant Secretary C. H. Huston, to Alaska this summer for the purpose of making a general investigation of conditions in which that department is particularly interested. The Bureau of Fisheries, the Coast and Geodetic Survey, the Lighthouse Service and the Steamboat Inspection Service are the bureaus of the department which are closely identified with the affairs of the territory. It is the purpose to determine in what ways these bureaus can be made of greater benefit in developing Alaska. Particular attention will be devoted to the salmon fisheries, which yield products of an average annual value of about $40,000,000 and in normal seasons give employment to upwards of 20,000 persons and represent an investment of about $70,000,000. It will be the purpose also to observe conditions in respect to the fur-seal industry at the Pribilof Islands, which work is administered by the Department of Commerce through the Bureau of Fisheries.

UNIVERSITY AND EDUCATIONAL NOTES

The *Journal* of the American Medical Association states that ground was broken on April 10 for a new building which will accommodate the departments of botany, zoology, pharmacology and physiologic chemistry at Tulane University of Louisiana School of Medicine, New Orleans. The building is to be four stories high and will be erected at a cost of about $180,000, $125,000 of which has been subscribed by the general education board. The laboratory will be equipped at a cost of $30,000 and it is expected that the institution will be completed in December.

Dr. Warfield Theobald Longcope, Bard professor of medicine at Columbia University, and physician in chief at the Presbyterian Hospital, New York City, has been appointed professor of medicine at the Johns Hopkins University Medical Department, and physician in chief at the Johns Hopkins Hospital, beginning on July 1, when the one-year term of Dr. H. Canby Robinson will expire. Dr. Robinson went to the hospital with the understanding that at the end of one year he was to return to his post as professor of medicine and dean of the Vanderbilt University Medical Department.

Professor Charles L. Norton, head of the division of cooperation and research at the Massachusetts Institute of Technology, will become head of the department of physics, vacant by the acceptance by Professor E. B. Wilson of a call to the Harvard School of Public Health.

Benjamin Britton Gottsberger, who since 1920 has been a consulting engineer with offices in New York City, has been appointed professor of mining in Yale University to succeed Professor James F. McClelland who resigned in 1919.

AT the New York Post-Graduate Medical School and Hospital, the laboratory of pathological chemistry, formerly a division of the department of laboratories, has been made an independent department and the name changed to the department of biochemistry. The personnel consists of Victor C. Myers, Ph.D., professor and director; Cameron V. Bailey, M.D., and John A. Killian, Ph.D., assistant professors; Hilda M. Croll, M.A., associate and Herbert W. Schmitz, M.D., assistant.

DISCUSSION AND CORRESPONDENCE

THE FUTILITY OF THE HUMAN YOLK SAC

IN the current issue of the *Anatomical Record*, Professor Arey publishes a brief but very interesting contribution (No. 90) from the Anatomical Laboratory of Northwestern University. He describes a human chorion containing two embryos, of 11.5 and 12 mm. respectively, one of which has a yolk sac, and the other has none—that is, none was found, and sections of the umbilical cord showed no trace of a yolk stalk. Hence the broad conclusion is drawn that "the human yolk sac is a vestige unessential to growth or differentiation (including vasculogenesis)." It is stated that one of these embryos "received all, or essentially all, the cells destined to form a yolk sac" and that "the total absence of a yolk sac in one embryo, which is otherwise normal in every way, further demonstrates conclusively that this organ is not essential to the growth of an embryo or to the proper differentiation of its parts; indeed, the embryo in question is slightly larger than its twin."

Since from the days of Wolff the yolk sac has been regarded as the source of the intestinal tract, and in young human embryos is seen to be the organ from which the allantoic duct and the digestive tube proceed, the startling nature of this conclusion becomes apparent. But it is universally recognized that the yolk sac does its work in early stages, and though the sac usually persists as a functionless rudiment until birth, its duct normally becomes parted through atrophy in embryos younger than the one under consideration. Does Dr. Arey's case indicate anything more than the precocious obliteration of the stalk of an organ no less essential than the placenta, likewise cast off after its very vital functions have been performed?

If the question is raised, Where then is the yolk sac in Dr. Arey's case? his own studies furnish a plausible answer, since in another specimen he has described a single sac with two stalks, each leading to a separate embryo. Under such circumstances, the early obliteration of one of the stalks would give rise to the conditions observed in the second case, and this possibility must be eliminated before accepting the proposed conclusion. In reading the account of a human embryo without a yolk sac, we recall Bentham's incredulous comment, "I am very glad, my dear sir, that *you* saw that, for had I seen it myself, I wouldn't have believed it."

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DEFLECTION OF STREAMS BY EARTH ROTATION

THE recent note by Professor Jennings suggesting that the steeper valley sides on the right of the south-flowing streams on Long Island may be due in some manner to wind action instead of to the deflective effect of the earth's rotation is a welcome contribution to an old problem. In spite of Gilbert's apparent acceptance of the earth's rotation in explanation of the unsymmetrical cross-section of those valleys, the small size of their streams has always stood in the way of it, all the more since Bowman showed, on the basis of accurate maps of the lower Mississippi, that even that great river shifted its course to the east or left, apparently under the control of the wind, and not to the west or right, as it should if the earth's rotation were in control.[1]

[1] SCIENCE, XX, 1904, 273-277.

It is, however, interesting to note that the remarkably well defined right-handed or eastward shifting of many radial streams that flow down the gentle slope of the great alluvial fan, known as the plateau of Lannemezan, at the northern base of the Pyrenees—beautifully shown on the 1:80,000 map of France, sheets 216, 217, 227, 228, 229, 239, 240, and 241—has been explained by Marchand and Fabre[2] not as a consequence of the earth's rotation but as a result of stronger action of rain driven by westerly winds; so that here it is the valley sides facing against the wind that are the steeper, while on Long Island the steeper valley sides face with the winds. It is difficult to understand just how either explanation works, but in any case the relation of the steep valley sides and the prevailing winds is unlike in the two examples.

W. M. Davis

Cambridge, Mass.,
April 2, 1922

[2] Les érosions torrentielles et subaériennes sur les plateaux des Hautes Pyrénées. *C. R. Congr. Soc. savantes*, 1900.

POSSIBLE CAUSE OF THE RED COLOR OF POTASH SALTS

The red color of certain potash and ordinary salt deposits has been observed in many parts of the world, for example, in the Indian, German, Alsatian and Spanish potash deposits, in Nova Scotia, west Texas and doubtless in other places that the writer has not heard of. The same, though a less intense coloration has been observed by the writer in the surface salt and strong brine standing in the trenches and in pools along the margin of the salt ponds where solar salt is made along the shore of San Francisco Bay, California. It has been noted at Searles Lake in the same state. I am told that the same red color exists also in the solar salt ponds on Turks Island. It is undoubtedly of common occurrence in many places where solar evaporation results in producing salt, either naturally or artificially.

The red color associated with certain potash minerals is so common that it has come almost to be regarded as a means of identifying certain of them, for example, the mineral carnallite in the German deposits. There is however, as chemists well know, nothing inherent in the composition of carnallite ($KCl.MgCl_2.6H_2O$) to cause this red tint and indeed the normal color of the pure double salt should be the same as that of ordinary white rock salt.

There has been a great diversity of opinion as to the origin of the red color in solar salt and bitterns where solar evaporation is in progress. That it is not necessarily due to the presence of iron appears evident from the observations of George Lunge, the expert on sulphuric acid manufacture. Lunge[1] states that:

> The red color exhibited by many alkaline salt lakes, which is often also apparent in the salt deposits, is ascribed by Payen[2] to the presence of small crustaceans, *Artemia Salina* Leach (*Cancer salinus* Linné), which appear in large masses when the water has attained a density of 1.16, and which are of a gray or greenish color; on further concentration to a specific gravity of 1.21, they die and form a red froth at the surface. . . . I, for my part, must decline to accept the assumption that the red color is regularly caused by the presence of *Artemia* or other animal organisms, if it is ever due to that cause; for the samples of red water which I had myself taken from the lakes of the Wade Atrun have preserved that color during the many years I have kept those samples. The red filtrate shows nothing under the miscroscope; the color is at once discharged by adding nitric acid or hypochloride and hydrochloric acid and is evidently caused by organic substances present in solution. There is no iron present.

Recent studies made in the U. S. Bureau of Fisheries, Department of Commerce, connected with the reddening of salt fish are of interest and importance in this connection. They are also of economic value in view of the considerable annual losses to the fish industry caused by salt fish developing a red color when stored under moist conditions. The Bureau investigations, which were conducted by W. W. Browne[3],

[1] Lunge, Geo., *Sulphuric Acid and Alkali*, Vol. 2, pt. 1, p. 58, 1909.

[2] Payen, Anselme, *Annales chim. et phys.*, 2d ser., Vol. 65, p. 156, 1837.

[3] Bureau of Fisheries, Document 896, 1920, pp. 27-28.

indicate that the red color is due to two microorganisms, which probably originated in the sea salt used in curing the fish. The color varies from pale pink to deep crimson, the former the result of the growth of a spirochete, and the latter produced by a bacillus form.

These microorganisms grow in completely saturated brine on salt fish and on salt piles, but no growth appears in media containing less than 15 per cent. of salt by weight. The most favorable temperature for the growth of both organisms is between 50° and 60° C. indicating that the salt lagoons of the tropics are probably sources of infection. Sunlight is not germicidal, which also points to their tropical origin where pigmentation is required against bright sunlight. Ordinary bacteria are killed by ten minutes exposure to the bright sunshine. Salt acts as a preservative preventing the growth of most organisms, but here is an instance of just the opposite effect.

In summary, the results of recent investigation indicate that the cause of the red color in solar salt and brine is due to organisms as indicated above and that their source is salt produced by solar evaporation. Both European and American sea salt is infected, but mined salt is free from their presence.

The studies made by the Bureau of Fisheries and by others before it (See Bibliography published by Bureau of Fisheries) have suggested to the writer that possibly causes allied to those now producing red coloration in solar salts may have been active as long ago as the Permian. Whatever may be the main cause of the reddening of the Permian potash salts, the question naturally arises, is the reddening in the potash salts of the German Permian, the Alsatian Oligocene and the Spanish Tertiary deposits due to the same or similar agencies that are causing reddening in the solar salt of the present time. It is probable that both types of salts have been formed under essentially similar conditions, that is, salt pan conditions. If this last statement be admitted, then it points to the growth of bacteria, at least intermittently, from the Permian down to the present.

This is presented to induce further study along this line and to elicit discussion and opinions. Such studies may also throw some light on temperatures during Permian and later geologic time.

W. C. Phalen,

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POPULAR SCIENCE

To the Editor of Science: I am sorry to see that Dr. E. Dorsey confirms[1] the opinion expressed by Dr. Brooks[2] and myself[3] that science is relatively losing ground in popular interest and esteem. I fear he is right also in saying that this is in part the fault of scientists. For the prevalent indifference and even hostility of the public to the higher teachings of science may be matched by the indifference and even hostility of certain scientific men to the "vulgarisation of science."

It is quite true, as Dr. Dorsey points out, that isolated facts, however numerous and authentic, do not constitute science. I have kept that point in mind in all our Science Service work. For instance I said in a recent magazine article:[4]

> We can get from the reading of science not only new things to think about, but, what is more important, new ways of thinking about things.

But I hope that Dr. Dorsey will not discourage those of us who are trying to get a larger amount of "mere information" in the newspapers. A few more facts are really needed to season the mass of fiction there. We may also hope to get over some idea of the relations between facts and how the scientist finds his facts and what he gets out of them. But we can not expect that the newspaper reader will acquire the habit of persistent experimentation, constant criticism, rigorous reasoning, projection of hypotheses, balancing of theories and suspension of judgment characteristic of the scientific mind. If the layman

1 Science, 55: 374, 1922.

2 *Journal Washington Academy of Sciences*, 12: 73, 1922.

3 Science, 55: 241, 1922.

4 "Science from the Side Lines," in *The Century*, January, 1922.

could get all this he would be not a layman but a scientist. The most we can expect is that the layman may gain sufficient acquaintance with scientific thinking to understand the methods and aims of research and to appreciate its value to civilization. That he does not commonly acquire such comprehension and appreciation is because the men who understand the value of science have been too often unwilling to take the pains to impart their information and inspiration to him.

We are told that Agassiz required of his students in every department to prepare "first a monograph, second a scientific lecture, third a popular lecture, fourth a simple child's tale." How many of our annual army of Ph.D.'s would pass the third and fourth of these intelligence tests? Agassiz had his reward in the dozens of devoted disciples who became the teachers of the next generation and in the thousands of young people who bear his badge as they search forest and strand with curious eyes. But we need more men of the Agassiz type—and we seem to be getting fewer.

England, as I showed in Science, seems to have more men of high standing who are willing and able to translate their learning into the vernacular. It would be hard to match in all America the popular lecturers of the Royal Institution from Faraday to Bragg. But even in England we hear complaints of the growing gulf between the specialist and the public. The once-popular lectures to workingmen are now said to be running short of both speakers and hearers. Last year the columns of *Nature* were filled for months with discussions of why the lay membership of the British Association for the Advancement of Science was falling off. The British Association has always had the advantage of ours in the large number of citizens, not professionally engaged in scientific pursuits, who would support and attend the annual meetings but now it is becoming, like the American Association, a congeries of highly specialized sections.

Several of the correspondents in *Nature* expressed the opinion that the public had lost interest and confidence in science because scientists have lost their fighting spirit and the courage of their convictions. They take everything lying down nowadays and do not dare to defend their views or even defend their right to hold and teach their views.

This is a point worthy of consideration by those American men of science who have adopted the policy of treating with dignified contempt the present legislative and ecclesiastical attacks upon their intellectual freedom. Little is being done in scientific circles to check the rising tide of superstition and intolerance now sweeping over the land. Perhaps when appropriations are cut off, as in South Carolina, on the ground that the university has an evolutionist on the premises our scientific pacifists may sharpen up their pens and turn out literature as interesting to the general reader as Huxley's debate with Gladstone about the demons who converted the pigs of Gadara into pickled pork.

Dr. Dorsey is wise in putting "accounts of discoveries" first in his list of popular science subjects. But who will write them? I have been hunting in vain for writers who could sense the dramatic elements in such a scene as Archimedes' bath and tell how this ancient graft case led to the law of specific gravity. Who will describe the feelings of Faraday when he saw the loose end of a little magnet rotating about an electric wire in the dingy laboratory of the Royal Institution and then explain what that had to do with the trolley cars that are passing in the street?

The history of science is as rich a field for the cultivation of good literature as the history of literature, art and music but it remains untilled for want of attention. Students have been trained to look another way. The aim is now to eliminate the personal element from science and reduce it to an abstract and timeless formula. This may be necessary as a scientific method but it naturally results in the decline of interest. The old textbooks are more readable than the modern. A distinguished physicist, in discussing this point with me, said: "When I was in college I had to study Hastings and Beach but I read Deschanel for my own amusement." I am not advising that our textbooks should return to the leisurely literary style of long ago but we can not expect depersonalized science to be popular. Whatever is without "human interest" is not interesting to humanity. Dehydrated potatoes are convenient for conveyance but they have to be soaked up before they are palatable.

Edwin E. Slosson
Science Service
Washington

SCIENTIFIC BOOKS

An Introduction to Cytology. By Lester W. Sharp. McGraw-Hill Book Company, New York, 1921. 452 pages, 159 illustrations.

For a subject of such wide interest and great significance as cytology, there are surprisingly few text books. For years Wilson's classic work, "The Cell in Development and Inheritance," has been the chief reference volume, especially of the beginning investigator. Very recently two English texts, one by W. E. Agar, "Cytology, with Special Reference to the Metazoan Nucleus," and another by L. Doncaster, "An Introduction to the Study of Cytology," have appeared. These are good books, dealing in both cases, however, with a rather limited field and largely with animal material. There has long been felt the need for an introductory text which would present an outline of the subject in both its botanical and zoological aspects. The rapid advances made by numerous investigators, working upon a great variety of materials, and the intimate relation of these in many cases to equally rapid developments in the other new science of genetics, have made the writing of a cytological text book a very difficult matter.

Professor Sharp, despite these obstacles, has done an excellent piece of work for he not only covers the fields of botany and zoology, but embraces in his consideration of subjects most of those necessary for an understanding of the scope of cytological knowledge. Very properly, however, he places emphasis upon the topics of greatest general interest. We find, therefore, that of the 452 pages of text, 240 are devoted to the hereditary mechanism and the results of its operation. Zoologists, particularly, will welcome so comprehensive a summary of the achievements of their botanical fellows as Professor Sharp presents. While this is naturally the strong part of the work, zoological material is well considered. Indeed, the author deserves special commendation for the completeness and fairness with which the contributions of zoologists are treated. In view of the general excellence of the book in this respect, it might be permitted, in the interest of the accuracy for which the author very evidently strives, to point out that in a few cases he has allowed his personal studies to influence his presentation of topics concerning which there are differences of opinion. Perhaps the most conspicuous example of this is in the discussion of the differential structure of the chromatin thread. While there may be uncertainty on this point in plant material, there is none in many animal forms.

The method by which the material is presented is entirely to be commended. In recognition of the developmental stage of the subject, Professor Sharp has endeavored to set forth its status by showing what the problems are and how they are being met, rather than by attempting to define in categorical terms the content of our knowledge. The spirit and motives of an investigation are as important as its achievement, and, since cytology is now so largely a matter of discovery, it would be a misrepresentation to exhibit it otherwise than as an active field of research.

As practical measures for such a presentation it may be noted that the numerous illustrations are, almost always, copies of those found in research papers instead of those from text books; extensive bibliographies follow each chapter, offering the means for a comprehension of the extent of the work done and for following up any particular subject;[1] there is a full index in which may be found the taxonomic position of all materials discussed; scattered through the chapters are brief historical or critical reviews of nomenclature; there are frequent diagrammatic figures which

[1] As indicating the scope and character of these references it may be noted that at the end of Chapter XI, "The Reduction of the Chromosomes," a total of 170 individuals, of 11 nationalities, are quoted. The distribution of these biologists is interesting, indicating, as it does in a general way, the interest in cytology exhibited in different countries. Of the 170 individuals referred to, there are 54 Americans, 46 Germans, 26 British, 13 French, 9 Japanese, 7 Scandinavians, 6 Belgians, 4 Hollanders, 2 Russians, 2 Italians, and 1 Pole.

present concisely the essential steps in the processes under consideration. These, with other features, make the book very accessible and helpful. It might here be suggested that the diagrams would be improved by larger index characters, and that somewhere a concise index to the various terminologies scattered through the chapters would make them more available.

It is not to be hoped that in a book of this character there should be an absence of errors, although in this instance they are not so numerous as usual. Certainly they do not render the text as a whole unsafe for the unguided beginner. Because of the merit of the book in general and its obvious adaptability to the present needs of a great variety of people, it is particularly important to reduce errors of all sorts to a minimum. Undoubtedly, the cordial invitation of the author for assistance in eliminating these will be met with a helpful response by his fellow workers. Here it should suffice to speak of only more general features needing attention.

Owing to the fact that the book will most largely be used by those generally unfamiliar with cytology, and having varied approaches to it, there is need for the greatest clearness in distinguishing between the different categories of objects and conditions described. This is not always done and there is sometimes confusion between gene and character, and between the valence of the elements in the chromosome complex. In the effort to simplify the presentation of the maturation phenomena in some of the diagrams, only one mitosis is shown. While this displays clearly one of the important conditions of meiosis it entirely neglects another, viz., the essential unity of the two maturation mitoses as a process. This is further emphasized by the consistent use of the terms "heterotypic" and "homotypic." Enough evidence has been presented to show beyond question that the first maturation mitosis is not necessarily a reduction division as the terms imply. It is necessary only to recall the behavior of the sex chromosomes in the Hemiptera and the "selected chromosomes" in Phrynotitix, as described by Wenrich, to demonstrate this. There is something in meiosis besides a reduction division and an ordinary equation division. It is important to show clearly that meiosis is a unique phenomenon.

Doubtless, there are other instances of similar differences in point of view between author and reviewer which might be used to illustrate the present status of opinion in cytology, and the degree of adaptability of the text of Professor Sharp as an introduction to the subject. What has been given will, however, suffice to show that the existing differences of opinion are not extreme, that they are fairly presented in the text, and that in their exposition, a work has been produced that will serve to extend the usefulness and influence of cytology greatly. It is not venturing far to predict that the "Introduction to Cytology" will take its place as a worthy member of the very successful series of which it is a part.

C. E. McClung

SPECIAL ARTICLES

CONTINUOUS RENEWAL OF NUTRIENT SOLUTION FOR PLANTS IN WATER-CULTURES

In the experimental study of the salt nutrition of plants, it is of course very important that all the influential features of the culture media be definitely known. The initial composition of a mixed salt solution employed for water-cultures may be known with a marked degree of accuracy, but the chemical make-up of such a nutrient solution begins to be altered immediately after the introduction of the plants; materials, of course, move from the roots into the solution, as well as in the opposite direction, and the solution soon becomes significantly different from what it originally was. Since there is no feasible way by which all the various kinds and rates of alteration may be adequately determined, the culture solutions must be renewed from time to time if the growth of the plants is to be correlated with known chemical conditions surrounding their roots, and renewal must be frequent enough to allow these unknown alterations to be regarded as uninfluential.

How frequently water-culture solutions should be renewed is always a difficult question. With small culture vessels, with large plants, or with many plants in a vessel, it is clear that renewal ought to be more frequent than with larger vessels, smaller plants, and so forth. The labor involved is generally a serious consideration also. Whether solutions were renewed frequently enough, in particular experiments, to allow growth to be correlated with the characteristics of the solutions as these were originally prepared has been a subject of discussion from time to time. To answer this question for any experiment, a number of different renewal frequencies may be simultaneously tested, to determine how often the solutions must be changed in order that no difference in growth may result with still more frequent renewal.

A consideration of this question, together with the amount of labor involved in renewing a large series of solutions, leads obviously to the suggestion that the solution might be made to flow continuously through the culture vessel, the inflow being of known composition and the outflow being discarded. If the rate of flow is rapid enough, the discarded solution will not be significantly different from the inflow, and the roots may be said to have been in a known set of chemical surroundings throughout the culture period. Several rates of flow should be simultaneously tested, at least in a preliminary way, in order to make sure that the data studied shall have been secured with a sufficiently rapid rate. By employing continuous flow, the labor of renewing solutions would be practically avoided, since the apparatus would operate continuously without alteration, aside from the preparation of solutions and their introduction into the apparatus from time to time. The apparatus should automatically maintain any desired rate of flow through the culture vessel.

The need of an apparatus for continuous flow has become increasingly evident throughout the recent development (begun by Schreiner and Skinner, and Tottingham) of water-culture experimentation by means of logically complete series of salt combinations. A preliminary step was taken when Trelease and Free,[1] working in this laboratory in 1916, concluded that Shive's nutrient solution R5C2 (1.75 atm.) gave better growth the more frequently the solution was renewed, a continuous flow giving better growth than did daily renewal. Although, with the gradually improving technique of the water-culture method, many workers[2] have doubtless appreciated the desirability of continuous flow, constantly flowing solutions appear not to have been subjected to any further tests thus far recorded in the literature.[3] It is interesting to note, however, that the logical need of continuously renewed culture solutions was clearly stated by Stiles.[4] when he wrote: "In no case has a constantly renewed culture solution been employed. Thus the ratio of the various constituents was probably constantly changing throughout the experiments, and instead of being a constant factor was an unknown and varying one." Also, Duggar[5] mentioned the need of frequently renewed or continuously flowing solutions, but concluded that any operation involving continuous flow "would be impracticable in most of our experimental work."

This paper is planned to emphasize still further the need of flowing solutions and to present a brief description of an arrangement for securing them.

The accompanying diagram shows the main features of the apparatus, which consists

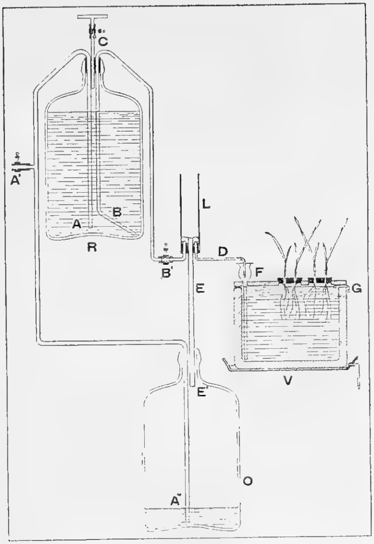
[1] Trelease, S. F., and E. E. Free: "The effect of the renewal of the culture solutions on the growth of young wheat plants in water-cultures. *Johns Hopkins Univ. Circ.*, N. S., No. 3, March, 1917, pp. 227 and 228.

[2] Conner, S. D., and O. H. Sears: "Aluminum salts and acids at varying hydrogen-ion concentrations, in relation to plant growth in water cultures. *Soil Science*, 13: 23-33, 1922, p. 27.

[3] In 1865 Nobbe flowed solution into a vessel in which plants were growing, but he seems not to have tried to control the rate of flow.

[4] Stiles, Walter: "On the interpretation of the results of water culture experiments." *Annal. Bot.*, 30: 427-436, 1916.

[5] Duggar, B. M., "Hydrogen ion concentration and the composition of nutrient solutions in relation to the growth of seed plants. *Annals Missouri Bot. Gard.*, 7: 1-49, 1920, p. 43.—*Idem.*, "The use of 'insoluble' salts in balanced solutions for seed plants." *Ibid.*, 7: 307-327, 1920, p. 308.



essentially of four parts: the upper reservoir (R), the constant-level tank (L), the lower reservoir (O), and the culture vessel (V). The upper reservoir (R) holds 5 gallons of solution when full, and acts like a constant-pressure aspirator, drawing air through tube A′A and delivering solution through the siphon tube (B), to the constant-level tank (L). The latter is a piece of 5-cm. glass tubing closed below by means of a rubber stopper with three tubes, B, E, and D. Solution flows into the tank through tube B, at a rate somewhat greater than is required for the culture vessel, and the excess passes into the lower reservoir (O), through the tube E, the tank level being automatically maintained at the top of the last-mentioned tube. The rate of flow through B is adjusted by adjusting the height of the lower end of tube A with reference to the upper end of E. Solution flows at a practically constant rate from the constant-level tank, through a small-bore delivery tube (D), and drips regularly into the thistle-tube receiver (F) of the culture vessel. The desired rate of flow through tube D is secured by adjusting the height of the upper end of E with reference to the lower end of D—that is, by adjusting the "head" maintained by the constant-level device.

The culture vessel shown is a 3-gallon, glazed earthenware "butter" jar, covered by a paraffined top, of wood, cement or plaster of Paris, with eight large openings, in which are set the flat cork stoppers that support the plants. There are five wheat seedlings in each stopper, forty seedlings in all. The top is supported about 4 mm. above the top of the jar. The receiver tube (F) has a waxed-paper cover, through which passes the delivery tube. Tube F extends nearly to the bottom of the culture vessel, and solution flows into the latter, keeping it filled to the brim and overflowing at the top, through the waste tube (G).

Solution that collects in the lower reservoir (O) has not been vitiated in any way by its passage through the constant-level tank, and it is raised to the upper reservoir (R) from time to time, together with additions of newly prepared solution. This transfer is effected through the tube A″A, by closing cocks A′ and B′ and applying suction at C (by means of an ordinary filter pump). When the transfer is completed, cock C is closed and cocks A′ and B′ are opened.

The reservoirs should be covered with opaque paper, to exclude nearly all light and retard the development of algæ.

The constant level device and the lower reservoir may be dispensed with entirely if the temperature of the upper reservoir can be maintained practically constant, or if only an approximately constant rate of delivery of solution is desired. In this case, tube B would discharge directly into the receiver tube (F). This simpler apparatus is the one employed by Trelease and Free.

Doubtless, the apparatus here described may be modified in many ways, to suit the facilities and requirements of different experimenters; but this form operates very satisfactorily. As thus far used, a series of five are delivering five different solutions to their respective culture vessels at a rate of about 16 liters a day, which amounts to 400 c.c. a day for each of the forty plants in the culture. With liter jars, five plants per culture, and solution renewal every three and one half days (as in the plan published by the National Research

Council Committee on Salt Requirements of Plants) each plant would receive 57 c.c. per day.

Sam F. Trelease
Burton E. Livingston
Laboratory of Plant Physiology,
The Johns Hopkins University,
March 23, 1922

NOTE ON THE SYNTHESIS OF ETHYL BUTYRATE IN EGG SECRETION

In our analyses of egg secretion, Miss Woodward[1] and I[2] have isolated an enzyme of the lipase group. The material, precipitated as a white powder, is soluble in both sea-water and fresh. In the presence of this "lipolysin," droplets of egg fat decrease in diameter while the hydrolysis of other neutral fats and the cleavage of ethyl butyrate are measurably accelerated.[3]

Since lipolysin is a parthenogenetic agent;[1, 4] since the unmodified egg-secretions also have parthenogenetic[5] and lipolytic[3] powers; and finally, since eggs with secretions removed by brief exposure to charcoal are completely sterile,[3] it seems likely that lipolysis plays some rôle in the normal initiation of development.[1] However, the evidence that egg-secretions have these powers is still incomplete. It has not been reported whether, under conditions significant for fertilization theory, the effects already observed are reversible.

Accordingly, I prepared egg-secretion as free from contamination as possible and used chloroform to inhibit bacterial action. To 10 or 15 c.c. of this, I then added, in one set of experiments, .5 c.c. of absolute ethyl alcohol; in another, 5 c.c. of 2N. Butyric acid was introduced last of all. The final concentration of the acid was roughly .25 N. and .4 N.

The acidity of the systems was, of course, immediately reduced by the salts present in both the secretion and the sea-water. Under the circumstances then, the loss in total acidity has no meaning for the problem in hand. Only differences are important, and, if in the presence of egg-secretion, a portion of the butyric acid is transformed into butyric ester, the tubes in which this occurs should require less alkali than the controls in order to reach the turning point, P_{H_7}, of di-brom-thymol-sulpho-phthalein.

The differences of acidity actually found between 10 c.c. of control and 10 c.c. of digest, in one case, after 40 minutes at 20° C., amounted to .8 c.c. NaOH N/20; in another, after an hour, to 2.4 c.c. NaOH N/20, in both instances, in favor of the controls.

Absolutely, these discrepancies are small, but even greater differences might fail to be convincing, for conceivably, the organic constituents of the secretion, still largely unknown, might in some way destroy or otherwise remove butyric acid from the reaction system. Fortunately, however, ethyl butyrate has an odor so penetrating and characteristic that even minute traces can be unmistakably detected. By this delicate test, the ester, regularly absent from the controls, was present in noticeable quantities in the digests with secretion and was easily recognized by others not familiar with the experiments. For eighteen hours the ester smell continued to grow in intensity.

On the basis of these results, I attribute to egg-exudate the power to accelerate the synthesis of ethyl butyrate. This is neither more nor less than might be expected since the same exudate also accelerates the corresponding hydrolysis.

Otto Glaser
Amherst College,
February 2, 1922

1 Woodward: *J. Exp. Zool.*, Vol 26, pp. 459-501.
2 Glaser: *Am. Nat.*, Vol. LV, pp. 368-373.
3 Glaser: *Biol. Bull.*, Vol. XLI, pp. 63-72.
4 Woodward: *Biol. Bull.*, Vol. XLI, pp. 276-279.
5 Glaser: *Biol. Bull.*, Vol. XXVI, pp. 387-409.

NATIONAL ACADEMY OF SCIENCES

At the annual meeting of the National Academy of Sciences held in the U. S. National Museum, Washington, on April 24, 25 and 26, papers were presented as follows:

The new building of the National Academy and the National Research Council: C. D. Walcott, President of the Academy. The erection of a magnificent building, costing $1,300,000, as the home of the National Academy of Sciences and the National Research Council, will shortly be begun on the square bounded by B and C streets, 21st and 22d streets, northwest, Washington. The building will serve as a center for American science in its various fields. Here investigators from all parts of the country and from abroad may be brought togther for counsel and cooperation. Facing the Lincoln Memorial, the marble building in simple classical style will rise three stories from a broad terrace. It has a frontage of 260 feet. On the first floor there will be an auditorium seating some 600 people, a lecture hall holding 250, a reading room, library, conference rooms and exhibition halls. The basement concontains a cafeteria and kitchen. The two upper floors will be devoted to offices. The building is the gift of the Carnegie Corporation of New York, while the ground was bought at a cost of about $200,000 through the donations of about a score of benefactors. Bertram Grosvenor Goodhue of New York is the architect. He is one of the best known architects in the country and designed the St. Thomas Church, the West Point buildings, the Nebraska State Capitol and many other buildings. The contract for the construction of the building has been let to Charles T. Wills, Inc., of New York, and it is expected that the building will be ready for occupancy in the autumn of 1923. Lee Laurie, the sculptor, has been selected to do the decorations, which will symbolize and depict the progress of science and its benefits to humanity. A series of bronze bas-reliefs will show a procession of the leaders of scientific thought from the earliest Greek philosophers to modern Americans. On passing through the entrance hall the visitor will find himself in a lofty rotunda. Here he will see in actual operation apparatus demonstrating certain fundamental scientific facts that hitherto he has had to take on hearsay. A coelostat telescope, mounted on the dome of the central rotunda, will form a large image of the sun on the white surface of a circular table in the middle of the room. Here visitors will be able to see the sun-spots, changing in number and form from day to day, and moving across the disk as the sun turns on its axis. A 60 foot pendulum, suspended from the center of the dome, will be set swinging through a long arc, repeating the celebrated experiment of Foucault. The swinging pendulum will mark an invariable direction in space, and as the earth and the building rotate beneath it, their rotation will be plainly shown by the steady change in direction of the pendulum's swing over a divided arc. Two great phenomena of nature, the sun and the rotation of the earth, are thus to be exhibited. Other phenomena to be demonstrated in striking form in the central rotunda are magnetic storms, earthquakes, gravitational pull of small masses, the pressure of light, the visible growth of plants, swimming infusoria in a drop of ditch water, living bacteria and other interesting phenomena. In the seven exhibition rooms surrounding the central rotunda the latest results of scientific and industrial research will be illustrated. One room will be set aside for the use of government bureaus, another for industrial research laboratories, others for the laboratories, observatories and research institutes of universities and other institutions. The newest discoveries and advances in the mathematical, physical and biological sciences and their applications will be shown in this living museum, whose exhibits will be constantly changing with the progress of science. One week there may be displayed the latest forms of radio telephony; the next perhaps a set of psychological tests or a new find of fossils or a series of synthetic chemical compounds. Such a mutating museum will continue to attract and instruct large numbers of tourists and residents.

Queries concerning the origin of the Australian floras: PROFESSOR D. H. CAMPBELL, Leland Stanford, Jr., University, California. (1) The conditions in the north and south temperate zones are very different. The boreal floras are relatively uniform, owing to the proximity of the Eurasian and North American continents. The south temperate floras are much less intimately related on account of the extreme isolation of the principal land masses, viz., South America, South Africa and Australia. (2) An early separation of the land masses of the northern and southern hemispheres is indicated by the very great differences between the vegetation of the north and south temperate zones. The most prominent types in each region are either completely absent from the other, or very sparingly represented. The south temperate zone has no oaks, chestnuts, walnuts, poplars, maples and many other deciduous trees and shrubs of the north. On the other hand, the Casuarinas and Proteaceæ (Banksia, Grevillea, etc.), the Eucalypti and other Myrtaceæ, as well as many other evergreen trees and shrubs, are unknown in the northern regions. The same is true of the Conifers. The true pines, firs and spruces of the north are replaced by the Araucarias, Agathis and Podocarpus of the south. (3) Australia presents an extraordinary degree of endemism, especially in western Australia, the headquarters of the autochthonous flora. (4) Australia has three distinct floras—*a.* The tropical rain-forest of the coastal regions of Queensland and New South Wales.

b. The sub-antarctic flora of Tasmania and the alpine regions of New South Wales and Victoria. *c.* The autochthonous flora, practically universally distributed, but especially developed in western Australia. (5) The tropical vegetation of northeastern Australia is evidently closely related to the floras of New Guinea and the Malay Archipelago. (6) The sub-antarctic flora, especially developed in Tasmania and New Zealand, is evidently related to the Fuegian flora of South America. It has been the subject of repeated investigation. (7) The autochthonous flora, which comprises a large majority of the Australian plants, is the main subject of the present discussion. This flora is supposed to have developed in western Australia, when it was completely separated from the eastern part of the continent, and to have later spread over the whole continent. The main problem at hand is to discover evidence which will throw light on the origin of this flora. (8) There are some notable correspondences between the flora of South Africa and Australia indicating some former land connection; but as yet no evidence for this has been found, except at a very early period. (9) Gondwana Land, the great southern continent, believed to have existed at the end of the Paleozoic, is supposed to have united South America, Africa and Australia; but a much later connection between South Africa and Australia must be assumed to explain the resemblances between their present floras, as presumably there were no Angiosperms in existence at the period of the supposed Gondwana continent. What is particularly needed is evidence showing the relation of the land masses of the southern hemisphere during the Cretaceous and the Tertiary. Especially important is a knowledge of the fossil plants of these periods, from temperate South America, South Africa and Australia. (10) It is possible that when the fossil plants from these regions are thoroughly studied it may prove that in the south temperate zone, as in the corresponding northern latitudes, during the Cretaceous and much of the Tertiary a practically uniform flora prevailed. Should such prove to be the case, it is probable that the existing floras in the south temperate regions are the descendants of this uniform flora, which shut off in these completely isolated areas have become altered to a greater or less extent. Western Australia, the most completely isolated of the southern regions, has developed the richest and most specialized flora.

The nature of disease, resistance or immunity in certain plants: Professor L. R. Jones, J. G. Dickson and J. C. Walker, University of Wisconsin.

A side effect from the importation of parasites of injurious insects: Dr. L. O. Howard, chief of the Bureau of Entomology, Department of Agriculture. In the efforts to bring about a natural biological control of injurious insects in many parts of the world, an increasing amount of work is being done by the entomologists of the different nations to bring into their own countries the foreign parasites of foreign insect pests that have been accidentally introduced and have become established. In the course of this work, the motivating idea is the control of the specific introduced pest; but it has developed in many instances that the introduced parasite is not specific to the introduced host, but attacks allied native injurious species. The speaker described a number of these instances in America. These findings offer a very strong additional argument in favor of the prosecution of work of this character.

Mitochondrial bodies in the spermatogenesis of Chorthippus Curtipennis (Scudd.): Dr. E. L. Mark and L. C. Wyman, Harvard University. Numerous bodies found in the apical (Verson's) cell of the testicular follicle, as well as in the primary and secondary spermatogonia, the first and second spermatocytes, and the spermatides of this grasshopper are described as spheroidal structures composed of two substances, a central nonstainable core and a deeply stainable mantle or cortex. The appearance of the bodies when stained is that of a vesicle with clear contents and stained wall of no great thickness. They occur in a single large cluster, or in smaller groups, and are accompanied by finely granular deeply staining cytoplasmic substance. These vesicle-like bodies are believed to be mitochondria, and are genetically continuous from the primary spermatogonium to the formation of the spermatid. In the metamorphosis of the spermatid into a spermatozoon their history has been traced till they break up into minute granulations enveloping the axial filament of the thread-like mature spermatozoon. At each of the cell divisions of spermatogenesis the vesicles are collected into a ring at the periphery of the equatorial region of the spindle figure, and soon after the chromosomes divide and separate, in the metaphase of cell division to form two daughter nuclei, it is found that these vesicles are likewise arranged in the form of two parallel rings—each containing about the same number of vesicles—one on each side of the plane of cell division, and that with the constriction of the cytoplasm during the division each ring occupies a position between the nucleus of the daughter cell and the cell plate. This ring becomes condensed into an irregular disk which lies close to the nuclear membrane, where it remains during the interkinetic, or so-called resting, stage. On the approach of cell division, the disk breaks up into clusters of vesicles, varying in number from two or three to a dozen or more, which become distributed irregularly through the cytoplasm, but chiefly in regions peripheral to the spindle figure. During the late prophase and early metaphase of nuclear division, the clusters of vesicles with their enveloping finely granular matter are again collected into an equatorial ring. At the end of the second maturation division, which results in the formation of the spermatid, the vesicles, at first small and numerous, constitute a thick disk-like structure at one pole of the nucleus. By the time the chromatin has resumed the appearance of a fine network, two things have happened in the disk-like group of vesicles, now become spheroidal; by confluence they have increased in size and diminished in number; at the same time a differentiation has taken place in them so that a few small centrally-located ones, probably not resulting from confluence, are deeply stainable, whereas the more peripheral and larger ones have become so distended with non-stainable substance that they appear very pale. The confluence of the peripheral pale vesicles continues till there are only two, which are mutually flattened in a plane passing through the center of the nucleus. Each of the two contains a small number of the small deeply staining vesicles. Meanwhile the cytoplasm on the side of the cell corresponding to the vesicles begins to elongate to form the tail. Then the two vesicles move away from the nucleus a short distance and each becomes spheroidal. Between the two appears the axial filament and as the cytoplasmic outgrowth becomes still more elongated, the two spheroidal structures also become elongated in a direction parallel with the axial filament, which they closely invest. The small contained deeply staining vesicles become arranged in a longitudinal row; the wall of the outer enveloping sac disappears, setting free the deeply staining vesicles, which now become distributed along the axial filament, and finally break down, furnishing the finely granular envelope enclosing the axial filament.

Vegetative types of Datura due to differences in somatic number of chromosomes: Dr. A. F. Blakeslee, Carnegie Institution of Washington, Cold Spring Harbor, L. I., N. Y. Normal plants have 2 n chromosomes in somatic cells. Certain Datura mutants differ in chromosome number from the norm. Of *balanced* types, with an equal number of chromosomes in each set, forms occur with 1 n, 3 n and 4 n chromosomes. Of *unbalanced* types, with an excess or a deficiency of one or more chromosomes in one or more of the individual sets, forms occur with such somatic formulæ as $(2n + 1)$ and $(4n - 1)$. These differences in chromosome number, especially in unbalanced types, cause distinct differences in somatic structure. Several thousand vegetative forms are considered theoretically possible from chromosomal types already discovered.

A method for the study of filterable viruses as applied to vaccinia: Dr. W. G. MacCallum and E. H. Oppenheimer, of the Johns Hopkins University. Attempts at the isolation of the infective agent in vaccine and smallpox have failed. It can at least be separated from most contaminating material if it be centrifugalized in a suspending fluid of appropriate specific gravity. The infective material in vaccine lymphs rises to the top in a fluid of specific gravity 1.16 and sinks to the bottom in any fluid of specific gravity lower than 1.13.

Continuation report on experiments in epidemiology: Drs. Simon Flexner and H. L. Amoss, Rockefeller Institute for Medical Research. The continuation report on epidemiology relates first to the epidemic disease, mouse typhoid, reported on at the last spring meeting of the academy, and second to an epidemic disease, rabbit septicemia, which is not infrequently met with among domesticated rabbits and the nature of the spread of which we have undertaken to study under controlled experimental conditions. These two diseases represent also two divergent modes of propagation of epidemics of disease, namely, by way of the gastrointestinal organs as in mouse typhoid, and through the respiratory organs as in rabbit septicemia. The ultimate purpose of the investigation is the securing of precise knowledge which may come to bear on and extend knowledge regarding the manner of spread and its underlying causes of such epidemic diseases in man as meningitis, poliomyelitis, influenza, cholera, etc.

Replantation of entire limbs without suture of vessels: Dr. W. S. Halsted, Johns Hopkins Hospital, Baltimore, Md. The experiments were made in the effort to ascertain the cause of the swelling of the arm after the radical operation for cancer of the breast. This swelling has been universally attributed to the excision of the lymphatics or lymphatics and veins of the axilla. The author believes that infection is the essential factor. In our experiments a cut was made through all of the tissues of the thigh except the sciatic nerve, femoral artery, femoral vein, and femur. The divided structures were immediately sutured and the wound completely closed. At various periods after the operation the vein and artery were ligated. In one instance two days sufficed, but ordinarily four days were required for the adequate reestablishment of the venous circulation through the scar. The artery can not be safely tied until about the twelfth (?) day. The grafted limb becomes swollen for only a few days after the amputation, and again in some instances for a day or two after ligation of the vein. Lantern slides were shown of the new vessels passing through the scar which alone maintain the life of the leg. An operation for cancer of the breast which eliminates the danger of a swollen arm was briefly described and illustrated.

Recent discoveries on the antiquity of man: Dr. H. F. Osborn and C. A. Reed.

Stature and head form in Americans of old families: Dr. A. Hrdlička. Conditions to be reported upon are a part of the results of a careful study of a large group of adult normal men and women descending from families three to eight generations born American. The stature averages 5 feet 8½ inches in the men and nearly 5 feet 4 inches in the women, which is well above the general mean of this country and is higher than in any large group of whites in Europe. The head is of good size, particularly so in the women. The form of the head, however, shows a great variation, indicating only little tendency so far towards any intermediate, American, type. The type of physiognomy shows a closer approach towards such a type, though similar changes are also observable in the better classes of England.

Animal evolution: Dr. Austin H. Clark, U. S. National Museum.

The distribution of the Motmots of the genus Momotus: Dr. Frank M. Chapman, American Museum of Natural History. The Motmots, a distinctively American family of birds, range from the northern limit of the tropical zone in northeastern Mexico to its southern limit in northern Argentina. The family contains six genera and approximately fifteen species and twenty-one sub-species, of which about one half are included in the genus *Momotus*. Motmots are believed to have originated in Middle America whence they have made at least three invasions into South America, one probably pre-Andean and two post-Andean. The first invasion reached the forested area of southeastern Brazil where the now existing species is separated from its nearest ally by an area 1,000 miles in width in which no member of its genus (*Baryphthengus*) is known. This hiatus in the range of the group was possibly occasioned by the entrance of the sea into the Amazon Valley. The second invasion carried a form into the Andean subtropical zone from Costa Rica, over a Panama subtropical "bridge" which has since subsided, almost to Bolivia. The third invasion, made apparently from Panama, populated northern Colombia, the coastal region of Venezuela, Trinidad and Tobago, which were doubtless at that time attached to the continent. Subsequently the birds doubtless crossed the Andes over the comparatively low Andalucia Pass at the head of the Magdalena Valley, and spread over the greater part of tropical South America. In this area they have become differentiated into nine recognized races which present interesting responses to their environment, including some marked instances of convergence. The extreme forms, occupying different banks of the lower Amazon, have apparently become specifically distinct although they evidently have a common ancestor with which they are still connected.

New results on the theory of the minor planets: Professor A. O. Leuschner, University of California (by title).

Dark nebulæ: Professor H. N. Russell, Princeton University (by title).

The larger results of twenty years of solar radiation observations: Dr. C. G. Abbot, Smithsonian Institution, F. E. Fowle and L. B. Aldrich. This report gave a summary of twenty years' study of solar radiation. This is one of the most important of the constants of nature, for upon it depends the energy required for all our machinery and our muscular power. If the sun varied as much as the other stars, we should alternately freeze and fry. But Dr. Abbott's examination of all available evidence shows that the sun's heat has not varied more than six per cent. above or below the average in the last twenty years. But whenever a series of spots pass across the surface of the sun the amount of heat and light given off falls from one to five per cent. Any such change in the sun's rays has an effect upon the weather and electrical conditions of the earth. It is therefore possible to tell what the weather is going to be by watching the sun. The Weather Bureau of Argentina sent out forecasts a week in advance based upon the solar observations telegraphed in daily from the Smithsonian Institution at Montezuma, Chile. From compilation of about 2,000 observations, it has been found that the heat radiated by the sun amounts to 1.94 calories per square centimeter per minute. This would be sufficient to melt a layer of ice 424 feet thick all around the sun. A large number of by-products relating to the temperature of the sun, transparency of the atmosphere, the number of molecules per cubic centimeter in the atmosphere, the brightness of the sky, the cooling of the earth by long-wave rays, the distribution of brightness over the sun's disk, and the general theory of the nature of the sun have come out of the investigations.

Problems of modern physics: DR. H. A. LORENTZ, University of Leyden. The lecture passed in review some problems of prominent interest. Foremost among them are the quantum theory, the problems of atomic structure and of gravitation. All these are awaiting their solution and much remains also to be done before it will be possible to explain the properties of magnetic substances, to account for terrestrial and solar magnetism and to understand the more complicated forms of the Zeeman effect. The motion of electricity in metals and effects connected with it likewise require laborious investigation. Here much may be expected of low temperature research.

Researches on thiazoles: DR. MARSTON TAYLOR BOGERT, Columbia University. In the benzothiazole group, various new derivatives have been prepared and studied, several of which are interesting because of therapeutic or tinctorial possibilities.

Researches on selenium organic compounds: DR. MARSTON TAYLOR BOGERT. New selenium organic compounds have been synthesized and studied in the quinazolone and benzelenasole groups, the azo dyes from the latter being much deeper in shade than the corresponding sulfur compounds.

Reaction between silver perchlorate and the halogens: PROFESSOR M. GOMBERG, University of Michigan. A study of the reaction indicated in the title has been undertaken in order to prepare, if possible, the compound radical (ClO_4):

$$2AgClO_4 + I_2 = 2AgI + 2(ClO_4).$$

If found to exist as monomolecular it should, it was thought, be either identical or isomeric with the ion of the same composition; if dimolecular, $(ClO_4)_2$, it should prove a higher oxide of chlorine than any hitherto known. Numerous experiments were carried out during the last year, with the halogens chlorine, bromine and iodine, and with solvents chosen from a wide range of compounds. Iodine and ether were finally adopted as best suited for this reaction, because of the formation of less by-products. At this stage of the investigation it may be considered as having been fairly well established that $(ClO_4)_x$ actually does exist, but its molecular state has not yet been determined. The compound has been prepared only in solutions of one per cent. to five per cent., and has been found to be practically non-volatile with vapors of ether at 30° C. and 100 mm. pressure. It is a powerfully reactive substance. It reacts with the oxides of various metals; it attacks zinc, magnesium, copper, silver, iron, tin, and other metals with the formation of the corresponding perchlorates; with water it gives perchloric acid, and it liberates iodine from hydriodic acid. The investigation is to be continued.

The thermal decomposition of tungsten: DR. GERALD L. WENDT.

A confirmation of Saha's theory of the ionization of the elements at high temperature: DRS. ARTHUR A. NOYES and H. A. WILSON, California Institute of Technology. By employing the usual thermodynamic expression for the change of chemical equilibrium with the temperature, and supplementing this by an evaluation, based on fairly well established theoretical considerations, of the specific constants occurring in that expression, Saha (*Phil. Mag.*, 40: 479, 1920) has shown that one can compute from the ionization-potential of an element the extent to which its neutral atoms are converted into ions at any temperature or pressure; for example, the extent to which sodium undergoes the reaction $Na = Na^+ + e$, where e denotes the electron. This computation has proved of great astronomical interest because of the new possibilities it affords of interpreting the presence, absence, or relative intensities of the spectra of certain elements under different stellar conditions. The fact, however, that Saha's computations involve certain hypotheses makes the experimental confirmation of his conclusions highly desirable; and it is the purpose of the authors' paper to show that the experiments of one of them (H. A. Wilson) on the electrical conductivity of flames furnish such a confirmation.

The general system of isotopes as related to the formation and disintegration of atom nuclei:

Professor William D. Harkins, University of Chicago. The nucleus of any complex atom may be considered as a highly condensed proton-electron aggregate. Up to the present none of these condensed aggregates have been found to be electrically neutral (neutrons), and in *most* atoms which exist on earth and in the meteorites each electron binds two protons. Thus the composition of the nuclei of most atoms may be expressed by the formula $(p_2e)_M$, in which p represents a positive electron (proton), e an electron, and M is the atomic number. No atomic species has been discovered in which one electron binds more than two protons. The simplest complex nucleus is that of the helium atom (the alpha particle) which has the formula $(p_2e)_2$ This is also the most abundant group present in more complex nuclei. It was shown by Harkins and Wilson in 1915 that according to the special relativity theory the amount of energy liberated in the formation of four grams of helium from protons and electrons, that is, from hydrogen, is 6.7×10^{11} calories, or five million times the energy liberated when the same weight of hydrogen unites with oxygen to form water. This is about three fifths of the energy which would be liberated in the complete change of 238 grams of uranium into 206 grams of lead, 32 grams of alpha particles, —6N electrons (where N represents the avogadro number) and about 0.05 grams of radiant energy. The energy which would be liberated in the formation of alpha particles from hydrogen is so great that it would seem that this reaction should proceed at an extremely high speed. That this is not the case may be due to the fact that for some unknown reason one electron does not form a very stable union with one proton, but the common ratio is two of the latter to one of the former in the most stable aggregates. Thus it is not improbable that four protons and two electrons seldom meet at one time in such relative positions as to allow the alpha particle to be formed. It may be suggested that the first step in the building of an alpha particle may be the formation of the aggregate p_2e, which is stable with reference to aggregation, but easily unites with a like particle to form the group $(p_2e)_2$, or the alpha particle. According to Rutherford's hypothesis the carbon nucleus consists of four groups of the formula p_3e. While the evidence in favor of this assumption is not specially convincing, there is on the other hand no evidence against it. However, definite evidence will be presented which proves that the alpha particle is the principal group concerned in the growth of carbon nuclei into those which are heavier. The composition of any complex nucleus may be expressed by the formula $(p_2e)_M(pe)_n$, in which n represents the *isotopic number*. This number varies from 0 to 54 for known atomic species, and is 0 for most atoms. In the range in which the isotopic number is small, the most abundant species of atoms are those whose isotopic numbers are divisible by 4, while for higher isotopic numbers the maxima of abundance are not so distinct, and occur in general for the isotopic numbers which are even. The most important relations which should be taken into consideration in showing the nature of the general system of isotopes are: (1) The number of negative electrons in most atom nuclei is *even*, so in general the atomic weight and the isotopic number are both even when the atomic number is even, and are both odd when the atomic number is odd. (2) As the atomic number increases the isotopic number of the more stable isotopes of an element also increases. This may be expressed as follows: As the *net* positive charge on an atom nucleus increases the atom becomes more unstable unless at the same time the nucleus becomes more negative with reference to its *relative* content of negative electrons. (3) For any set of isotopes the atoms become more unstable with reference to a beta disintegration as the isotopic number increases, and more unstable with reference to an alpha particle disintegration as the isotopic number decreases. This relation does not specify what form of disintegration will take place in any special case, since this probably depends upon the grouping, but it does give the relative rate for any disintegration which actually does take place. Obviously this relation has been tested only in the case of the radioactive elements. The relations which exist in the general system of isotopes will be presented in the form of an extensive plot which exhibits a large number of relations, many of them periodic, which can not be well treated in an abstract.

A theory of electric conduction in metals: Professor Edwin H. Hall.

Cooperative studies of California earth movements: Dr. Arthur L. Day, director of the Geophysical Laboratory, Carnegie Institution of Washington. Recent information from astronomical sources has indicated a northward crustal movement of small magnitude in northern California. The suggestion has been made that the accumulated strains produced by such movement eventually produce rupture and an elastic recoil or earthquake. Cooperative studies have been undertaken by the Carnegie Institution of Washington, U. S. Coast and Geodetic Survey, U. S. Geological Survey, the geological departments of the universities of California, the California Institute of Technology, and the Bureau of Standards, with the purpose of gathering precise data bearing upon this subject. It is a part of the program not only to locate the surface displacements either gradual or disruptive, but also to develop instruments and establish stations for the location of sub-surface zones of movement.

Geological overthrusts and underdrags: Professor W. M. Davis, Harvard University (by title). Overthrust masses of earth crust have been found, the front of which has advanced a score of miles or more beyond its original position. On tracing such masses backward, no indications of a cavity left by their advance have been found; hence it may be possible that they have obliquely emerged from beneath rear portions of the crust which have not taken part in their movement. If so, the rear portions should exhibit displacements due to what may be called the ''underdrag'' of the obliquely emerging masses. Such displacements would be characterized by an increase in horizontal dimensions in the direction of underdrag, and manifested by normal faults on moderately slanting fault planes. The mountain ranges of the Great Basin of Utah and Nevada appear to exhibit such displacements.

The effects of winds and barometric pressures on the Great Lakes: Dr. J. F. Hayford, Northwestern University. The surface of the water of any one of the Great Lakes is never level except by accident. It always has a slope in some direction, produced by the wind, by barometric pressures, or by the water of the lake oscillating as if it were in a great wash-basin. The correct knowledge of these things is a key to various scientific problems and ultimately will prove to be worth millions, in their application, to the people of the United States. It has long been known that a wind blowing over a lake tends to pile up the water on the lee shore and to pull it down on the windward shore. How large is this effect? Is the response of the water to the wind immediate? It has not been possible to answer these questions confidently in the past. Now it is known that the response is prompt and that the effect of a given wind in disturbing the water level at any point in the world may be computed in advance. It is known that the strongest winds that blow have almost no effect in changing the water level at various points, as, for example, at Milwaukee on Lake Michigan and Mackinaw City on Lake Huron. On the other hand, it is known that a wind of 50 miles per hour from the southwest piles up the water a foot at Buffalo and pulls it down simultaneously more than a foot at the west end of Lake Erie. The reason for this extreme contrast between different places and for the fact that the wind effect is greatest in long shallow bays is now accurately known. The lake surface is also continually tilting up, first in one direction, then in another, in response to varying barometric pressures. The water tends to go toward a region of low barometric pressure and pile up there. Such effects at Mackinaw City and Milwaukee frequently amount to three inches or more, although wind effects at these points are almost inappreciable. Just as a piano string struck once, or the air in an organ pipe continuously agitated by a reed, vibrates with its natural period, so the water of each of the Great Lakes under the many impulses given it by the winds and barometric pressures oscillates back and forth. Sometimes the whole of a lake is concerned in an oscillation, and sometimes the lake oscillates in parts. Such oscillations in lakes are called seiches.

Striking similarities between the igneous rocks of Brazil and South Africa: Dr. H. A. Brouwer. Striking similarities in geological age and in composition exist between the old granites and gneisses with intrusive younger granites, the precretaceous intrusive sheets of diabase, the lava flows of the Serra Geral and the Drakensberg, the pipes and dykes of kimberlite and the intrusive and effusive alkali rocks (nephelinesyenites, phonolites, etc.). The alkali rocks are found on both sides of the Atlantic Ocean near the coast; they form denuded volcanic centers and if the west coast of Africa and the east coast of South America be considered in juxtaposition the location of these older volcanoes would be very similar to that of the young volcanoes of alkali rocks (Kenia, etc.) near the young fracture-system, bordering the rift valleys in East Africa. Very long dykes of nephelinesyenites prove the existence of similar fractures in the central part of South Africa.

Fauna of the Pleistocene asphalt deposits of McKittrick, California: Dr. John C. Merriam, president of the Carnegie Institution of Washington, and Chester Stock, University of California. The discovery of an enormous accumulation of perfectly preserved remains of extinct animals found in asphalt beds in the environs of Los

Angeles, California, some years ago furnished some of the most interesting data on the history of life thus far secured in America. A similar deposit representing an assemblage of animals of a somewhat different type has recently been opened for extensive investigation on the western border of the Great Valley of California. Remains of a wide variety of higher animals and birds were found at this new locality. The collection represents the geological period immediately preceding the present and offers the best opportunity thus far known to study the life of this late geological stage under the conditions obtaining in the Great Valley of California.

The telephone engineer a public trustee: Frank B. Jewett, vice-president, Western Electric Company. In his paper, which was a statement of the unique position which the telephone engineer of to-day occupies in relation to the general public, Dr. Jewett outlined the organization of the communication service of the United States and pointed out the position and scope of work of the engineer in this organization. Dr. Jewett indicated that the telephone art, even at the end of nearly half a century of the most intensive development and monumental growth, was still far from being an agency requiring little or no change. He showed that the recent developments in physical science had opened up vast possibilities of new and improved communication services which the telephone engineer was endeavoring to make available for public service, and indicated some of the problems which were being successfully attacked. He also pictured some of the tremendous difficulties which confronted the telephone engineer in incorporating these new services into the existing structure, which was itself growing rapidly along already developed lines, without producing disruptions of service. Finally he pointed out that the telephone engineer of to-day had come to recognize that his function was in effect that of a public trustee and that his problem was not alone that of developing new and improved instrumentalities, but of developing these instrumentalities and making them available to the public without subjecting the telephone user to annoyance as a result of experimentation on the public at large.

The loud speaking telephone: Frank B. Jewett, vice-president, Western Electric Company. For many years, and in fact almost from Dr. Bell's discovery that human speech could be transmitted to distant points electrically, there has been incessant quest for a satisfactory loud speaking telephone. Innumerable attempts to devise instruments of this kind have been made in the last thirty or forty years and until recently all have been substantial failures. Recently, however, really successful instrumentalities have been produced and the field of possible influence on all social and human relations which has opened up was evidenced graphically in the Armstice Day exercises attendant upon the burial of the Unknown Soldier at Arlington, Virginia. In these ceremonies vast audiences in San Francisco, New York and Washington listened to the President of the United States and other speakers and joined in common exercises of respect to America's dead. Dr. Jewett's paper, which was illustrated by a local demonstration and by a demonstration of talking over the regular telephone wires from New York, described the physical and electrical problems whose solution had to be achieved in order to make the loud speaking telephone a success. He pointed out that the problem consisted essentially of four main elements, namely: (1) The development of telephone transmitters capable of picking up the sound vibrations of the speaker's voice when the latter was speaking normally at some distance from the instrument, and of faithfully translating these vibrations into electrical vibrations for transmission over the wires; (2) the transmission of these electrical vibrations undistorted to the distant point; (3) the amplification at the distant point of the received electrical impulses to an energy value many times greater than that produced by the transmitter at the speaker's end of the line; and (4) the translation back into sound vibrations of these greatly amplified speech waves through an appropriate loud speaking receiver. He pointed out that if the received speech through the loud speaking receivers was to be of acceptable quality no serious distortion could take place in any of the links of the chain from the speaker to his distant audience, and that the inherent characteristics of the loud-speaking system call for even more faithful reproduction than is necessary in ordinary telephones of recognized good quality. He pointed out further that because of the necessity of using ordinary telephone lines, which in most cases were in close proximity to numerous other telephone lines used in the regular way, it was necessary that the currents transmitted from one end of the line to the other should be substantially of the same magnitude as those produced in the use of the ordinary telephone. He showed that this requirement, combined with the necessarily inefficient energy characteristics of the originating transmitter and the tremendous energy requirements of the loud speaking telephones had made the problem inherently insoluble until means had been developed for producing telephone lines with very uniform transmitting characteristics and until amplifying devices of great power, uniformity and freedom from inherent distortion production had been developed.

The physical examination of hearing and binaural aids for the deaf: R. L. WEGEL, Western Electric Company, New York City. The function of the auditory sense is to detect sounds of different wave shapes, the ratio of the pressure on the ear drum varying over a range of 1 : 1,000,000. It must also differentiate between sounds so nearly alike that no existing physical apparatus is capable of separating them. Binaural audition adds a sense of orientation and discrimination together with a more uniform sensitivity for sounds approaching from different directions. A binaural set for aiding the hard-of-hearing was exhibited. An abnormal auditory sense may be regarded as one lacking to a greater or less degree in (1) range of sensation (frequency or intensity), (2) quality of sensation in various regions of the range, (3) binaural sense. Methods have been studied for exploring the outstanding elements of these functions. A new audiometer for measurement of hearing was shown.

The relative sensitivity of the ear at different levels of loudness: DR. DONALD MACKENZIE, Western Electric Company. Up to the present time there has been no satisfactory technique for loudness comparisons of different tones. In this paper a description is given of an alternation phonometer which makes it an easy matter to adjust to equal loudness two tones of different pitches. With this instrument a determination has been made of the relative sensitivity of normal ears of both men and women, over the pitch range from bass G to C5, at sound intensities midway between the faintest audible and the painfully loud. It is found that the sound energy necessary to produce a given loudness is smaller the higher the pitch, at least within the range examined. Different ears agree more closely at these intensities than at the least audible, and no difference is detectible between men and women. Interpretation of the results shows them to be in harmony with Fechner's law, according to which the difference between the sensations due to two lights of the same color or two tones of the same pitch is proportional to the ratio of intensities of the lights or sounds causing the sensations. This simple law holds only at moderate intensities. Phonometric comparisons by a small number of observers were made at intensities from very faint to very loud. It appears that any one ear varies from day to day, but these variations are most noticeable at the extremes of loudness. The results taken all together strongly suggest that, on the average, the relative sensitivity of the ear to different musical notes is practically the same whether the sounds are loud or faint.

Recent progress in aeronautics: PROFESSOR J. S. AMES, The Johns Hopkins University.

Coefficients of slip and the reflection of molecules: DR. R. A. MILLIKAN, Norman Bridge Laboratory of Physics, Pasadena. This paper contains a presentation of the theoretical relations between the coefficient of slip and the law of reflection of gas molecules from the surfaces of solids and liquids. It presents, also new experimental data taken by the author and his pupils which completely check the correctness of this theory. It gives for the first time the exact ratio between the number of impinging molecules which are specularly reflected in the case of a given gas from given liquid and solid surfaces, and the number which are diffusely reflected. The most interesting facts brought to light by the investigation are, first, that this ratio is different for different kinds of molecules when the nature of the surface remains constant, and, second, that there is a larger coefficient of slip between oiled surfaces and gases than between the same gases and ordinary unoiled surfaces of metal or glass.

Origin of penetrating radiations of the upper air: DR. R. A. MILLIKAN, Norman Bridge Laboratory of Physics, Pasadena. It is of intense interest to know whether the penetrating radiations which have been heretofore studied up to altitudes of 9,000 meters are of cosmic or of terrestrial origin. Pre-war observations made in manned balloons in Germany gave indications that they were of cosmic origin. Observations published last year from the University of California were in opposition to this view. Indeed, the California observers attributed the increase in the rate of discharge of the electroscopes with increasing height, as found in Germany, to the effects of temperature upon the electrical conductivity of the supports of the gold leaves in the electroscopes. The observers at the California Institute of Technology have definitely proved that the temperature effects upon the supports when the experiments are properly performed are practically negligible. They are now making balloon flights in which self-recording instruments are sent up to the very top of the atmosphere, that is, to a point at which only one sixteenth of the atmosphere is still above, and should be able to determine with certainty by these experiments whether the penetrating rays are of cosmic or of terrestrial origin. While the instruments sent up weigh but 175 grams (6 ounces) they are capable of bringing back a complete record of the temperatures, the pressure, and the penetrating radiations existing at all of the altitudes which they reach. These altitudes should be about three times as great as those ever obtained before in experiments of this kind. These balloon flights will be reported later.

On the measurement of a physical quantity whose magnitude is influenced at random by primary causes beyond the control of the observer, and on the method of determining the relation between two such quantities: Dr. Walter A. Shewhart, New York City. The objects of scientific investigation are twofold, *i. e.*, the determination of some form of average value and its probable variation, and the determination of the relation existing between two or more such quantities. In many problems of physical and engineering science it is possible to assume that causes of variation of the variable under consideration may be controlled by the observer. Certain problems in these sciences as in the fields of economics and biology arise, however, wherein it is impossible to control the causes of variation, and they must be submitted to a statistical method of solution. An outline of the necessary analysis is given and illustrated. Application of the theory of correlation and its physical interpretation was discussed.

Ether-drift experiments at Mount Wilson in 1921 and at Cleveland in 1922: Professor Dayton C. Miller, Case School of Applied Sciences, Cleveland, Ohio. The Michelson-Morley experiment to detect the relative motion of the earth and ether was performed at Cleveland in 1887. In explanation of the null result then obtained, the Lorentz-FitzGerald effect was proposed. The experiment was repeated by Morley and Miller in 1904, with a much larger and more sensitive apparatus, which was also especially arranged to make a direct test of the Lorentz-FitzGerald effect. Again a null result was obtained. The suggestion was then made that the earth drags the ether, and while there is no "drift" at the surface of the earth, it might be perceptible at an elevation above the general surface. The experiment was again performed by the present author, at the Mount Wilson Solar Observatory in March and April, 1921, where the elevation is nearly 6,000 feet. The results indicated an effect such as would be produced by a true ether-drift, of about one tenth of the expected amount, but there was also present a periodic effect of half the frequency which could not be explained. The interferometer had been mounted on a steel base and in order to eliminate the possibility of magnetic disturbance, a new apparatus with a concrete base and with aluminum supports for the mirrors was constructed. Observations were made in November and December, 1921, the results being substantially the same as in April. Before any conclusions can be drawn, it is necessary to determine the cause of the unexplained disturbance. The interferometer has again been mounted at Case School of Applied Science, in Cleveland, and observations are now in progress, the results of which were reported in this paper, which was illustrated by lantern slides and motion-pictures. About 700 feet of motion-picture film was taken at Mount Wilson by a member of the observatory staff, showing the location and construction of the apparatus and also the method of making the observations.

Some extensions in the mathematics of hydromechanics: Dr. R. S. Woodward, Washington, D. C. The most general specification of fluid motion requires a minimum of twenty symbols, or factors. Of these the most important are the three velocity components, the three spin components, and the four potentials from which the velocity components are derived by differentiation. *The first part* of the paper shows how it is more advantageous, in general, to make use of the relations between the Laplacians, or the Laplacians of the Laplacians, of these factors, than it is to make use of the relations of a lower order. It is shown that this extension greatly systematizes and simplifies the statement and the solution of problems on the motion of viscous fluids. *The second part* of the paper refers to what the author has ventured to call preharmonics, which are the triple integrals of harmonic functions which figure extensively in hydromechanics. It is shown how to find all of the preharmonics corresponding to all of the harmonic functions of positive and negative integral degrees.

Normal coordinates and Einstein space: G. D. Birkhoff.

Algebraic solutions of Einstein's cosmological equations: Edward Kasner.

The geometry of paths: Oswald Veblen.

Biographical memoir of Dr. J. A. Allen: F. M. Chapman.

Biographical memoir of Benjamin Apthorp Gould: G. C. Comstock.

Biographical memoir of Henry Pickering Bowditch: W. B. Cannon.

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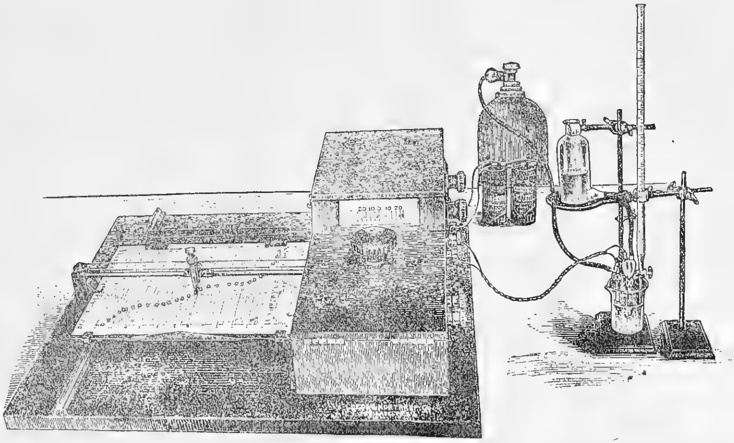

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THE FACTOR OF SAFETY IN RESEARCH[1]

ONCE in the drear dead days unfortunately still fresh in memory the head of a great institution for the aid of education wrote, with reference to research, these words: "In the last two decades more sins have been committed in its name against good teaching than we are likely to atone for in the next generation." Evidently the time of reformation had not arrived when this disparagement was uttered, for some ten years later the same pen recorded history as follows: "Much of that which has gone on in American universities under the name of research is in truth only an imitation of research."

To some of you, more than commonly zealous in support of investigation and with a background of rural experience, these words may come with memories of the odor of new mown hay and visions of waving yellow fields and the reflection that excessive heat sometimes causes mental aberrations. For the quoted passages could have come only from an annual report, naturally written just after the end of the fiscal year; but unfortunately for this simple explanation, the fiscal year of the institution in question does not end in June, and the derogation of research was conceived in the cool gray days of autumn. Moreover no charge of alienation of reason could be brought against the author of these rebukes that would not lodge with equal justice in other quarters. The chief executive of another great institution which has done and is doing as much in the field of research as any of its kind in America voiced a similar sentiment thus: "Quite too much attention is paid to those who when they make some slight addition to their own stock of information fancy that the world's store of

[1] Address of the President of the Michigan Academy of Science, Arts and Letters, March 29, 1922.

knowledge is thereby increased by a new discovery." It is not fair in this case to remove the quoted words from their context, which was really a commendation of research as a university function. But in view of the wariness with which such views are expressed in public, the slight stricture here permitted to appear is probably only the weather-worn outcropping of a stratum much more extensive.

Indeed, it is not an uncommon idea even among men actively engaged in investigation that there is a fearful waste of energy upon research that might as well be left undone. Has it not been pointed out in every discussion of cooperation in scientific work how much better would the world be served, could the labor now being frittered away upon unimportant matters be organized under the direction of some one capable of separating the wheat from the chaff? A few years ago Edwin Linton, in an appreciation of Spencer Fullerton Baird, who must have been a practical person to have deserved the commendation bestowed upon him, wrote: "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." Likewise the energetic chief of the Federal Bureau of Entomology, on looking through a collection of doctor's theses with the interests of his own bureau in mind, finds "that only a very small percentage of this output represents work which can be of the slightest use to humanity in its immediate problems regarding the insect world." "At present most of the best men are working away in their laboratories practically heedless of . . . the tremendous necessity for the most intense work by the very best minds on the problem of overcoming and controlling our strongest rivals on this planet." Had Dr. Howard been a physicist, or engineer, or metallurgist, he could no doubt have changed a word here and there and made the same statement with equal vigor. Those of you who every May have scanned a series of doctor's theses may wish to explain in some other way the fine despair with which he exclaims, "And how can we emphasize the prime importance of devoting our earliest attention to those problems which most immediately concern our well being."

These are not the only investigators who have views that substantially agree in regarding much research as wasted, and the number who are willing to express such views in public is presumably but a fraction of the number who hold them in private.

Research is not, it is true, alone in including much which is of no direct value. How much of literature could not be suppressed, to the advantage of author, publisher and reading public? Is there not much of so-called art which might never have been born, and leave the world happier for its non-existence? However, to recite the ills of sister lines of endeavor is not to cure or even excuse our own.

But are they ills? Is it to be in any wise deplored that the research by which John Brown wins a degree, or Professor Jones keeps his mind fertile while teaching, is not of the sort that promises to lighten the burdens of human society or increase its means of pleasure? At least, is it to be deplored to the extent that Student Brown and Professor Jones should have refrained from research if they were unable to fix upon a more practical subject of investigation? I believe it is not only *not* to be regretted that some pieces of research must seem trifling, but that the system under which we now operate, in which unimportant or perhaps in themselves valueless contributions are sometimes made, accomplishes a greater result than any system that could be devised under which such insignificant researches would be excluded.

Let me disillusion at once those who imagine that I am about to defend research on the ideal ground that truth for truth's sake is indeed practical, and that therefore any investigation which discovers a grain of that precious commodity is an economic gain. I would be willing to make such a defense if it were desirable to pitch the combat on so high a plane. But it is no time to wrestle with the angels above the clouds while the forces of evil are unvanquished in the valley. I have no intention of discussing at length what is practical. Perhaps one should regard general knowledge as the most practical kind. The elimination of *ennui* and of the loose habits formed in the periods of mental vacuity to which the ignorant and the merely technically trained are frequently subjected may result in improved health and increased longevity, and so be a highly practical matter. An engineer or a physician seldom reaches the economic heights of his profession without the engaging or compelling mental exterior which only a general education can develop to the full. One need not admit that only those things are practical which look practical to the world at large. One need not even admit that a thing is useless even if it could be known—as it can not—that no better food supply, or no decrease of hardship would ever come out of it. The conception of the practical which makes it include general knowledge is capable of strong support, but I shall not avail myself of it. I propose to accept, for the purpose of this address, the definition of the practical as given by the man in the street.

Nor have I any intention of deciding whether a practical education is the best one. So far as I can see, the whole science of astronomy might be forgotten, and my present daily life would go on about as before. I would enjoy the sunlight and profit by its energy as I do now. The seasons would follow one another in the same order if we were ignorant of the causes of their succession. The eugenic effects of moonlit and starlit nights would be as great as at present. Should the navigator who brings me comforts from distant parts of the globe get into trouble, that difficulty could soon be obviated. But one element of vastness in the thoughts of men would be gone forever, and it is not unlikely that experiences of other kinds would shrink in proportion. What physical advantage, gained by devoting to some applied science the energy now devoted to the planets, could compensate for such a loss?

It is not my purpose, however, to address myself to idealists, though no doubt that is the character of this audience. Arguments on a lower level are now much more urgent. We are all familiar with the investigations which have been undertaken for the simple purpose of discovering scientific truth, but which afterwards have led to results of the highest practical importance. Biologists know by heart the story of Professor Harrison who by painstaking experiments devised a means of keeping alive a small group of cells after removal from the body of the animal to which they belonged, and of watching them grow under the microscope. He was seeking to demonstrate a principle of morphology and development, and he succeeded to the satisfaction of himself and his co-workers. Neither he nor they considered the possibility that his method of tissue culture would ever be used to the obvious advantage of man. But this method was later used by a great surgeon, who kept tissues alive for years and who pointed out the possibilities which the method contained of disclosing the causes of death and thereby of prolonging human life. Thus the experiments first used to settle a disputed question of biology promise, in the opinion of many, to bring us nearer to that oldest of human goals, the fountain of eternal youth. The possibility of practical advantage to be derived from these culture methods weighed heavily in the allocation of the Nobel prize in medicine which was bestowed upon the surgeon. There should be no detraction from the credit due to one who has the vision to discover new uses for old methods, but rather increase of credit to the original discoverer. Professor Harrison would be the last to ask that the Nobel prize be transferred to him. All he would ask is that research in general be supported in a broad way which will occasionally make possible further practical applications.

Perhaps less generally known is the recent improvement of submarine cables, whereby their capacity is increased five-fold. Experiments extending over a long period of time had as their aim improved insulation which would prevent or reduce leakage. These efforts succeeded to a marked degree only after another worker, with the mere advance of scientific knowledge in mind, invented a new alloy having the desired insulating properties. The field of physics is full of such examples. The work of Maxwell on the electromagnetic wave theory led to wireless telegraphy; Roentgen's rays were discovered in the course of a piece of pure research; and, indeed, all of the early work on electricity was done in a spirit of investigation having no other object than to discover the truth.

What might have happened to these discoveries had they promised to emerge in an atmosphere in which it was considered that "much that has gone on in the name of research is in truth only an imitation of research," can only be surmised. Whether they would have been made in the laboratories of an institution where they stood a chance of being regarded as "sins against good teaching" so heinous as to demand expiation for a generation, may be doubted. Even if their worst prospective reception had been that of being regarded as slight additions to the discoverers' own stock of information and not an increase of the world's store of knowledge, their origin could hardly have been inspiriting to their author. One pauses to meditate upon the reasons for the long delay in the appreciation of the work of the Abbé Mendel in hybridization of garden peas, and of that of Willard Gibbs on the "phase rule," and to wonder whether even then men in positions of influence were convinced that they could "spot" in advance those things which were worth doing.

It would be hazardous to assert that cases as striking as the foregoing are common. Less spectacular examples are, however, not rare. Although many of the economically valuable applications of science to practical ends are directly made by investigators who are consciously striving to make those applications, it is probably in every case true that their success has depended upon previous discoveries not made with a practical aim in view. Some one has gone so far as to say that every discovery of science which has proven of economic use was first made as a contribution to pure science.

Justification of research along lines that promise no amelioration of man's condition must not, however, lie only in the possibility that the amelioration will result even without the promise. Some investigations must be carried on purely for the training of investigators. Until, by use of tissue cultures or an analogous procedure discovered by the pure scientist and then applied by others, some means of indefinitely prolonging life is discovered, new investigators must be developed to replace the old. New investigators are developed only by practice, and in practice they must solve problems. For this educational work a problem of small value often serves as well as a weightier one. Indeed, since first attempts often show the hand of the novice, it may be doing a real service to science to withhold the more serious problem for a second or later investigation. It is not reasonable, therefore, and perhaps it is not wise to insist that even the training of research students shall all be done on subjects that are in themselves of high value either directly or indirectly. Objecting to our system of traininig in research by means of small investigations that are not in themselves important is like proposing to abandon the study of arithmetic by means of problems on the ground that no one ever bought seven gallons of vinegar at twenty cents a quart, and that therefore it is a waste of time to discover how much the liquid cost.

To convince ourselves that the rearing of young investigators on a diet of insignificant problems is not inevitably fatal, and that it may even be beneficial, it is only necessary to look backward instead of forward, and gather assurance concerning the future from what has happened in the past. Did Pasteur, for example, learn the art of investigation on a problem that he foresaw was to be a lasting boon and cause of untold happiness to men? This being a presidential address, I will probably exhibit no greater degree of ignorance than is to be expected if I inquire whether the solution of a puzzling problem relating to the isomeric tartaric acids was by any one at that time held to be full of economic promise. Molecular structure we may regard to-day as of high importance, perhaps in some instances even in a practical way, but hardly in Pasteur's early manhood. That his researches were considered by his contemporaries futile, even from the pure science viewpoint, is plain; for when Pasteur's reputation had been established, when he was professor of chemistry, even when he was dean of his faculty, than which no higher honor presumably could come to a man of science, he was advised by Biot and Dumas, veteran chemists, not to waste more time on the subjects which were then uppermost in his mind. These investigations led, however, through the chemistry of fermentation to the bacteria of fermentation, and thence to the organisms of disease, and to-day the appreciation of the practical value of Pasteur's work is universal.

We may be told that Pasteur could have started midway in his career if some one had put him there at the outset by advice; and if we reply that there was no such person to advise him, we may be reminded that there are plenty of advisers to-day. These advisers are precisely the foundation on which those who decry the uselessness of many present investigations propose to build a system in which only useful and important projects are undertaken. Granted an abundance of omniscient advisers, their plan should work; but if these foundation stones prove defective, the structure resting on them will fall. How readily such advisers may be discovered and drafted into service is perhaps capable of computation. No doubt each person who proposes to eliminate uselessness in research has in mind at least one who is able and willing to undertake the task of elimination. Otherwise the proposal would hardly be made. One need, therefore, only count the number of those who would dispense with impractical investigation to determine the minimum number of advisers with which the system might start. Probably there are others having ability, but also modesty, who can not be immediately discovered. So far as I know no one has attempted to determine how much leadership a federation to prevent uselessness in research might count upon.

There is danger in this connection that the controlling factor of a career be misjudged. Careers are only occasionally guided by advice; for the rest, they are the product of evolution. Each step depends on what has gone before, and determines what shall come after. Granted the characteristics with which Pasteur's parents endowed him, his life proceeded naturally from one thing to another. One need not be a fatalist to conceive that the only way for him to end with proof of the germ theory of disease was to start with isomerism in tartaric acids. Had he been artificially set down at some mile-post on the way, without having traversed the preceding distances, it is questionable whether he could have been made to follow the same road, even with the help of advice from those who believed they were qualified to give it. Without the abiding faith that he was on the right road, which only his own previous work, not the suggestions of his elders, could give him, it is scarcely likely he would have persevered through the long periods of discouragement. To him who asserts that Pasteur could have been put upon the problem of pathogenic organisms in his early days and have reached the goal of his maturity at an earlier date, the only suitable reply seems to be the verse which might prove to have apostolic origin if the Scriptures recorded everything, "Verily, optimism hath its own reward."

Had Pasteur's hypothetical early start on pathogenic organisms failed to lead him to the present conception of the etiology of disease, what would have been the damage? Would the world simply have lost Pasteur, and never been the wiser, in the same manner as it has probably lost many another genius, perhaps through mistaken advice coming from those who were supposed to know? Could humanity have counted on a substitute for Pasteur, arising at an equally early date and arriving, either with or without advice from superiors, at the same conclusions as Pasteur reached? It is not likely. Failure to discover the truth by Pasteur would have been a calamity. His work would have been careful, painstaking. Everyone watching his later career would have recognized that his work on the theory of pathogenic organisms must have been thorough. But, owing to immaturity, or want of perseverance because he lacked the faith in his own hypotheses which only gradual development of them could insure, it had demonstrated nothing, its results were negative. Surely this would not have been an encouraging fact for any one else who conceived the germ theory of disease and contemplated efforts to prove its correctness. The oligarchy set up to guide research in useful directions would hardly have advised young men, or others, to enter that field. The fact that careful work by an able investigator, even if then young, had failed to find any proof of the bacterial origin of disease, could easily have damned the truth to a generation or more of undiscovery.

If any comfort is to be taken in the gloomy picture of what would have happened if Pasteur had, at the behest of some supervising agency, undertaken as a first problem something else than the isomerism of tartaric acids, and thereby missed the germ theory of disease, it must lie in the belief that a man of Pasteur's timber would have done great things in another field. But such a consideration does not answer the argument that his early work, practical or not, was a necessary training in order that his maturer work might be valuable.

Doubtless the case of Pasteur can be duplicated by that of other eminent scientists whose first research seemed to bear no relation to their later high attainments. Perhaps that is regularly true, except in the small number of cases in which by the laws of chance it is to be expected that preliminary work and eventual important discoveries shall lie in the same field. The fields in which the accomplishments of great investigators lie may thus appear to be matters of accident; but then, an accident is but the inevitable consequence of other accidents that have gone before.

If it is not fatal, but sometimes even useful, to start the new investigator on his way with a problem whose solution promises no practical improvements in human affairs, what is to be said of those who are mature in research? Probably most of these trained workers would be better satisfied with their showing to their fellow men, even if not more content with themselves, if they could be perpetually engaged on practical projects. Even if it be granted, as has been done in the introductory remarks of this address for the sake of limiting the discussion, that practically useful investigations are the only ones desirable, is it possible to maintain a system of research in which only practical things are attempted, and make it work? For various reasons the practical problem that suggests itself to an investigator may be one which he can not undertake. Lack of facilities readily accounts for many such cases, geographical position for others. The problem that seems most feasible may not seem highly important even from the pure science point of view. What is the investigator to do under these circumstances? Refrain from undertaking a problem which he feels sure is not of great value? Even if that means doing no research at all? Perhaps. But if he decides to keep on working, he may take comfort in the story of the foolish virgins, and reflect that in his small way he is keeping his lamp trimmed and burning even at the cost of some oil which seems wasted, until the bridegroom cometh with a problem that is more worth while. For nothing is so quickly fatal to research as interruption of it. This university furnished, for valuable war work, some investigators whose previous work was regarded even by themselves as of small value. I am not speaking of any of you here present. The gentlemen to whom I refer are in their laboratories to-night. They find the labors to which the great conflict introduced them so pleasurable, nay, even enthralling, that they have no time to listen to mere presidential addresses. The life of any eminent scientist of the present generation would probably furnish a further example of the *ad interim* value of unimportant research. At least this is true of those in my own field upon whom I have taken the trouble to reflect. They have engaged in continuous investigation, the continuity being due in part, in every case, to insignificant productions. It is very seldom, and then only under unusual circumstances, that a serious interruption is followed by a return to high productivity.

Nor must it be forgotten that many men who are engaged in research of minor value are the trainers of new investigators who may be more "lucky" than themselves. I think with profound respect of the professor of physics in a small western college who keeps working in a small way, who has never made a striking contribution, practical or otherwise, to his science, but who every year or two sends to a great eastern university a graduate student. Although these students are most of them still young men, they have done creditable things, some of them practical. Is it likely that the professor in the small college could thus inspire his students to a career of learning without the stimulus that comes from his own research? You may answer this question to your own liking, as I am doing. In a vicarious way, this man seems likely to exert upon his science an influence out of all proportion to the immediate significance of his own investigations.

My challenge to the critics of the present system of research to produce anything better does not rest on the idealistic argument that truth for its own sake is the highest aim of the scholar. This argument might not appeal to those for whom this address is intended, who, while not present in this audience, may yet receive the challenge. It rests on the demonstrated fact that many discoveries thought unimportant when made have proven to be valuable later, on the belief that new investigators are often as successfully prepared by unimportant practice problems as by more fundamental ones and with sometimes less danger to the progress of science, and on the assumption that the continuity of labor which problems of small value permit is conducive to aggregate high productivity. This is the system under which we now operate, a system which leaves the individual free, and which does not chide him too severely if he sometimes engages in insignificant labor. It is a system which provides for the doing of many services in order that some of them may prove valuable. Can it be improved upon? Quite possibly. Can it be improved upon by attempting to suppress all efforts that seem to have no significance? I think not. The principle of this method is one which has been widely adopted in other affairs of life and has been found good. Firing a whole cartridge full of shot in order that one ball may bring down the game is a recognized principle of the huntsman. Is the remaining shot wasted? It is. Is the system which uses cartridges of shot, most of which is wasted, an uneconomical one? Any hunter will tell you it is not. The bullets of a machine gun are mostly wasted, but the system as a whole insures hitting the mark. Drilling wells that never yield oil is wasteful; but the system of drilling numerous wells where there is a chance of striking reservoirs is a profitable one. Casting bread upon the waters, to return again sevenfold in the form of flesh of fish, would be much more profitable if all the bread, instead of being cast at random, could be put into the mouths of those fishes that were afterwards going to be caught, and denied to those that would later escape the net. But could such individual feeding be carried out? Not economically; not even at all. Casting bread upon the waters is the easiest and least wasteful way of obtaining a return. Hundreds of inventions are made for every one that fills an important place in human economy. Numerous excursions, genuine or spurious, were necessary before the north pole was discovered. Business concerns by the hundred are established and succeed or fail, but by only a few of them is economic progress made. Thousands of students must be gathered into colleges, so that a few scholars may be produced. Even presidential addresses are subject to the same rule. In order that a few of distinction may be produced, many that fall short of the goal must be written and heard. If presidential addresses must be had, trial and error is the only way to secure quality.

The factor of safety has been employed for æons in animals, which waste millions of eggs and spermatozoa to insure continuity of the species. Professor Jennings, in one of the brilliant presidential addresses to which reference has been made, pictured himself as the accidental product of union of one among thousands of eggs and one among millions of sperms, and congratulated himself on being with us. We congratulate ourselves on having him with us. Along with Jennings, it is true, we have to accept a lot of inferior persons. We even have to take those who decry research because much of it is useless. But these disadvantages, these wasted combinations, are what insure such as Jennings. Only a small percentage of seeds ever germinate, and fewer still ever mature. The entire struggle for existence is based on the principle that security and advancement are best secured through wasteful over-production.

So in research. To find radium, we must permit scores of fruitless efforts in chemistry. To invent the wireless telephone, there must be numerous investigations that concern humanity little or not at all. To discover the mechanism of heredity, some one must be permitted to do much that has little or no bearing either upon that or upon anything else worth while. The great advances of the theory and practical employment of electricity, of industrial chemistry, of immunity, of surgery, all have been made at the cost of much plodding and puttering. It is doubtful whether they could have been made in any other way.

The foregoing defense of the present freedom of the investigator is not to be regarded as a recommendation of still further freedom. It is not proposed that young investigators shall be delivered from all advisers. No muzzle is to be placed upon those who have comments to make upon the value of the work of their colleagues. Restrictions laid upon advice and criticism are likely to be as dangerous as restrictions imposed upon problems for investigation. All that is insisted upon is that no such advice or criticism shall carry with it any weight that is not inherent in the advice or criticism itself. Those in whose hands lies the power to make or mar the career of investigators should be exceedingly cautious how they create an atmosphere that seems in any way to discourage or limit the freedom of research. I have referred in my introductory remarks to several instances in which responsible officials have, in my opinion, transgressed in this regard. They are not the only ones, and there are other ways of committing the same sin. One of these ways is the appointment of an investigator to a position for the purpose of studying a certain problem. There comes to my mind one such appointment in a research institution. The appointee was, in his own words, "brought down here to study ———" —but to name the specific problem would be to name the institution. He did not feel free to attack another problem until that one was solved. It made no difference that he had come vaguely to feel that the problem would never be solved, or that other investigations would yield greater returns. By the terms of his appointment, his energy could be directed into other channels only with the permission of his superior officer. Such direction from above could be justified only in the case of an assistant or an investigator on temporary appointment, not in the case of a permanent colleague. Research in a general field may legitimately be the aim of an institution in the appointment of an investigator, and the appointee would naturally be one who had demonstrated an abiding interest in that field; but even in such cases, the progress of science demands that he be free from restraint.

Very different from such interference is the friendly advice of a teacher or the criticism of a colleague. Advice and criticism carry no concealed weapons. They are sometimes good, and to repress them eliminates the good with the bad. Indeed, good advice is more easily frowned down than is the bad. If my argument were regarded as against the giving of advice, and were taken seriously, those whose advice is best would be the most restrained by it. The greatest freedom of suggestion from all sources is advantageous, for advice is sometimes good, and to get what is good one must also hear the worthless. That is the reason for this address—and this statement may be interpreted in any way you choose.

To sum up, a successful system of research, even when the practical is the ultimate aim, demands the greatest freedom of the investigator. While direction from superiors may effect gains in limited fields, the losses entailed in the whole system are probably invariably greater. Great industrial concerns maintain staffs of workers whose tasks are assigned to them, and such startling achievements as the wireless telephone have resulted from their directed energies; but the responsible heads of these enterprises recognize that untrammeled research in pure science must precede and build the foundation for their labors, and some of these industrial institutions are now deliberately maintaining research workers in fields which promise at present no practical results whatever. The freedom which is insisted upon for the investigator will, it is expected, often lead him to problems that have no practical value, or even no great scientific value. But a system in which such liberty is a cornerstone insures a continuous output and a wide range of results. Among these results are most certain to be some, perhaps many, of practical value. Any interference with this system which would limit investigations to those of supposed importance would interrupt their continuity, limit the output, restrict the variety, and defeat its own purpose. The development of a scientific foundation is an evolutionary process. Man has never yet interfered very successfully with the great scheme of organic evolution, and there is no reason to suppose that he can propose a superior substitute for the evolutionary process in the development of science. Selectionists have practically abandoned the belief that they can create new things at will, and are content now to discover, preserve, and combine what already exists or what may come into existence without their aid. Practical scientists may well take their cue from the selectionists, permit investigation to take its own course, and choose from among its products such as seem capable of application.

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WHAT BECOMES OF THE FUR SEALS

The census of Alaska fur seals in 1921 as computed by Mr. Edward C. Johnston, of the U. S. Bureau of Fisheries, amounted to a total of 581,457 animals, exclusive of 22,546 surplus males which were killed for commercial purposes. This is a low but substantial increase of 5.2 per cent. over the figures for 1920. The annual percentages of increase of the class of breeding cows since 1912 have been as follows:

1913	12.54
1914	1.06
1915	11.02
1916	12.99
1917	9.44
1918	11.63
1919	9.97
1920	6.59
1921	5.22

Since it is this class which is the controlling element of the herd it will be instructive to examine these figures with considerable care. In the first place, the great variation from year to year in the rate of increase is most noticeable; but it is no greater than that which is found to exist on the several rookeries, as an examination of the complete reports published by the Bureau of Fisheries will show.

To some persons the above figures may appear satisfactory. Every year since the cessation of pelagic sealing in 1911 a gain has been shown, whereas a loss was sustained from 1886 to that date. It was during this last period that uncontrolled slaughter of the females developed and threatened the very existence of the species before it could be checked through diplomatic channels.

Others will doubtless ask, "Why have the increases been so low?" A species of animal the female of which brings forth one young each year and approximately ten in a lifetime should increase annually more than 8.98 per cent. on the average. But that is all that an average of the above percentages will show.

Several facts have been learned the past few years which throw some light on this important subject. For instance, it has been found in several successive years that only one half of the females which are born live to be three years old. The loss of the class on the islands before the pups learn to swim is about one per cent. It varies from three fourths of one per cent. to one and one half, depending entirely upon how many bulls more than necessary are present on the rookeries. The annual loss of females through actual killing on the islands does not exceed 75, or less than five hundredths of one per cent.; all such deaths are purely accidental and largely unavoidable in the conduct of commercial work.

Therefore, the loss can take place in but one other place and that is in the sea. The figure of 50 per cent. loss the first three years was obtained in the following manner: The loss of breeding females, due to old age, is about 10 per cent. each year because the average breeding age is about 10 years. If this 10 per cent. be deducted from the number of breeding females in any year, say 1915, the remainder will represent the breeders of that year which remained alive in 1916. If this be taken from the total number of breeders in 1916, the last remainder will represent the increment of new three-year-old cows that year because the first young are born the third year. In several seasons this increment has been only about 50 per cent. of the number of female pups born three years previously. In other words, the loss amounts to one fourth the total number of births in any one year. Out of the females born during the last nine years, therefore, the following losses have been suffered:

1912	20,246
1913	23,067
1914	23,312
1915	25,881
1916	29,249
1917	32,006
1918	35,728
1919	39,293
1920	41,881
1921	44,163
Total	314,831[1]

The great question is, "What has become of this enormous total of 300,000 female seals?"

Some are killed by unlawful pelagic sealing. A few bullets and buckshot are found in the carcasses of males almost every year on the killing fields, although no seal can be shot legally. The number so killed, however, must be insignificant and the work sporadic in character up to 1921. While it should not be ignored by any means, it is not sufficiently great to concern us in such a broad analysis of the subject as we are here making.

Some other females are lawfully killed at sea by Indians under the provisions of the treaty of December 15, 1911. The number so taken in any one year is not excessive, a few hundred at most, yet it is sufficiently great that it should be stopped. The object of the treaty mentioned was to abolish pelagic sealing so as to protect the female seals. Therefore, permitting the work at all defeats the main purpose of the agreement and the objectionable clause should certainly be amended at the first opportunity. The Indians were given the privilege because they had hunted seals at sea from prehistoric times. There are many ways in which the natives can be recompensed without permitting them to destroy the important element of any species of wild life.

There is no evidence of any loss of seals at sea due to disease or starvation. The animals are always fat and healthy when they leave their island home and also when they return. Exceptions to this rule are so rare that they may be entirely ignored.

There is only one other known method by means of which the herd suffers a loss in the sea. This is the result of the depredations of killer whales. Each spring and fall these "wolves of the sea" come about the Pribilof Islands in schools and have been seen to devour seals in large numbers. I once saw a school capture three seal pups in less than five minutes. In their eagerness to capture their prey they sometimes "run aground" and of course then die. The stomachs of two which thus came ashore were once examined by Captain Bryant and in them he found 18 and 24 seals, respectively, $2,000 meals each of them.

That the destruction of seal life about the islands by the killers is very great is incontrovertible. Whether it continues as both animals migrate southward is unknown. We know with a fair degree of accuracy the direction and distance traveled by the seals but the habits of the animals during the long period of their lives when they are in the water are practically unknown.

There may be other pelagic enemies besides the killers, but it is doubtful; if so, they are entirely unknown.

Of course, the males suffer as great a loss as the females and there is some evidence which indicates that it is even greater. As a class the former do not swim so far to the southward, and it is possible that the killers normally remain in the colder waters. At any rate, we know that 300,000 of them have been lost during the past nine years. If they had been taken commercially and their skins sold for revenue they would have brought the enormous total of $15,000,000, upon the assumption of a value of $50 per skin. But during much of this period they brought $100 each or more.

Such financial loss to the government can not be passed unheeded. That sum would have paid for all of the scientific investigations, good and bad, which have ever been made of the fur seal. Each year the actual loss amounts to more than $1,000,000.

It has been urged that a small part of this be used for the study of this new "fur seal question." Seldom does a scientific investigation

[1] It should be explained that in fur seal census computations, while the figures appear exactly as though a precise enumeration had been made, only round numbers are intended to be implied. The possible error in the above computations would be approximately plus or minus five per cent.

have such a chance to show immediate financial results as this. If the activity of the enemy could be reduced one per cent. it would increase revenue over $10,000 per year.

It is therefore suggested that the activities of the killer whale be thoroughly investigated in its relation to the fur-seal herd. To do so, will require the services of a well-equipped vessel. It should be provided with a whale gun and a man to shoot it, because some of the animals would have to be killed.

The stomachs of the killers taken should of course be examined. It may be asked why the preliminary work can not be done by the shore whaling stations, but it so happens that almost every cetacean known is commercially valuable except the killer. From the diminutive porpoise to the huge sulphurbottom all are taken but the orca, and it is left entirely alone. Therefore, the fur-seal question can not be studied on shore, where whales are utilized commercially without special arrangements being made for the capture of the killers.

If the killer be found the great destroyer of fur seals which is suspected, then methods for its destruction should be devised. In lieu of submarines, it might be made the object of target practice of navy gunners. Or a bounty might be offered, so as to make them commercially profitable for whalers to handle. Or what is probably best of all such suggestions, fully equip whaling vessels to scour the seas, just as sheep men of the west keep coyote hunters constantly on duty.

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SCIENTIFIC EVENTS

LOSS FROM ANIMAL DISEASES

THE Advisory Committee, appointed by the British Development Commission in 1920, has issued its report on the facilities now available for the scientific study of the diseases of animals, and improvements recommended. Sir David Prain was chairman of the committee.

According to an abstract in the London *Times*, the present value of cattle, sheep, and pigs in the United Kingdom is estimated, the report states, at between four and five million pounds. The Scottish Animal Diseases Research Association estimates the annual loss from disease in Scotland at close on £1,000,000, and the committee thinks that the loss in England and Wales must be four times the loss in Scotland. The facilities for research at the five veterinary colleges in the United Kingdom and Ireland "constitute a national disgrace." The sum allocated to veterinary research is "trifling in comparison with the sums set aside for medical, agricultural, and fishery research." There are certain existing facilities at universities, medical schools, the Brown Institution, and attached to the English and Irish Departments of Agriculture and to the Royal Army Veterinary Corps. In South Africa there is a model organization for the study of animal diseases, £123,447 having been spent during the year 1920-21 on veterinary education and research. In India immense opportunities are almost wholly neglected. Leaving out of account the work in South Africa, the state of research into animal diseases within the empire is at present lamentable.

The committee advocates (with reservations by Sir Walter Fletcher) increased salaries to workers of proved capacity at Camden Town, and a capital grant for new laboratories there. It suggests that facilities for research should be placed at the disposal of the Royal Army Veterinary Corps, and that a sum should be set aside annually by the commissioners for special researches into animal diseases.

With regard to the training of investigators, it anticipates that a large proportion will come from the veterinary profession. It is against the increase in the number of universities with veterinary faculties, but wishes more money to be given to the existing veterinary colleges. It proposes that the Development Commission should appoint a diseases of animals research committee, the majority of whom should be men of science. To this new body all applications for grants from the development fund for research into the diseases of animals should be referred.

THE CALIFORNIA STATE FISHERIES LABORATORY

THE State of California, through its Fish and Game Commission, has constructed a laboratory in East San Pedro, at Los Angeles

Harbor, for the study of the biology of the fishes utilized in the now very large sardine and tuna canning industries. The state government has found that such studies are an imperative necessity in the exercise of its legal control over the fisheries. They are necessary, not merely for the determination of biological facts bearing directly upon methods of conservation, but also for the interpretation of the statistics which are now collected by the state for the purpose of observing the condition of the fisheries. The statistical system used is unique, and has proved its independence of the errors usually introduced by statistics gathered by personal inquiry, but the perfection of the data thus gathered does not eliminate, but rather enlarges the importance of biological knowledge and hence of laboratory work.

The building is of reinforced concrete, two stories in height, and of modified Spanish architecture with red tile roof. There are sufficient accommodations for from six to ten research workers in the three laboratories and work room. A large library room, a file room, a dark room and store room are also provided.

It is hoped to collect a library upon fishery subjects which will be very complete, and to that end a number of the important periodicals in the field have been purchased in their entirety. However, aside from the publications of the International Council for the Investigation of the Sea, there are not a great many such periodicals, and the real sparseness of our knowledge of the commercial fishes is emphasized by their lack.

The permanence of the laboratory is assured by the existence of a law specifying the collection of the statistics and the biological investigations necessary. It is felt that it will be very difficult for reactionary interests to repeal the law, or to attack the funds collected by special taxes for the maintenance of the work. Dependence upon appropriations made from year to year has proved disastrous in the case of the federal government and in those of a number of states, and it is to be hoped that such a system as is in existence in California will remain independent of appropriations.

The biological problems which face the fishery expert are wide in scope and will inevitably interest the ecologist and the systematist. For their solution vast quantities of materials are available in the canneries and fish markets, while the detailed records of the catch which are gathered provide a basis for a real science of vital statistics of the fisheries. Men interested along such lines will be cordially welcomed in the new laboratory, in so far as its accommodations are adequate.

Will F. Thompson

MATHEMATICAL PUBLICATIONS

The *Bulletin* of the American Mathematical Society contains several notes concerning mathematical publications from which we quote.

The council of the society has received an offer from an anonymous donor to pay the cost, up to $4,000, of an extra volume of the *Transactions* of the society, to be brought out promptly. This extra volume will be sent without charge to all subscribers and exchanges now on the list.

Mrs. Mary Hegeler Carus, as trustee for the Edward C. Hegeler Trust Fund, has given to the Mathematical Association of America the sum of $1,200 annually for five years for the purpose of publishing a series of monographs whose purpose should be to popularize mathematics by making accessible at nominal cost the best thoughts and keenest researches in this field set forth in expository form comprehensible to teachers and students of mathematics and to other readers of mathematical intelligence. The deed of gift includes the promise to capitalize this annual income by a permanent endowment fund if at the end of five years the project shall have proved successful.

The members of the division of mathematics of Harvard University have constituted themselves an informal committee to solicit contributions to relieve the present financial need of the *Jahrbuch über die Fortschritte der Mathematik.* The deficit for the coming fiscal year will amount to about $1,000. The editor, Professor L. Lichtenstein, has appealed for aid. The Emergency Society for German and Austrian Science and Art, which last year appropriated 20,500 marks for the *Jahrbuch,* contemplates the continuance of its support, subject to the cooperation of American mathematicians.

On the occasion of the sixtieth birthday of Professor David Hilbert, of the University of Goettingen, his friends, colleagues, and former students presented to him an address, an album of photographs, and a memorial volume of mathematical papers. Among those who joined in these remembrances were over sixty-five American friends and former students. The celebration was directed by a committee consisting of Professors O. Blumenthal (chairman), R. Courant, G. Hamel, E. Hecke, A. Schönflies, and (for America) E. R. Hedrick. The mathematical papers of the memorial volume will appear separately either in the *Mathematische Annalen* or in the *Mathematische Zeitschrift.*

The preparation of the complete edition of the works of Sophus Lie, undertaken in 1912 by Teubner, but suspended because of the greatly increased cost of printing, will be resumed with the financial support of the Norwegian Mathematical Society. The title of the edition will read: *Sophus Lie, Gesammelte Abhandlungen, im Auftrage des Norwegischen Mathematischen Vereins und mit Unterstützung der Akademien zu Kristiania und Leipzig, herausgegeben von Friedrich Engel und Paul Heegaard.* It is planned to publish seven volumes, of which volume three, the first to appear, is now in press.

GRANTS FOR RESEARCH BY THE NATIONAL ACADEMY OF SCIENCES

The following grants for researches have been approved by the National Academy of Sciences:

Bache Fund

H. Nort, Gouda, Holland, for counting the stars on the Franklin Adams charts....$ 200

H. S. Jennings, Johns Hopkins University, for studies of the cytology of the rhizopod difflugia.... 500

Herbert M. Evans, University of California, for the determination of the œstrus cycle by means of histological changes in the vaginal and uterine fluid in other mammals than the rat (especially the rabbit and the cat).... 500

Carl G. Hartman, University of Texas, for the completion of observations on the œstrus cycle of the opossum.... 500

Draper Fund

E. A. Fath, Carleton College, for the purchase of a string electrometer for application to the photometry of the stars.... 375

W. W. Campbell, Lick Observatory, for the purchase of eclipse apparatus.... 450

J. Lawrence Smith Fund

George Perkins Merrill, U. S. National Museum, in aid of further investigations of meteorites 500

Gould Fund

Benjamin Boss, Albany, N. Y., for the support of the *Astronomical Journal*.... 1,000

Marsh Fund

Carl O. Dunbar, Yale University, for collection and study of Permian insects.... 150

Miss Winifred Goldring, State Museum, Albany, N. Y., for investigation of Devonian plants of Gaspé.... 75

W. J. Sinclair, Princeton University, for continuation of his studies on the stratigraphic succession of mammalian faunas of the White River oligocene.... 300

Rudolf Ruedemann, State Museum, Albany, N. Y., for studies on the graptolites of North America.... 200

F. Canu and R. S. Bassler, United States National Museum, for continuation of monographic studies on recent and fossil bryozoa 150

C. W. Gilmore, United States National Museum, for continued work on a monographic study of the fossil lizards of North America.... 300

Joseph Henry Fund

Carl T. Compton, Palmer Physical Laboratory, Princeton, N. J., for researches on the electric moments of molecules.... 1,000

H. J. Muller, University of Texas, for the purchase of a microscope designed especially for selective illumination of given cells or portions of cells by means of visible or ultra-violet light for use in studies in cytology, embryology and genetics.... 250

Aleš Hrdlička, United States National Museum, for support of investigations relating to the origin and antiquity of man on the American and Asiatic continents.... 500

THE ELIAKIM HASTINGS MOORE FUND

On the occasion of the twenty-fifth anniversary meeting of the Chicago Section of the American Mathematical Society, held in Chicago on April 14 and 15, 1922, the following resolutions, with the names of 174 contributors, were presented to Professor E. H. Moore in a beautifully bound and illuminated manuscript:

Conscious of the great influence which you have exercised upon the development of mathematical science throughout this country, particularly in the Middle West during the last twenty-five years,

Admiring the outstanding qualities of your researches in various fields of mathematics,

Grateful for the inspiration and the encouragement which you have given to those who have come to the University of Chicago to study mathematics,

Recognizing the large contribution which you have made to the creation and the growth of the Chicago Section of the American Mathematical Society,

Deeply appreciative of the friendship which, during many years, you have shown toward those who have had the good fortune to know you,

The undersigned members of the American Mathematical Society, formerly students of mathematics at the University of Chicago, or members of long standing in the Chicago Section, have wished to use the opportunity afforded by the twenty-fifth anniversary meeting of the Chicago Section to present to you a testimonial, which is intended to link your name in the years to come with the development of mathematics in this country.

To this end they have contributed to a fund which is to be offered for trusteeship to the American Mathematical Society upon the following conditions:

1. The fund is to be known as the Eliakim Hastings Moore Fund.

2. The interest on the fund is to be used at the discretion of the council of the society, and upon the recommendation of a committee appointed from time to time for this purpose, in furtherance of such mathematical interests as

(*a*) The publication of important mathematical books and memoirs.

(*b*) The award of prizes for important contributions to mathematics;

it being further recommended that during the next ten years preference be given to the former, and that publication of Professor E. H. Moore's researches in general analysis or other fields shall have precedence over all other claims.

3. The fund is to be kept intact by the American Mathematical Society except in so far as it is used to aid in the publication of Professor Moore's researches. For this special purpose a part of the principal, not exceeding one third, may be used provided the interest on the remainder be allowed to accumulate until the fund has been restored to its original value.

The trusteeship of the Eliakim Hastings Moore Fund was accepted by the council of the American Mathematical Society at its meeting on April 15. The society intends to keep the fund, which now amounts to nearly $2,000, open for further contributions so that it may become the nucleus for a much larger fund at the disposal of the American Mathematical Society for aid in the publication of important mathematical work. Contributions may be sent to the secretary of the society, Professor R. G. D. Richardson, Brown University, Providence, Rhode Island.

Arnold Dresden

SCIENTIFIC NOTES AND NEWS

At the recent meeting of the National Academy of Sciences, Dr. Joseph S. Ames, professor of physics at the Johns Hopkins University, and Mr. Gano Dunn, president of the J. G. White Engineering Corporation, were elected members of the council. Delegates from the academy were appointed as follows: To the seventh centenary of the University of Padua, May 14 to 17, 1922, H. D. Curtis and F. H. Seares; to the hundred and fiftieth anniversary of the Académie Royale des Sciences de Belgique, May 24, R. A. Millikan; to the sessions of the International Research Council, Brussels, beginning July 18, George E. Hale and R. A. Millikan.

From the fund collected by the women of America to present a gram of radium to Mme. Curie, there remains, after about $110,000 had been paid for the radium, a surplus of about $50,000, the annual income from which will be given to Mme. Curie.

Sir Bayley Balfour, regius keeper of the Botanic Garden at Edinburgh and professor of botany in the university since 1888, has retired. He is succeeded by his assistant, Mr. W. W. Smith.

Sir Ronald Ross has been elected a member of the Athenæum Club for "distinguished eminence in science."

Sir Humphry Davy Rolleston was elected president of the Royal College of Physicians of London on April 10, succeeding Sir Norman Moore.

The committee on scientific research of the American Medical Association has made the following grants: $250 to Professor Yandell Henderson, of Yale University, for the purchase of apparatus to be used in investigation of some problems of the regulation of respiration; $225 to Dr. E. B. Krumbhaar, director of laboratories of the Philadelphia General Hospital, for studies on the etiology of inguinal granuloma conducted by Dr. James C. Small; an additional $400 to Dr. Herbert M. Evans, of the University of California, for the continuance of his researches on the relations between ovulation and the endocrine glands.

In June, Professor Walter S. Haines, of Rush Medical College, will complete fifty years of teaching in the department of materia medica and therapeutics. A banquet of Rush alumni will be held at the Congress Hotel on May 17, during the session of the Illinois State Medical Association, at which it is planned to give recognition to this unusual record of service.

About three hundred men and women, including physicians, social workers and members of the nursing profession, attended a dinner on April 26, given to Dr. S. Josephine Baker, head of the bureau of child hygiene of the New York City Health Department. Dr. Baker has been appointed by State Health Commissioner Herman M. Biggs as consultant in child hygiene in connection with the organization of a new division in the state department of health provided by the Davenport law.

Dr. Joseph C. Swenarton has been appointed assistant director of the bureau of bacteriology of the Baltimore City Health Department.

L. E. Roberts, formerly assistant director of research of the American Writing Paper Company, Holyoke, Mass., is now physical chemist at the Pacific Coast Experiment Station of the Bureau of Mines at Berkeley, Calif.

R. E. Hall, formerly with the Geophysical Laboratory of the Carnegie Institution at Washington, has been appointed to take charge of the physical laboratory of the Pittsburgh station of the Bureau of Mines.

Professor John Frazer, dean of the Towne Scientific School of the University of Pennsylvania, has been appointed engineering exchange professor to France next year. In this capacity he will represent seven American technical schools.

Dr. Harry Richmond Slack, Jr., A.B. (Georgia, '08), M.D. (Johns Hopkins, '12), associate professor of laryngology of the Johns Hopkins Medical School, has been appointed exchange professor to the Union Medical College, in Peking, China. Dr. Slack will be professor of otolaryngology and organize and preside over that department. He will sail from San Francisco about August 1 and be gone for a year.

Dr. Mary E. Collett, of the University of Buffalo, will spend next year in Sweden as fellow in physiology of the American-Scandinavian Foundation.

Professor C. E. Ferree, of Bryn Mawr College, has been appointed one of an international commission of four for the standardization of the work on field taking, to report at the Thirteenth International Congress of Ophthalmology to be held in London in 1925.

Kurd H. Endell, professor of economic engineering at the Technical High School of Berlin, recently made an inspection of many of the open pits and underground properties on the Mesabi iron range in Minnesota and the iron-ore loading docks at Duluth and Superior.

At the recent national convention of Sigma Gamma Epsilon at Pittsburgh, Pennsylvania, the new grand council was constituted by the election of Dean H. B. Meller, University of

Pittsburgh, *President;* Harry Crum, Lawrence, Kansas, *vice-president;* Dr. C. E. Decker, University of Oklahoma, *secretary-treasurer;* E. F. Schramm, University of Nebraska, *historian,* and Dr. W. A. Tarr, *University of Missouri,* editor.

Professor A. Gurwitsch, formerly professor of anatomy and histology in Petrograd, is now on the faculty of the newly founded university at Simferopol, Crimea, Russia. As the university library is without recent scientific publications, he would welcome the receipt of reprints, books or periodicals from his colleagues in the United States.

Dr. Vernon Kellogg, permanent secretary of the National Research Council, gave an address before the Graduates Club of Ohio State University on May 2, and the annual Phi Beta Kappa address at Oberlin College on May 4. He will give the annual Phi Beta Kappa address at the University of Virginia on June 12.

On April 26, Dr. Frederick Bedell, of Cornell University, spoke before the staff of the California Institute of Technology and the Mount Wilson Laboratory on "Some alternating current phenomena."

Dr. Frederick V. Coville on April 26 delivered a lecture on "The influence of cold in stimulating the growth of plants" before the Kansas chapter of the honor society of agriculture, Gamma Sigma Delta, at the Kansas State Agricultural College.

Dr. Brayton H. Ransom, of the division of zoology of the Bureau of Animal Industry, United States Department of Agriculture, gave a De Lamar lecture on April 24, at the School of Hygiene and Public Health of the Johns Hopkins University, entitled "The hygienic importance of recent discoveries in ascariasis."

Dr. E. P. Lyon, dean of the College of Medicine of the University of Minnesota, delivered the annual Alpha Omega Alpha address before the Alpha Chapter of the University of Nebraska College of Medicine on April 21, on the subject "Humidity as a physiological factor."

Professor E. B. Titchener, Sage professor of psychology, Cornell University, delivered a lecture on "The structure of the physiological psychology" on April 8 before an open meeting of the William James Club of Wesleyan University.

At the recent meeting of the Michigan Academy of Sciences, Dr. J. McKeen Cattell gave the evening lecture under the auspices of the University of Michigan, his subject being "The uses of psychology."

The Morison lectures before the Royal College of Physicians of Edinburgh were delivered by Professor G. Elliot Smith, on May 1, 3 and 5, the subject being "The evolution of the human intellect."

George R. Davis, engineer in charge of the Pacific division of the U. S. Geological Survey, died recently in San Francisco.

Adolph B. Amend, for more than twenty years with the house of Eimer & Amend, New York City, died at his home in Brooklyn on April 19.

Dr. Andrew McWilliam, consulting metallurgist and formerly professor of metallurgy in Sheffield University, died at Sheffield on April 5.

The death is announced of Dr. Francis Darby Boyd, Moncrieff-Arnott professor of clinical medicine in the University of Edinburgh, at the age of 55 years.

A monument to the memory of the late Professor George Trumbull Ladd, professor of moral philosophy and metaphysics at Yale University from 1881 to 1906, whose death occurred in New Haven on August 8, 1921, was unveiled in the grounds of a Buddhist temple near Tokyo, Japan, on March 11, in the presence of Mrs. Ladd, Mr. Charles Beecher Warren, American ambassador to Japan, and Japanese friends of Professor Ladd. Speeches were made by the American ambassador and a number of Japanese officials, and Mrs. Ladd gave a brief response. The monument consists of a slab of gray, volcanic rock. It stands on the top of the hill of the bell tower in the grounds of Soji-ji, the great Buddhist temple at Tsurumi. Beneath the slab are a part of the ashes of the psychologist and philosopher, brought to Japan at his request.

THE Ramsay Memorial trustees will at the end of June consider applications for two Ramsay Memorial fellowships for chemical research. One of the fellowships will be limited to candidates educated in Glasgow. The value of the fellowships will be £250 per annum, to which may be added a grant for expenses not exceeding £50 per annum. Full particulars as to the conditions of the award are obtainable from Dr. Walter W. Seton, secretary, Ramsay Memorial Fellowships Trust, University College, London.

THE Liverpool School of Tropical Medicine has awarded the Mary Kingsley medal to the Oswaldo Cruz Institute of Rio de Janeiro in appreciation of the scientific work of the late Dr. Oswaldo Cruz. Dr. Carlos Chagas is the director of the institute now, and the letter accompanying the medal states that the Liverpool school had decided to award this medal "For Devotion to Science" to Dr. Cruz, but was waiting for the close of the war before making any awards. The letter continues: "In the meantime Dr. Cruz had died, and the school now confers the medal on the Oswaldo Cruz Institute as a tribute to the memory of one of the greatest sons of Brazil. As the institute founded by him is destined to be the leading one of the institutions for medical research in tropical America, it is only just that it should receive this token of appreciation."

W. A. CRUSE, secretary of the Petroleum Section of the American Chemical Society, announces that members of the special committee for promotion of research on petroleum in cooperation with Dr. Van H. Manning, director of research for the American Petroleum Institute, are as follows: W. F. Faragher, chairman, Mellon Institute, Pittsburgh, Pa.; R. E. Wilson, Massachusetts Institute of Technology, Cambridge, Mass.; R. P. Anderson, United Natural Gas Company, Oil City, Pa.; N. A. C. Smith, Bureau of Mines, Pittsburgh, Pa.; C. E. Waters, Bureau of Standards, Washington, D. C.; R. R. Matthews, Roxana Petroleum Company, Wood River, Ill.; E. W. Dean, Standard Oil Company, 26 Broadway, New York, N. Y. At the recent meeting of the American Chemical Society in Birmingham, the Petroleum Section authorized the appointment of such a committee.

THE Biological Research Institute (Biologische Versuchsanstalt) of the Vienna Academy of Sciences, affords exceptional opportunities for students to pursue investigations in experimental biology on both animals and plants. Research tables may be occupied by properly qualified persons at a monthly rental of $20. Inquiries should be addressed to the director, Professor Hans Przibram, II. Prater, Vivarium, Vienna, Austria.

UNIVERSITY AND EDUCATIONAL NOTES

MR. E. W. SCRIPPS has established a foundation at Miami University for the study of population in its various aspects, particularly the population of the United States. Dr. Warren S. Thompson, professor of rural sociology at Cornell University, has accepted the appointment as director of the foundation.

DR. SYDNEY WALKER, JR., has provided for a scholarship in the department of physiology of the University of Chicago, to be known as the Sydney Walker III scholarship in physiology, in memory of Dr. Walker's son. It is to be used for the furtherance of research in physiology and provides $200 a year.

THE inauguration of Dr. Clarence C. Little, formerly of the Cold Spring Harbor Biological Laboratory, as president of the University of Maine, will take place on May 10.

PROFESSOR D. WRIGHT WILSON, Ph.D., professor of physiological chemistry, Johns Hopkins Medical School, Baltimore, has been appointed to fill a similar position at the University of Pennsylvania, to succeed Dr. Alonzo E. Taylor.

DR. ALBERT SCHNEIDER has resigned from the University of Nebraska. He will teach in the summer session of the University of California, and will then go to Portland, where he has accepted a position in North Pacific College and where he will continue his cancer research.

DISCUSSION AND CORRESPONDENCE

DID HUMPHRY DAVY MELT ICE BY RUBBING TWO PIECES TOGETHER UNDER THE RECEIVER OF AN AIR PUMP?

It is commonly stated that Humphry Davy melted two pieces of ice by rubbing them together under the exhausted receiver of an air pump, and thus showed conclusively that heat is not a material substance. In books which I happen to have at hand I find twelve different authors stating that Davy melted two pieces of ice by rubbing them together in a vacuum, and four of them stating in addition that the two pieces of ice were rubbed together by clockwork. In looking to see what Davy himself said about this experiment I have, to my surprise, failed to find any evidence that he ever performed just this experiment.

Of the authors whom I consulted, four give references. Two refer to the Collected Works of Sir Humphry Davy, vol. 2, p. 11. The other two refer to Davy's Elements of Chemical Philosophy. In the Elements of Chemical Philosophy, reprinted as Volume 4 of the Collected Works, I have not found any statement about the melting of ice by friction. In the first paper in Volume 2 of the Collected Works Davy describes twenty-two experiments and makes comments on them.

In Experiment 2, p. 11, he describes an experiment in which "by a peculiar mechanism" he caused two blocks of ice to rub together. "They were almost entirely converted into water." In the description of this experiment nothing is said about any air pump.

The description of the third experiment is not entirely clear. Davy says, "I procured a piece of clock-work so constructed as to be set to work in the exhausted receiver; one of the external wheels of this machine came in contact with a thin metallic plate. A considerable degree of sensible heat was produced by friction between the wheel and plate when the machine worked uninsulated from bodies capable of communicating heat. I next procured a small piece of ice; round the superior edge of this a small canal was made and filled with water. The machine was placed on the ice, but not in contact with the water. Thus disposed, the whole was placed under the receiver. . . . . The receiver was now exhausted. . . . . The machine was now set to work. The wax rapidly melting, proved the increase of temperature."

From this description it seems that the clockwork was not a mechanism for rubbing two pieces of ice together, but was used to produce friction between two metals, and that the heat developed by this friction caused the melting of some wax.

Any clockwork which Davy might have placed inside of the receiver would probably not have been sufficiently powerful to melt ice rapidly by rubbing it on ice. I have wondered if some author did not read the second experiment, glance at the third, and seeing the words *clockwork, exhausted receiver, ice* conclude that two blocks of ice were rubbed together by clockwork under the exhausted receiver. If so, this is an interesting illustration of the ease with which a misstatement may pass from one author to another. If there is evidence that Davy did melt two blocks of ice by causing clockwork to rub them together under the receiver of an air pump I hope some one will adduce it.

ARTHUR TABER JONES
SMITH COLLEGE,
FEBRUARY 23, 1922

A PARACELSUS LIBRARY IN THIS COUNTRY

In your issue of February 10, F. N. Garrison announces a new prospective publication in Germany of the complete works of Paracelsus, that great pioneer in analytical chemistry and medical reformer of the sixteenth century. It may not be generally known that what is no doubt the largest and most complete collection of the works of Paracelsus in this country is the one made during the last century by the late Dr. Constantine Hering of Philadelphia, and since his death in 1880 was acquired by the Hahnemann Medical College of Philadelphia, where it is now deposited. He spared no effort or expense to make it as complete as possible.

CARL HERING

THE TEACHING OF EVOLUTION IN THE BAPTIST INSTITUTIONS OF TEXAS

THE teaching of evolution in the Baptist denominational schools in Texas is being investigated as heretical. The denomination is strong in membership and maintains about 15 colleges and seminaries in the state, the chief of which is Baylor University at Waco. It appears that the trouble arose as the result of the publication in 1920, by the Baylor University Press itself, of an "Introduction to the Principles of Sociology," by Grove Samuel Dow, Professor of Sociology in Baylor University. The book is based upon the theory of evolution wherever it touches upon the biological aspects of sociology, although the term biological evolution is scarcely or not at all used in the text. At a recent conference of representatives of the Baptists of all parts of the state, such teachings were pronounced heresy, and a sweeping investigation is being made of all of the Baptist schools of the state to determine how much "heresy" is being taught. Professor Dow has resigned his position.

A somewhat related situation has existed at Southern Methodist University, Dallas, where the teaching of Dr. John A. Rice, Professor of Old Testament Interpretation, has created the severe opposition of a large part of his church. Dr. Rice's book, "The Old Testament in the Life of Today," looks upon the Old Testament as a series of independent historical papers, each subject to its own interpretation. Many are considered as having been revised by several authors before they have reached their present form. Each is regarded as a literary production, subject to all of the rules of literary interpretation; this introduces a personal factor into any understanding of the Old Testament, and completely does away with literal interpretations. Dr. Rice has also left his position, to become pastor of a Methodist church in another state.

S. A. R.

THE METRIC CAMPAIGN

MR. HALSEY'S recent letter in SCIENCE is of interest in view of the hearings that have been held during the past few months on the Britten-Ladd Bill. It was made clear in these hearings that wire, for instance, is readily defined as a 2 millimeter wire (2 mm in diameter) or, by a less convenient method, as a wire 0.079 inch in diameter. An inferior method is to refer to such a wire as a No. 46 Stubs' wire (2.01 mm or 0.079 inch) or a No. 14 Birmingham (Stubs') wire (2.11 mm or 0.083 inch). There are at least three other gages that have been used to a greater or less extent. It was shown in the metric hearings that if this convenient metric method continued to prevail, certain gage manufacturers would lose the advertising value connected with the use of their gages. It furthermore developed that it was a gage manufacturer who had organized what opposition he could in order to fight the metric system, had contributed $1,000 from his firm and had brought about the employment of Mr. Halsey in his metric fight. Mr. Halsey had profited by his anti-metric efforts in the past. His own words in this controversy were "We have killed the metric system before and we will kill it again." We have no objection to Mr. Halsey's attempted slaughter of the metric system. Readers of SCIENCE, however, may be unaccustomed to his method of argument. In his recent letter, for instance, he endeavors to make it appear that Professor E. C. Bingham of Lafayette College is "naïve" and ignorant regarding weights and measures, and that therefore he should not be encouraged in the successful campaign to secure the use of metric weights and measures throughout the industry in which he is an expert. Professor Bingham's many friends and acquaintances do not need to be told that he is unusually well informed and proficient in his work.

Mr. Halsey's use of the title "Commissioner" is also of interest. This has led a few people to believe for a time that Mr. Halsey in some way represented a federal, state or municipal organization.

Mr. Halsey refers to a report issued in October, 1921, as confirmation of all his contentions. It is amusing to find that this report was drawn up under the guidance of a committee of five men: the gage manufacturer referred to above, two others associated with him in his fight to kill the metric system, and an impotent minority of two good metric advocates.

However, the use of metric weights and measures, legal for all transactions in the United States since July 28, 1866, is above personalities. As a nation we find ourselves to-day endeavoring to bring about mutual understanding and world-wide trade. At least 46 countries have officially adopted the metric system for general use. Partly through the excellent work of the Decimal Association of London, England has already left America behind in the use of metric weights and measures.

The hearings are over on the Britten-Ladd Bill. The campaign to put this bill, or a modified form of it, through Congress is before our association. At the same time we are cooperating with the Toronto and other sections of the American Metric Association, and an ever increasing number of men and women in North America are using metric weights and measures. We ask for the cooperation of all in the United States and Canada.

Howard Richards,
Secretary,
American Metric Association

April 25, 1922

SCIENTIFIC BOOKS

THE BIOLOGICAL RESEARCHES OF GUSTAF RETZIUS

Volume XIX, Neue Folge, of the Biologische Untersuchungen of Gustaf Retzius completes the scientific works of the great anatomist and anthropologist who died in the summer of 1919.

This posthumous volume has been edited and compiled at the request of Madame Retzius by Professor Carl Furst, of the University of Lund. Professor Furst is the oldest living friend and colleague of Retzius, and was well equipped, both by virtue of long acquaintance and collaboration with the author, and by familiarity with his work, to edit for publication the series of technical papers which comprise the volume. These papers are seven in number, and are accompanied by twenty-one beautiful plates of folio size.

The first contribution, under the title, "Weitere Beiträge zur Kenntnis von dem Bau und der Anordnung des Ependyms und der sämtlichen Neuroglia, besonders bei den niederen Vertebraten" (Taf. I-XVI), describes the neuroglia and ependyma of various vertebrates in four sections, viz.: A. Amphioxus; B. Myxine; C. Petromyzon; and D. Selachians, Teleosts, Amphibia, Birds and Mammals. The text of section D has been inserted by the editor from a translation into German of an article originally published elsewhere by Retzius in Swedish. The editor states: "Wir bekommen dadurch von Retzius selbst eine Erklärung einiger wichtiger, hier mitgeteilten Figuren. Gustaf Retzius hat mehrmals frühere Arbeiten, die in schwedischer Sprache herausgegeben waren, später in Biol. Unter. in deutscher Übersetzung aufgenommen. Wenn ich diese Abhandlung aus der Müllerschen Festschrift einsetze lasse ich doch grossteils die historische Einleitung der Abhandlung aus. Der Inhalt dieses Historik ist nämlich in den hier oben mitgeteilten Abhandlung ausführlichen mitgeteilt."

The second paper, "Einige Beiträge zur Kenntnis der Structur der Ependym— und Nervenzellen im Rückenmark der Cyclostomen" (Taf. XVII, Fig. 1-24), describes a type of cell among the ependyma cells of the spinal cord of cyclostomes which has been called "inneren Sinneszellen" by several investigators, but which Retzius concludes are modified ependyma cells. The second part of this article considers the fibrillar structure of nerve cells of the spinal cord in this lowly group of vertebrates.

Nine of the folio pages and one plate (Taf. XVIII) describe certain phases of the structure of the lens of the eye, under the title "Zur Kenntnis des Baus des Glaskörpers im Auge des Menschen."

In the fourth and fifth articles (Taf. XIX-XXI) the author continues his already extensive studies on the spermatozoa of various animal groups, under the titles "Die Spermien der Cyclostomen" and "Noch einige Beiträge zur Kenntnis der Spermien bei den Affen," respectively.

"Die Gehirne der Affengattungen Cebus und Ateles" is without figures. It consists of some notes which supplement the author's earlier work, "Das Affenhirn in bildricher Darstellung," in which figures of these brains are found.

The final contribution "Die Verbindungen zwischen dem Sarcolemma und den Grundmembranen der Muskelfibrillen in bildricher Darstellung" (Taf. XVII, Fig. 25-27) is made up of three figures which represent the striated muscle of salamander larvæ, showing the finer structure of the muscle fibers and the relation of the ground membrane to the myofibrillæ and to the sarcolemma. Apparently a paper on this subject was contemplated by Retzius, but the text was not written. The editor refrains from supplying it, stating "Die Bilder demonstrieren selbst so gut diese Verhältnisse dass eine eingehende Erklärung nicht nötig ist. Prinzipiell will ich hier nicht versuchen, Wörte, die Retzius nicht selbst niedergeschrieben hat, ihm in den Mund zu legen." This statement admirably summarizes the attitude of the editor toward the contents of the entire volume.

The volume closes with an excellent table of contents of the two series of the Biologische Untersuchungen, namely, the two volumes which appeared in 1881 and 1882, and the nineteen volumes of the Neue Folge. Following this is a bibliography of the scientific works of Retzius, arranged by subjects. This bibliography consists of 333 titles.

It is fitting that the dedicatory page which in the preceding volumes has borne the names of so many distinguished anatomists should bear in the last volume the inscription by the widow of the author:

Dem Andenken meines verewigten Gemahls
GUSTAF RETZIUS
in Liebe und Dankbarkeit gewidmet.
Anna Hierta-Retzius.

To the sympathetic cooperation of his wife is due in no small measure, together with his own untiring zeal, the unique monument which Retzius has left in the nineteen folio volumes of the Biologische Untersuchungen, and the numerous other papers and monographs which bear his name.

O. Larsell
University of Oregon
Medical School

SPECIAL ARTICLES

POLYPLOIDY, POLYSPORY, AND HYBRIDISM IN THE ANGIOSPERMS

For some time investigations have been carried on in these laboratories on the subject of polyploidy in relation to polyspory and hybridism. The material used consists of both Dicotyledons and Monocotyledons, and represents either known hybrids or species belonging to genera or groups in which a great deal of natural hybridism is suspected. The conclusion has been reached that polyploidy is a common result of incompatible species crosses. The normal gametophytic number of chromosomes becomes multiplied by three, four, etc., as a consequence of such inharmonious crosses, in various degrees of complexity. A frequent, although not invariable accompanying feature of polyploidy is the phenomenon of polyspory.

As is well known, the normal divisions taking place in the spore-mother cells of the Angiosperms, lead to the formation of four spores. Some of the members of the normal tetrad of spores may exceptionally abort, as for example, in the microspores of certain sedges. This condition of abortion is the normal one in the formation of megaspores. In the case of polyspory the first division of the spore-mother cell leads to the formation of more than the two normal daughter nuclei. Two larger nuclei are generally formed by the union of certain of the chromosomes which undergo separation into daughter groups at a moment preceding that in which the remaining chromosomes pass into the metakinetic phase. The later dividing chromosomes, in separating tardily into daughter groups are ordinarily fewer in number than are those concerned in the formation of the two main daughter nuclei. The nuclear bodies formed by their fusion lie ultimately lateral to the spindle instead of terminal as in the case of the larger nuclei, and are of strikingly small size. There may be as many as four of the small nuclei at the end of the first division of the pollen mother-cells. When the second division takes place a further formation of normal large nuclei (aggregating four in number), and of abnormal small nuclei more numerous than are the large nuclei results. The large nuclei give rise usually to normal pollen grains but some or all of the grains resulting from them may abort. The small nuclei derived from the late-dividing and small groups of chromosomes give rise apparently always to abortive grains. A number of publications from this laboratory[1] have emphasized the importance of pollen sterility as a reliable morphological criterion of previous heterozygosis or genetical impurity.

Special attention has been devoted to abortive pollen as evidence of hybridism in the case of the Onagraceæ and Rosaceæ, but it is likewise found in many other groups. It is interesting to note that Tackholm in Sweden[2] and Blackburn and Harrison[3] in England, have recently pointed out the coincidence of hybridism and polyspory in the genus Rosa. Our investigations have made this condition clear for a considerable range of Dicotyledons and Monocotyledons. Tackholm has asserted on the basis of his extensive studies that all the roses belonging to the Canina section of the genus Rosa, in other words, the roses of Europe, of western Asia, and of northern Africa, are throughout hybrids probably thousands of years old and reproducing by apparently normal seeds, which are nevertheless formed "apomictically" and without the intervention of a sexual act. Obviously such seeds will "come true" as universally as do grafts or vegetative multiplications of any kind and for the same reason because they represent only subdivisions of the vegetative body.

Polyspory appears as a consequence of our investigations, which will be published in full at a later stage, as a frequent although not invariable result of hybridization of species (that is, of species crosses), and constitutes one more valuable structural or morphological criterion of heterozygosis. It frequently accompanies polyploidy and the manifestations of the so-called "lethal factor" in marked reproductive sterility in either known or suspected hybrids between species of the higher plants.

We have now the following morphological criteria of genetical impurity or heterozygosis in plants, namely, reproductive sterility (most easily observed in the case of the microspores or pollen), gigantism, variability (mutability), polyploidy and polyspory. Not all of these may occur in any given case, but the coincidence of any considerable number of these features should be regarded as supplying strong evidence of previous crossing of more or less incompatible species or varieties.

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[1] Jeffrey, E. C., Spore Conditions in Hybrids and the Mutation Hypothesis of De Vries, *Bot. Gaz.*, Vol. 53, No. 4, October, 1914; Some Fundamental Morphological Objections to the Mutation Theory of De Vries, *American Naturalist*, 1915.

Standish, L. M., What is Happening to the Hawthorns? *Journal of Heredity*, Vol. 7, No. 6, June, 1916.

Hoar, C. S., Sterility as the Result of Hybridization and the Condition of Pollen in *Rubus*, *Bot. Gaz.*, Vol. 62, No. 5, November, 1916.

Forsaith, C. C., Pollen Sterility in Relation to the Geographical Distribution of Some *Onagraceæ*, *Bot. Gaz.*, Vol. 52, No. 6, December, 1916.

Cole, R. D., Imperfections of Pollen and Mutability in the Genus *Rosa*, *Bot. Gaz.*, Vol. 63, No. 2, February, 1917.

Jeffrey, E. C., Evolution by Hybridization, *Brooklyn Botanic Garden Memoirs*, 1: 298-305, June 6, 1918.

[2] Tackholm, Gunnar, On the Cytology of the Genus *Rosa*. A Preliminary Note, *Sartryck ur Svensk Botanisk Tidskrift*, Bd. 14, 2-3, 1920.

[3] Blackburn, K. B., and Harrison, J. W. H., The Status of the British Rose Forms as determined by their Cytological Behaviour, *An. Bot.*, Vol. 35, No. 138, April, 1921.

THE REACTION OF DROSOPHILA TO ULTRAVIOLET

Although there is no unanimity of opinion as to the ability of insects to distinguish colors in the sense that humans do, it is fairly well established that the tendency is for them to react most strongly to wave-lengths in the violet end of our visible spectrum. This suggests the possibility that insects may be sensitive to ultraviolet, to which the human eye is relatively insensitive except indirectly by fluorescence in the cornea. The possibility is of interest in connection with the general problem of the biological relations between flowers and insects, for flowers may be "ultraviolet" as well as red, yellow, and so on. A committee of the National Research Council is planning to do field-work on this problem during the coming summer and it was thought that the following experiments might give useful preliminary information. They were made with the assistance of Mr. Ware Cattell.

Drosophila melanogaster exhibits a strong tendency to move toward the source of light. A large number of these flies were placed in a test tube about 30 cm. long and 2 cm. diameter, the end being closed with a plug of cotton. A strip of black paper was rolled around the tube to protect from stray light. By slipping the paper down from the end of the tube the flies could be "concentrated" next to the cotton plug. The paper was then replaced and the tube placed *horizontal* with its rounded end toward the spark from a 200 watt General Electric ultraviolet generator. Between the generator and the tube were placed four thicknesses, totaling about 1 cm., of Corning ultraviolet glass, number G586A (old number G55A62). After an exposure of 15 seconds the flies were found to have congregated in the end of the tube next to the source, showing that they were strongly attracted by the ultraviolet generated by the spark and transmitted by the special glass.

The transmission of this glass has been measured by the Bureau of Standards (Technological paper Number 148: "The Ultraviolet and Visible Transmission of Various Colored Glasses"). A thickness of one centimeter transmits about 70 per cent. of light in the neighborhood of 0.36; about 25 per cent. near .34; but only 5 per cent. at 0.40. This glass transmits also a small amount of red. The flies, however, did not react when we used a red glass which transmitted far more red than G586A.

To make a more accurate test, a quartz spectrograph was used to disperse the light from the ultraviolet generator. Light of wave-length greater than .39 was excluded by a strip of black paper in the focal plane. As before, the flies showed a very marked reaction when the horizontal test was "pointed" toward the ultraviolet source.

This last result was, however, rendered somewhat doubtful by the fact that the quartz lenses and the dispersing system scattered a small amount of blue and violet light. This scattered light was entirely eliminated, at least so far as human vision is concerned, by interposing a single thickness, 2.5 millimeters, of G586A in the path of the light. But even then the flies showed a marked reaction. The conclusion is that *Drosophila melanogaster* is more sensitive to ultraviolet light than is the human eye.

The question may still be raised that these phototropic reactions of *Drosophila* are due to fluorescence of eye media, similar to that experienced by the human eye when exposed to ultraviolet light. All that can be said at present in this connection is that the intensity was so low that we did not experience the visual sensation characteristic of such fluorescence, but the flies reacted promptly and definitely.

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION A—MATHEMATICS AND ASSOCIATED SOCIETIES

Section A of the American Association for the Advancement of Science met in Room 8 of the Main Building of the University of Toronto on Thursday afternoon, December 29, 1921, in joint session with the American Mathematical Society and the Mathematical

Association of America. Professor Oswald Veblen, chairman of the section, presided.

The program comprised the following addresses:

1. *A mechanical analogy in the theory of equations,* by Professor D. R. Curtiss, retiring vice-president of Section A.
2. *The research information service of the National Research Council,* by Professor R. M. Yerkes, of the National Research Council.
3. *Subsidy funds for mathematical projects,* by Professor H. E. Slaught.
4. *Algebraic guides to transcendental problems,* by Professor R. D. Carmichael, retiring chairman of the Chicago Section of the American Mathematical Society and vice-president of the Mathematical Association of America. In the absence of Professor Carmichael, an abstract of his paper was read by Professor Arnold Dresden.

At a meeting of the sectional committee preceding this program, the following nomination was made for chairman of the section, to preside as vice-president for Section A at Boston and to give his retiring address at Cincinnati: Professor G. A. Miller, of the University of Illinois. At a business meeting of the section following the program this nomination was approved, and Professor Miller was elected at a meeting of the council of the association, held on December 30.

A joint dinner for mathematicians and physicists was given at Burwash Hall on Friday evening, December 30.

WM. H. ROEVER,
Secretary

SECTION B—PHYSICS—AND ASSOCIATED SOCIETIES[1]

SECTION B of the American Association held its session on Thursday morning, December 29, 1921, in conjunction with Section C of the American Association, the American Physical Society, the American Meteorological Society, and the Section of the Physical Science Committee of the National Research Council. Professor John C. McLennan, of the University of Toronto, retiring vice-president for Section B, delivered his address on "Atomic nuclei and extranuclear electronic configuration." The vice-presidential address was followed by a symposium on the Quantum Theory, with the following speakers: (A) R. C. Tolman, director, Fixed Nitrogen Research Laboratory, Washington, representing Section C (Chemistry), A. A. A. S., "Review of the present status of the two forms of the Quantum Theory"; (B) H. B. Phillips, Massachusetts Institute of Technology, Cambridge, representing the American Mathematical Society, "Mathematical aspects of the Quantum Theory"; (C) Saul Dushman, The General Electric Company, Schenectady, N. Y., representing the American Physical Society, "Some recent applications of the Quantum Theory to Spectra." This meeting proved to be of very great general interest.

At the business meeting of Section B, C. A. Skinner, of the Bureau of Standards, was elected to be a member of the section committee, his term of office to end January 1, 1926. Dr. F. A. Saunders, of Harvard University, is the vice-president for Section B for 1922.

The American Physical Society.—This society held sessions beginning Wednesday, December 28, and continuing until Friday afternoon. The annual business meeting of the society was held on Friday, December 30, at which time the following officers were elected: *President,* Theodore Lyman, Harvard University, Cambridge, Mass.; *Vice-president,* Charles E. Mendenhall, University of Wisconsin, Madison, Wis.; *secretary,* Dayton C. Miller, Case School of Applied Science, Cleveland, Ohio; *treasurer,* George B. Pegram, Columbia University, New York, N. Y. The president of the American Physical Society gave an address on "The spectroscopy of the extreme ultra-violet." The physicists' dinner was held on Friday evening at Hart House. During the sessions of the society 77 scientific contributions were read.

American Meteorological Society.—Sessions were held beginning Wednesday morning, December 28, and continuing through Thursday afternoon. The annual business meeting was held on Thursday morning, and the following officers were elected: *President,* Sir Frederic Stupart, 315 Bloor Street, Toronto, Canada;

[1] Toronto, December, 1921.

Vice-president, W. J. Humphreys, U. S. Weather Bureau, Washington, D. C.; *Secretary and Treasurer,* Charles F. Brooks, Clark University, Worcester, Mass. On Thursday morning Professor Robert DeC. Ward, of Harvard University, gave his address on "Tendencies and progress in climatology during the past decade." The meteorological luncheon was held on Wednesday at 1 p.m. at Hart House. On Wednesday afternoon the society held a symposium on "Improvements in synoptic weather charts, especially on the reduction of atmospheric pressure observations," at which the following papers were read: (1) "The history of barometry in the United States," C. Leroy Meisinger, U. S. Weather Bureau, Washington, D. C.; (2) "Reduction of barometer to sea-level," C. F. Marvin, U. S. Weather Bureau, Washington, D. C.; (3) "Upper air pressure maps as possible aids in the solution of the barometry problem," C. LeRoy Meisinger, U. S. Weather Bureau, Washington, D. C.; (4) "Sea-level vs. the Megadyne base," Alexander McAdie, Harvard University, Blue Hill Observatory, Readville, Mass. (By title); (5) "Major wind streams vs. high and low pressure centers as the basis for weather forecasting," W. G. Reed, Philadelphia, Pa. (By title); (6) "Cloud movements as aids in forecasting," C. F. Brooks, Clark University, Worcester, Mass. Fifteen other scientific papers were read during these sessions.

Section of the Physical Science Committee of the National Research Council.—Meetings were held in Hart House, Prof. H. G. Gale acting as chairman.

It seemed to be the consensus of opinion that the Toronto meeting had been an exceptionally interesting and inspiring one. Contributing to the success of the meeting was the untiring work of the local committees and the cordiality of the members of the University of Toronto and the Royal Canadian Society. The international character of the Toronto meeting was noted by the presence of more Canadians than usual and by the distinguished visitors from abroad.

The secretary wishes to thank especially those who at the last minute took upon themselves the work of preparing papers for the joint meeting of Section B with the Associated Societies.

S. R. WILLIAMS,
Secretary, Section B

SECTION K—SOCIAL AND ECONOMIC SCIENCES

No separate session of Section K was arranged for the Toronto meeting on account of the recent death of the secretary, Dr. Loomis. A joint session of the section was held, however, with Section Q (Education) on Friday afternoon, December 30, 1921. At this meeting Dr. Frederick L. Hoffman, the recently elected secretary of the section, read an extended address on "The Organization of Knowledge," subsequently reprinted in SCIENCE of March 10 and March 17, 1922. Dr. Henry S. Graves of Washington was elected vice-president for Section K for 1922. Dr. Frederick L. Hoffman, dean of the Babson Institute, Wellesley Hills, Massachusetts, was elected secretary; his term of office will expire January 1, 1925. An understanding was arrived at under which the section, during the current year, will concentrate its efforts especially upon conservation problems. The American Metric Association, which is associated with Section K, held sessions on Friday morning and Friday afternoon, December 29. During this session, nine papers were read and much discussion was had suggestive of the slow but gratifying progress of the metric movement. On Friday evening the Metric Association held its annual dinner, participated in by a small but thoroughly interested group of members.

FREDERICK L. HOFFMAN,
Secretary

WELLESLEY HILLS, MASS.

SECTION N—MEDICAL SCIENCES

SECTION N (Medical Sciences) held a symposium on the Health and Development of the Child. Professor A. B. MacCallum, of McGill University, presided. Dr. Joseph Erlanger of Washington University read his vice-presidential address on "The past and the future of the medical sciences," already published in SCIENCE, Vol. 55, page 135, February 10, 1922. The following papers were read:

Hereditary factor in development: C. B. DAVEN-

PORT, Cold Spring Harbor, L. I.

The metabolism of children in health and disease: HAROLD BAILEY, Cornell Medical School, New York.

Newer aspects in the dietetics of children: ALFRED HESS, College of Physicians and Surgeons, New York.

Movie demonstration of the tonsil-adenoid work in the city of Rochester, N. Y.: L. GOLER, Public Health Officer, Rochester, N. Y.

The mental hygiene of children: C. N. HINCKS, Canadian National Committee for Mental Hygiene.

The meeting took place in the Academy of Medicine, Toronto, which was crowded far beyond capacity. Throughout the symposium, there was a most interesting discussion of the papers.

The experience of the sectional committee during the last seven years has convinced it that its former policy, to have a discussion of a definite topic with invited papers, was timely, instructive, and interesting to the members of the association, to those working in medical sciences, and to the community.

There was, however, a growing feeling that the section should undertake to reach more effectively the investigators in the various fields allied to the medical sciences. It was felt that these workers require more than ever the stimulation that comes from discussion of papers by the workers in allied fields.

An informal meeting was called on December 28, at which representatives of medical workers, parasitologists, economic entomologists and biologists were present. The central question was how real and widespread was the need for such closer coordination of allied workers; how this coordination could be met without the formation of new groups.

There was a surprising unanimity of opinion of the desirability and the necessity of such closer coordination for mutual information and stimulation. It was decided to form no new groups. It was decided that the secretary of Section N, Medical Sciences, in consultation with the secretaries of the parasitologists, the two entomological societies and others, was to arrange a program in such a manner that it might be possible for the members of these related societies to attend a meeting held under the auspices of Section N (Medical Sciences) with the minimum of conflicts; that Section N (Medical Sciences) should arrange an invitation program by representatives of the entomologists, the parasitologists, and medical workers, on topics of mutual interest. The opinion was definitely expressed that the specialists have so far transgressed the narrow limits of their respective fields that there is an increasing need of information and stimulation and exchange of views on the part of those working in allied fields; and finally, that the meeting of Section N (Medical Sciences) should be devoted primarily to the coordination of such allied workers.

This is a distinct departure from the policy of Section N in the past. If it should appear desirable to add to such a program, an additional program in the interest of the larger membership of the association, such a program shall be arranged.

It was also the consensus of opinion that once each year Section N (Medical Sciences) should hold a joint meeting with one of the national medical organizations or federations, so as to knit more closely the bonds between the American Association for the Advancement of Science and these other organizations. Such an arrangement already exists between the Federation of Experimental Biologists and Section N (Medical Sciences). It was proposed that once in every four years a joint meeting should be held between Section N (Medical Sciences) and the Anatomists, the Public Health Association, and the Bacteriologists.

Plans are now under way to make these suggestions effective. The secretary will appreciate suggestions and advice. This is no place to discuss the vexing problem of the relation of the sections, such as chemistry and engineering, and the large national organizations so loosely affiliated with the association, but the problem seems to be the same in all these instances, and any assistance to this complex problem will be appreciated by these and other groups who must plan the meetings for the coming years.

A. J. GOLDFARB,
Secretary

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SCIENCE OR ATHLETICS?[1]

THERE has never been a period in the history of science when educational questions relating to its advancement have appeared to possess such interest or when discussions have dealt so freely with the shortcomings of the educational system in its relation to the training of students of science. On the one hand is an intensely practical industrial world, insisting upon a close scrutiny of the content of the college courses and of the methods used in administering them,—from the standpoint of their immediate practical application to industrial problems and from this standpoint alone,—while on the other is the world of the college teacher, seeing or thinking it sees much in science and in the teaching of science that is not to be judged in this limited fashion. We are turned this way and that in the attempt to see all viewpoints and to make use of all constructive advice. We desire that our students shall be as well equipped as possible in whatever of science it is possible to teach them in the time that is allotted to us, so that when they leave us to take up their share in the general advancement of science they shall be able to acquit themselves honorably and to add whatever they may in the application of science to the problem of increasing the happiness and comfort of humanity.

Chemical education has not been spared in this discussion. Rather has it been the center of the major part of the discussion, for in no other single science has there been so spectacular and so amazing a success in research and in the tangible results of the application of research to practical problems. It has therefore come about that there is no other science in which it is more important that the college

[1] Read before the Section on Chemical Education at the Birmingham meeting, April, 1922. Contribution from the Department of Chemistry, Purdue University.

and the university shall succeed in evolving proper and effective methods for the scientific training of the youth of the land, since it is upon the mental equipment and the mental habits of our present and future students that the future of the science depends.

I propose to discuss certain phases of this subject from the standpoint of the college teacher. We respect the viewpoint of those practical men who, like Mr. Edison, feel that about the only trouble with the college graduate is that he knows nothing and is good for nothing, also of those other, perhaps broader minded, technical men who recognize the value of college training but who believe that the teachings of the class room and student laboratory are too far removed from the problems and methods of industrial applications. We also realize that some of our eminent research chemists are insisting that the college and the university should busy themselves with fundamental principles and that they should keep hands off the plant processes, while others are equally emphatic in the view that research should be more along practical lines.

Without, at present, presuming to argue any of these questions and respecting the integrity of all who offer them, we respectfully submit that in the effort of the college teacher to administer courses of training, either routine or research in purpose, there are certain factors that constantly baffle and discourage, that these factors are to a considerable extent under the control of some of those who complain of our shortcomings and even that the continuance of such conditions is directly traceable to the activities of some of the critics. This may seem to be a statement that requires justification.

I take it that every one will agree that the study of chemistry as a preparation for successful research or for work in the application of chemistry to practical problems is an enterprise that calls for the concentration and supreme effort of high grade intelligence. Any person who expects to devote merely left-over energy and surplus thought to superficial aspects of any science,—and especially of chemistry,—is foreordained to a career of attainment that is mediocre or worse. The students of chemistry of past years who consistently followed the practice of "living the life" in college, making of themselves "all-around men" by the time-hallowed practice of taking part in every possible activity on the campus and off it, except the one for which they paid their money and for which they sacrificed the best years of their lives,—these men, with few exceptions, now make up the army of fillers of small positions, doers of small things and thinkers of small thoughts. They have a certain routine part in the routine affairs of science but when they are gone their places will easily be filled by others who have followed the same line of reasoning and of conduct.

The college teacher who is dull and uninspiring in his contact with students will have a class of dull and uninspired students. This, no matter how well trained he may be or how earnestly he may desire to fulfill his mission as a teacher. But if the teacher is all that we may desire to see in a teacher:—well grounded in his subject, of broad vision and purpose, energetic, inspired and inspiring,—he may fire his students with boundless zeal for the things and deeds of science, he may grip their intellects and emotions while in the class room or laboratory, he may fill them with the highest kind of resolve for high endeavor, but he can not make true students of science of them when the whole atmopshere of the college is that of one grand hurly-burly of everything under heaven except study. Every teacher who hears this or who reads it knows that, to far too great an extent, this *is* the atmosphere of the modern American college. Some of our atmospheres are better than others,—or we might even say that some are worse than others. But when the student goes out from his session with the best teacher in the best college in the land he immediately finds himself in the midst of a multitude of distracting circumstances, events, activities and enterprises. It can not be denied that the effect of this is to lower the efficiency of the student, to weaken his mental resolve for high accomplishment and to render impotent much of the effort that has been expended by the instructor. It has repeatedly been emphasized that extra-curricular activities play a large part in the development of character and in the making of men who can deal with men. I am not denying this. Rather, I assent to it and give it emphasis. But I add, also, that the undue *multiplication* of student activities and campus side-shows plays an ever increasing part in the pulling down of the educational system with which we have labored so carefully and so painfully, and in the dissipation of the scientific efforts of those who should be our best students. Superficial training is the inevitable result and superficial training and narrowness of viewpoint are the blight of our system of scientific education to-day.

Many of our American colleges make an advertising point of the large numbers of students who flock to their doors, but I believe that it is no exaggeration to say that if we could exchange our annual crowds of graduates in chemistry, immature in intellect, unsettled in purpose and under-done in real scientific education as too many of them are, for a small fraction of this number of young men and women of good minds, well grounded in fundamentals, possessing a broader culture and accustomed to profound thinking on serious matters, the world at large and the science of chemistry would be immeasurably benefited. That we are, even now, occasionally finding some of these minds and doing something toward their proper development is cause for real rejoicing. That we might find and develop more of them if conditions were changed is a proposition that will bear examination.

What, then, is to be done about this question of the dissipation of the youthful fire of our students among the hundreds of non-essentials of college life? Change it, of course, say our critics. Exactly. And if our American colleges were now, in the truest and most complete sense of the word, "educational institutions" this would not, I verily believe, be a particularly difficult or perplexing undertaking. But, fellow scientists, our American colleges are to-day waking into the realization that they have somehow developed a *liason* with an organization that not only is not educational in its purpose,—it is actually one of the most insidious destroyers of educational standards that we have to combat to-day. This organization is no other than the modern highly commercialized intercollegiate athletic system, financed by forces that care nothing for education and fostered by extravagantly paid coaches who trample all of the ideals of education under foot in their desire for personal glory and personal profit.

There is a perfectly legitimate and desirable field for college athletics. We desire that our students shall have systematic physical exercise because this makes for health and contentment and thus, indirectly, for scholastic success. We know also that the spirit of competition is an all-powerful incentive for excellence in any line of activity and the athletic game is the logical expression of this. But this idea has become almost entirely overshadowed through the development of a system that places the vast majority of our students upon the bleachers and concerns itself with an excessive degree of specialization with an almost negligible minority. A friend of ours has tritely stated that the American people have become afflicted with a disease which he calls "bleacheritis." They find their highest enjoyment in lounging on the side lines, entertained by mediocre "movies," bad vaudeville, athletic contests or any other novel spectacle, and they take too little interest in wholesome activity on their own part or in play for the sake of its effect upon their minds and bodies. Even the hysteria of the college "pep session" accomplishes only a temporary rousing from this apathy. The result, in college life, is the almost absolute failure of physical education to accomplish any important part of its mission to keep the bodies of our students healthy and their minds alert, and to turn them back into the class room and laboratory full of vim and enthusiasm for the most important work of their education. This can not fail to work harm to the scholastic success of the student. That it goes even farther than this and that it seriously affects the educational standards of our colleges is a fact which we can not safely ignore.

Within the past few months there has been an unusual amount of discussion of the matter of professionalism in college athletics. The colleges have come in for a great deal of criticism and especially in a few instances where players have been disqualified from intercollegiate competition because of having participated in games of a semi-professional nature, and where there have been exposés of the attempts of coaches and others to influence prospective student athletes by the use of money. How much may we expect to accomplish by disqualifying a few players, here and there, or by the dismissal of a coach or two for the breaking of the rules regarding the payment of money to athletes? I think that we shall accomplish very little of a remedial nature by this sort of publicity unless we go considerably farther. These published cases of professionalism in students have been largely technical in their nature and it appears evident that the students in question do not feel any consciousness of guilt nor are they regarded as criminals by their fellows. The general public probably sees little in all this but a rather fantastic exhibition of hair-splitting and quibbling by college folk, who appear to magnify a purely technical offense into a serious case of law breaking. It is probably true that the majority of non-collegiate observers,—or at least of those who take an interest in athletic affairs,—sympathize with the players who are detected in what they regard as purely technical violations of unnecessarily strict technical rules.

The principal reason for all this is that the average person does not appreciate the real evil of professionalism in college athletics. He sees nothing inherently wrong in playing for money, any more than in doing any other legitimate thing for compensation. We have professional baseball and enormous numbers of us go to see it and feel that it is perfectly proper that gate fees should be charged and that the skilled players should be paid liberally for entertaining us. Why, then, should intercollegiate associations adopt such drastic rules against college athletic professionalism and why should faculties attempt to enforce these rules so rigidly? This is certainly not done solely in order to insure fair play in intercollegiate contests.

The fact is that mere playing games for compensation, in the college or out of it, is not *inherently* immoral or wrong in any way, except as it may bear some relation to the vital concerns of the college in its efforts to promote true education. But we are insistent that the least taint of professionalism shall be kept out of our college athletics because we know that whenever we admit it we shade our scholastic standards. If petty, technical professionalism may enter then unlimited professionalism and commercialism to the last degree can not be excluded.

I am saying no more than what is fairly common knowledge when I state that there is a sort of underground activity to-day that is exerting every effort to circumvent and evade our regulations concerning amateurism. However much some of us may boast of the "cleanness" of athletics in our various colleges, we all know perfectly well that the cases of violations of the rules that are occasionally brought to light are merely the more obvious ones. We disqualify our players for participating in a summer game in a village of a neighboring state but we harbor far more serious cases of real professionalism in the boys who are provided with workless jobs, fraternity homes and other outside-financed "education" in order that they may take important places on athletic teams. These boys are hunted out while yet in the secondary schools and they are brought to college and kept there by an organized effort on the part of men who, in some cases, care nothing for educational standards or for education itself, but who know athletic excellence when they see it and who are determined to have the best of it for the college of their choice. This work is done quietly, as a rule. Occasionally some novice in the business makes a slip and an uproar ensues. This has happened on several occasions, quite recently. As a result, it is apparent to a close observer that the interests that work for commercialism are now scurrying to cover. They realize that they have been riding to a fall and in order to save intercollegiate competition from the impending wreck they have become loud in their pharisaical professions of a determination to see that the law is obeyed and that college sports are kept clean. But even in this they are careful to keep attention focused upon the summer-playing bugaboo, so that the more serious issues are obscured.

Visualize, if you will, the college teacher,—instructor, professor, department head or dean,—making his final summary of grades for the members of his classes or sending in his mid-semester reports of delinquencies. Imagine that you see the name of one of these star athletes upon the list of those who have been found wanting. No very vivid imagination is required to complete the picture. It is quite likely that many of our teachers are upright enough and strong enough to resist the pressure which will result. Also it is quite possible that many are not so strong. This is particularly true of the teachers who hold the more subordinate positions and who feel themselves less secure in their standing. And the assault against class standards is not, by any means, confined to actual threats against individual instructors. A more subtle influence in the form of a very human and a very universal desire for personal popularity and a lurking fear of loss of dearly earned prestige finally leads to the same result. As individuals and as faculties we feel more and more strongly a timidity in the enforcement of rules,—not only rules of scholarship but rules of every description. This, I am firmly convinced, is the basic cause for the now too obvious drift of our colleges toward laxness in morale and toward the lowering of the standards of work required of those who are to receive our degrees. The futility of our most earnest efforts toward inspiring and effective teaching becomes increasingly apparent.

Fellow chemists, this is a problem which affects all of us most vitally. We have had an enormous amount of publicity for the fact that American science was not, before the war, able to cope with German science and various reasons have been assigned for this undoubted fact. The efficiency of American science was suddenly increased, during our war period, by the spur of life-and-death necessity. But this spur no longer exists and if our chemistry,—research, applied or teaching,—is to continue to hold its own we must see to it that our young college graduates go forth into the struggle fully equipped with well trained minds and hands,—well trained not only in the ability to do certain routine tasks that we have set for them in the colleges and universities, or in the ability to follow slavishly in the methods and habits of thought of their teachers, but broadly trained in scientific fundamentals, in general culture and in the ability to do independent and profound thinking on important matters of science and of life. This they do not now acquire as they could and as they should.

Whether or not you may agree with the conclusions I am about to draw, I do not believe that the essential facts as I have already stated them can successfully be denied. I do not believe that we can make any very great headway in our effort to stop the obvious decline in our standards of scientific education until we can succeed in limiting the distractions of campus activities to sane and reasonable values. We can not bring about this change until we divorce the educational system from the present commercialized system of intercollegiate athletics. And, finally, the incubus of commercialized athletics can not be shaken off until we throw out of our educational system all of our extravagantly paid professional coaches. For a fraction of a year of work we pay a football coach three or four times as much as an able and experienced professor in any other department will receive. We need not feel any surprise when we discover that he has done the best he could to earn this salary and thus to insure permanency in his position, or that he has employed every means in his power to obtain the best material for his teams, rules or no rules, and we need not expect that anything short of constant vigilance will serve to curb his extra-legal activities. His job is to develop a team that will be able to outplay the teams of approximately seven other colleges in as many contests of approximately forty minutes each, per season. He is going to do this to the best of his ability, regardless of cost, and we may think as we please about it.

Our colleges are spending relatively enormous sums upon athletic activities whose end is not, in any sense, physical development of the students but solely the winning of games and championships, while the educational needs are grievously suffering, through lack of support. This spectacle is not one that can be contemplated with equanimity by those who have faith in education and hope for its future development. We are losing the sense of perspective in educational affairs and we may not expect to elevate our colleges from a position of mediocrity in scientific training until we shall have reacquired this sense. This happy consummation is not to be attained so long as we remain in the present state of competitive hysteria or so long as we continue to provide disproportionate support for an activity that has no relation to scientific or other education except that of obstruction to it. I do not envy those colleges of the United States that are planning to sink millions in athletic stadia. I verily believe that the day will come when these colossal monuments to the suicidal folly of a so-called "educational" system will be an offense to the eyes of believers in true learning, for in that day we shall find it hard to convince our critics that we do not esteem the spectacle of two hundred and eighty minutes of actual playing of football each year as of greater importance than the training of American youth in the science of chemistry.

And now, in what way can there be any truth in the statement made in the earlier portion of this paper, to the effect that the men who are looking to the college to supply trained chemists, as well as trained scientists in other fields, are directly responsible for the continuance of this condition? Simply by this: that these people are, almost without exception, college and university alumni and that organized alumni activities concern themselves almost exclusively with efforts to further athletic successes in their colleges, to the neglect of opportunities to better educational conditions. This is certainly not because of any desire to hamper the educational work of the college. Quite the opposite is the case. They do not busy themselves so much with other modes of assistance, merely because for some reason it has not occurred to them that such assistance is possible. They believe that the college needs advertising and they have repeated so often that they nearly believe it, the old fallacy that athletic prowess is the best advertisement for institutions of higher learning.

I hope that I do not merit the appellation of "alarmist" but I do sincerely believe that the present condition and the present trend of scientific education is such as to give thoughtful people cause for concern, and I believe that we shall not get very far in our attempts to improve matters until we elect to discuss these things fearlessly and openly and then courageously to act upon our convictions. In the inspired words of Vernon Kellogg:[1] "It is incredible that in this all-important matter of getting our higher education straightened out we shall go on indefinitely acting as if we were helpless. Let the college or the university that wishes to do the greatest thing just now to be done for higher education and true learning in America step forward and boldly do the unusual thing. Let it devote the most of its energies to the most important part of its work. It will soon not be alone in its doing. It will become a prophet with honor in its own land."

The choice of courses is now ours. If we fail to exercise that choice in the name of true education and true science, we may later find that the decision has passed from our grasp. Or can it be that, as history has so often recorded of individuals, of organizations and of nations, we shall continue simply to drift until the accumulation of disaster shall shock us into realization?

E. G. Mahin

BUGS AND ANTENNAE[1]

Members of the Entomological Club of Madison, entomologists in various parts of the United States, and radio "bugs":

The Madison Entomological Club, as host,

[1] Science, 54: 19 (1921).

[1] A radio lecture given at the request of the Entomological Club of Madison, Wis., and broadcasted from the General Electric Company's station, "WGY," at Schenectady, N. Y., at 9 P.M., April 24, 1922. The transmission to Morgantown, W. Va., about 400 miles, was practically perfect, it being as distinct as though presented in a classroom. Unfortunately static or other conditions prevented it being heard at Madison, Wis., and seriously interfered at New Haven, Conn., and Wooster, Ohio.

welcomes all who listen in. It is a great pleasure in this first radio entomological lecture to be specifically authorized to convey to Madison entomologists and others the greetings and best wishes of Dr. Howard, chief of the Federal Bureau of Entomology, Dr. Gibson, Dominion entomologist of Canada, and the presidents of the older entomological societies on the eastern coast, namely, Cambridge, New York, Brooklyn, Washington and Philadelphia, the last founded in 1859, the oldest of its kind in the country and with its founder, Ezra T. Cresson, still active. The pioneer and veteran entomologist of Canada, Dr. Bethune, has authorized the extension of his congratulations and best wishes to present day workers. We would also express our appreciation to the General Electric Company of Schenectady for placing this lecture upon its program.

There are great possibilities in broadcasting and, for the purpose of determining its present value, the speaker requests reports by mail giving the number of entomologists at each unit receiving this lecture. Crop and market reports are broadcasted. Why not warnings of insect depredations? Regional programs and lectures by visiting specialists are very desirable present day possibilities.

This has been called the age of man. Is it not really the age of insects? They occur almost everywhere. They actually imperil our existence by attacking crops, destroying forests, annoying and worrying domestic animals, and are well known carriers of deadly infections, such as typhoid fever, yellow fever, cholera and sleeping sickness. Were it not for the beneficent activities of birds and many other natural agents, we would be overwhelmed by the numerous pests contemptuously designated as bugs. There are in New York State some 20,000 different species of insects and perhaps 100 entomologists engaged in collecting and studying them. There are presumably more than 100,000 species in the United States with over 1,000 entomologists and in the entire world a million to ten million different species of insects (a large proportion unknown) and a relatively much smaller group engaged in their study. Each of these insects occurs in four distinct stages, namely, the egg, the maggot or caterpillar, the pupa or chrysalis and the adult or perfect insect, consequently the entomologists of the world are engaged in the stupendous task of classifying and learning the habits of four to forty million different forms. Accurate differentiation must precede investigation of life histories, otherwise deplorable confusion is almost inevitable. There is no group in the animal, the vegetable or the inorganic kingdoms which presents so many diversities as the exceedingly numerous and varied forms known as insects. It usually takes several years and frequently much longer to work out a satisfactory life story of even one insect, consequently a limitless field is before us. We extend to radio "bugs" and others interested an invitation to join in exploring and making known this vast realm of the undiscovered.

Man is inclined to congratulate himself upon his wonderful progress, forgetting that in many cases he has yet to reach the degree of perfection seen in numerous animals. The recently developed monoplane, for example, does not differ greatly in its general proportions from those of our hawk moths, and the biplane is almost a duplicate of a pair of dragon flies, one flying above the other; both models that have been favorites in the insect world for thousands of years. Dare any man say that our latest advancement in applied science, namely, the radio telephone, is more than a relatively crude modification of methods which have been used by insects for countless ages?

Radio "bugs" are rightfully proud of their aerials or antennæ, yet they have developed relatively few types and apparently have not learned, except in a very general way, of the million or more different kinds of insect antennæ, each admirably adapted to a specific purpose and some wonderfully suggestive of aerial communication.

Ages ago the gall midges, minute flies which produce galls on many plants, learned the advantages of elevated or elongated antennæ and we find here species which have solved the problem by the development of greatly elongated antennal segments, thus increasing very materially the length of the entire organ and others which have attained the same end through a doubling or trebling of the normal number of segments or joints. As a result, some have antennæ twice as long as the body. Each segment is a unit and though the comparison may not be a strictly accurate one, we are inclined to regard the antennal segments as linked in multiple units.

It is well known that the antennæ of many insects have very efficient olfactory and auditory structures. The latter may be simple hairs springing from sensory pits, whorls of hairs or even more complex structures.

The radio enthusiast would certainly be interested in an aerial or antenna of the multiple inverted umbrella type, the arms of the umbrellas being loops and in some forms greatly extended on one side, presumably for directive receiving; the umbrellas arranged in double or triple series in multiple units mounted with flexible connections and an articulate base permitting limited rotation. Such structures are found in gall midges.

We would call attention to the peculiar circumfila or encircling threads supported by numerous short stems entering sensory pits or detectors, the latter within the antennal segments. The simplest type of circumfilum is a low thread or circle, not a coil, near the base of the segment and frequently connected by a filament on one face with a similar circle near the opposite extremity. These threads may be modified and follow a sinuous or wavy course instead of a straight one; they may be greatly increased in number to form an enclosing net work, suggestive of the bed spring aerial; the portions between the supporting stems may be greatly stretched or drawn out as it were to form relatively enormous loops and in some we have the loops on one side of the antennæ very greatly produced. We may even find in some antennæ a combination of the low and simple type together with highly developed loops. There is one group where these structures are modified in such a curious way as to resemble miniature horse shoes upon opposite sides of each segment; the supporting stems suggesting the nails used for the attachment of horse shoes.

There are over a thousand variations in gall midge antennæ, presumably for cause. Solomon advised some of his fellow mortals to consider the ant. May we suggest to radio enthusiasts a similar attitude toward gall midges—master builders of antennæ which are both the admiration and despair of man.

Concluding, may we register faith in radio and radio antennæ, anticipating through them closer and more helpful relations with fellow men.

E. P. Felt

State Entomologist
of New York

JOHN CASPER BRANNER

The following resolution was passed at a meeting of the Academic Council of Stanford University held April 7, 1922:

As witness of our affection for Dr. Branner and respect for his memory, we desire to make our own and incorporate (in part) in the minutes of the Academic Council the appreciation prepared for the *Illustrated Review* by his friend and colleague, Professor Stillman:

"In the death on March first of President Emeritus John Casper Branner, Stanford University loses one of its most distinguished scholars, one of its greatest teachers and most respected and beloved personalities.

"Dr. Branner was born in New Market, Tennesee, on July 4, 1850. He attended school at Maury Academy in Dandridge, Tennessee, and later enrolled at Maryville College. At the age of eighteen he entered Cornell University, where he received his bachelor's degree.

"While still an undergraduate he was selected (1875) by Professor Charles F. Hartt to assist him in a geological survey of Brazil, which occasioned several years of work in Brazilian geology. In 1882 he was again commissioned, by the United States Government, to go to South America to investigate insects injurious to cotton and sugar-cane industries. From 1883 to 1885 he was engaged by the Pennsylvania Geological Survey to make a topographic map of the Lackawanna Valley.

"When David Starr Jordan became president of the University of Indiana in 1885, he appointed his Cornell college and fraternity mate to the professorship of geology at that institution, a position he held until again called by Dr. Jordan to the similar chair in Stanford University. In the meantime he acted (1887-1892) as state geologist of Arkansas, while retaining his chair at Indiana.

"From 1891 until his retirement from the university in 1915, Dr. Branner occupied the headship of the department of geology and mining, holding also the office of vice-president of the university from 1898 to 1913. Upon the creation of the title of chancellor for Dr. Jordan, in 1913, Professor Branner was elected president, a position which he held until January, 1916, when he also retired under the age limit established by the university, and became president emeritus. During his years of service at Stanford, Dr. Branner found occasion to direct or participate in professional missions, such as his expedition to Brazil under the patronage of Alexander Agassiz in 1899, and again in 1907-1908. He was also one of the special government commissioners on the Panama Canal, and on the California earthquake of 1906.

"The scientific service of Professor Branner has been widely recognized. He was a member of the National Academy of Sciences, the American Philosophical Society, was president (1904) of the American Geological Society, vice-president (1890) of the American Association for the Advancement of Science, held membership in the Geological Societies of London, Edinburgh, France, was president (1911) of the American Seismological Society, and was a member of geologic and geographic societies of several Brazilian states and of other countries. He has received the degrees of Ph.D. from Indiana University in 1885, of LL.D. from the University of Arkansas in 1897, from Maryville College in 1909, and from the University of California in 1915, and the degree of Sc.D. from the University of Chicago in 1916.

"His publications are numerous and, while the great majority are on geology, many evidence the breadth of his active interests in botany, entomology and other lines of natural sciences. His grammar of the Portuguese language (now in its fourth edition) grew out of his Brazilian experience. His bibliography of Clays and Ceramics, an important compilation; the "How and Why Stories," a charming collection of southern negro dialect myths (1921); his genealogy of "Casper Branner of Virginia and His Descendants"; and his recently completely but as yet unpublished translation from the Portuguese of Alexandre Herculano's *Establishment of the Inquisition in Portugal,* all evidence his breadth of interests and his tireless energy.

"As a teacher Professor Branner exerted upon his students an influence which inspired them to their best efforts. His broad experience, his own sytematic and untiring research, his realization of the supreme importance of practical experience as the final test of all theories, were well calculated to stimulate the ability and energy of his students, while his simple, sincere, and sympathetic personality attached them to him with a rare devotion."

Dr. Branner's attitude toward the office of president was characteristically expressed in his inaugural address:

"I am here to serve you in every way in my power and in everything that pertains to your work as instructors in the university and as scholars interested in your own special lines of work. I expect and I intend to be the servant of every member of this faculty except myself. I consider the support I can give you my most important duty, and it will be my greatest pleasure."

In becoming president of the university, Dr. Branner did not cease to be teacher and colleague. He made the problems of all the departments his own. In his relations with students and faculty the informality of attitude and high courtesy were unchanged. He maintained the same dignified simplicity he had exhibited as executive head of his department.

Dr. Branner's life is a great heritage for Stanford University, for California, and for the nation.

Ray Lyman Wilbur,
President

SCIENTIFIC EVENTS

A COUNT OF BIRDS

Renewed interest in the bird population of the United States has led to a revival of the efforts, begun in 1914, by the Biological Survey of the United States Department of Agriculture, to collect information on the number and distribution of the birds breeding in this country. Counts have been made each succeeding year, and interested persons who are thoroughly familiar with the breeding birds of their respective vicinities are asked to aid in the work. By continuing these counts over a period of years and counting the same areas each year, knowledge can be gained not only of our total bird population but also of its fluctuations from year to year. The counts, moreover, will greatly help in determining what effect the present state and federal laws have on the increase of game and insectivorous birds. The department hopes that counts will be continued on all land where they have previously been made, and it especially desires to obtain also series of counts indicating the bird life on the plains; on the deserts, both with and without irrigation, and in the southern and western states.

It might be well to select new areas where physical conditions are not likely to change much for a number of years, so that if succeeding annual counts show changes in bird population it will be known that they are not due to changed environment brought about by man. On the other hand, there is much to be learned regarding the adaptation of birds to changes of environment; any area therefore on which reports can be made year after year may be chosen, even though conditions are likely to change. Possible inability to repeat a count on the same tract need not, however, deter any one from making the count this year.

The height of the breeding season should be chosen for this work. In the latitude of Washington, D. C., at latitude 39 degrees, May 30 is about the right date for the first count. In the latitude of Boston the work should not begin until a week later; while south of Washington a date still earlier than May 30 should be selected. The department wants to learn how many pairs of birds actually nest within the selected area. Birds that visit the area only for feeding purposes must not be counted, no matter how close their nests may be to the boundary line.

Several kinds of counts are needed for a study of the relative abundance of birds under changing and stationary conditions. It is hoped that many persons interested in bird life will make one or more counts this season. If only one count is made, the tract selected should represent average farm conditions for the locality, should not have an undue amount of woodland or orchard, and should contain not less than forty acres a quarter of a mile square nor more than eighty acres. If there is an isolated piece of woodland of from ten to twenty acres conveniently near, a separate count of the birds nesting there will be useful in addition to the count on the rest of the farm. In this case the report, in addition to specifying the size and exact boundaries of the area, should give the principal kinds of trees, and whether there is much or little underbrush.

A third count is desired of some definite area of woodland, which is part of a larger timbered tract. Still a fourth count, supplementary to these is needed. The average farm in the northeastern states contains about one hundred acres, and the average count hitherto has been of the birds nesting on the fifty acres of the farm nearest to and including the farm buildings. It is now necessary to obtain counts also of the remainder of the farm, the wilder part containing no buildings, especially on the same farms where counts about the buildings have already been made. Besides these, counts on any other kinds of land are much desired for comparison.

Any one who is willing to do this work is requested to send his name and address to the Biological Survey, Washington, D. C. Full directions for making a count and report blanks will be sent in time for plans to be made before the actual time for the field work. Since the bureau has no funds with which to pay for this work, it must depend on the services of voluntary observers.

THE CHEMICAL EXPOSITION[1]

The Eighth National Exposition of Chemical Industries will be held this year in the Grand Central Palace, New York, during the week of September 11 to 16, inclusive. It will follow immediately upon the fall meeting of the American Chemical Society. The early date will give college and university men an opportunity to see the exhibits before the beginning of the college year. There is much in this coming exposition to interest university men. Each floor has exhibits of laboratory apparatus, and one floor has a considerable group of this type of equipment. Many new pieces of apparatus, new chemical compounds, and other material and instruments will be found here.

The interests for industrial chemistry in the exposition are wide and varied: from raw materials in minerals, ores, manufacturing crudes or by-products, through the range of ma-

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

chinery, apparatus and equipment and instruments for control, precision, recording, gaging and measuring, and a thousand other items used in converting the raw materials into the finished products. The finished products themselves, whether they be organic, inorganic, solid, liquid, gaseous, or of any other form, are all to be there. Many new things upon which manufacturers were working when the war ended and which have been more leisurely perfected since will be shown for the first time. Industrial progress continually calls for greater advancement and perfection in manufacture, and each year sees many notable improvements upon the exhibits in the exposition. Counting only these, the time of technical and business men is well spent in inquiring into the exhibits. One exhibitor, who for the past few years has been devoting time to the perfection of a new form of apparatus, said the other day that it is now when men have time to spare for consideration of these things that he expects a considerably larger and more interested attendance in his booth. "When the plants are idle as they are now, the most progressive companies are examining into our apparatus, and a remarkable thing is that we are making some installations in plants which are now closed, so that when they begin work they will be in better position than ever and have an advantage in taking this opportunity to prepare to reduce their costs for the future. I'm looking for many more such openings through our exhibit and with considerable enthusiasm for the entire exposition."

The managers report that three full floors of the Grand Central Palace are already taken for the exposition and a part of a fourth. They expect all space will be engaged before the opening date. Already, 303 exhibitors have contracted for space.

The exposition will contain two interesting special sections: one upon the subject of fuel economy, where exhibits intended for the more efficient use of fuel, its combusion, distribution, or control will be made. The other will deal with shipping containers, including the container itself, whether of metal, wood, fiber, paper, glass or in cooperage products of slack and tight barrels, tanks and towers, and with machinery for packaging, labeling, handling, and conveying the packaged material and marking it ready for final shipment.

Work upon the program has not yet been actively undertaken but it may be expected to compare more than favorably with the high standards of the preceding expositions. The management have returned to the Grand Central Palace with their offices, and all inquiries should be directed there.

FELLOWSHIPS IN MINING RESEARCH

THE cooperative department of mining engineering of the Carnegie Institute of Technology, Pittsburgh, announces the offer of two fellowships in mining research, and two in teaching and research, in cooperation with the Pittsburgh Experiment Station of the United States Bureau of Mines. The fellowships are open to the graduates of universities and technical schools who are properly qualified to undertake research investigations. The value of each fellowship is $750 per year of ten months beginning on July 1 for the position of research fellow and on August 1 for teaching fellow.

Investigations will be on the following subjects: (1) Acid Mine Waters: (*a*) physical-chemical study of the mechanism of corrosion in acid mine water; (*b*) neutralization with limestone, blast furnace slag, etc.; (*c*) recovery of iron oxide for gas purification and other purposes; (*d*) purification for use in boilers. (2) Shooting Coal: (*a*) factors in shot firing which favor the production of lump coal; (*b*) effect of location, size, and depth of bore holes; (*c*) kind of explosive; (*d*) sequence of firing; (*e*) method of charging and firing; (*f*) method of cutting coal. (3) Spontaneous Combustion and Coal Storage: (*a*) effect of size of coal; (*b*) effect of moisture; (*c*) effect of anthraxylon and attritus; (*d*) action of various forms of sulphur. (4) Geology: (*a*) relation of relative proportions of anthraxylon and attritus in coal to its coking properties and by-product yield; (*b*) correlation of coal seams by microscopic characteristics; (*c*) constitution of coal seams in western Pennsylvania. (5) By-products Coking: (*a*) determination of the heat of carbonization of coal; (*b*) determination of the volatile matter in coke at various temperatures. (6) Utilization of Coal; (*a*) study of the economic utilization of the roof coal of the Pittsburgh seam, including structure, composition, coking properties, and by-product yields. (7) Coal Mining: (*a*) determining the compressive strength of coal from various beds.

All the time of the research fellow is to be devoted to work in the Experimental Station of the U. S. Bureau of Mines which is located adjacent to Carnegie Institute of Technology. The position of teaching fellow includes ten hours each week devoted to teaching work in mining, and the balance to work in the Experimental Station.

EXCHANGE PROFESSOR TO FRANCE IN ENGINEERING AND APPLIED SCIENCE

Dean John Frazer, of the Towne Scientific School of the University of Pennsylvania and professor of chemistry, has been chosen as exchange professor to France for the coming academic year, by the committee on exchange with France of professors of engineering and applied science, representing Harvard, Yale, Columbia, Cornell, Massachusetts Institute of Technology, the Johns Hopkins and the University of Pennsylvania.

The movement for the annual exchange with France of a professor of applied science had its origin as the result of a letter written shortly before his death by the late President Richard Maclaurin, of the Massachusetts Institute of Technology. The French administration responded very cordially to the offer for the annual exchange of a professor and selected for their first representative Professor Jacques Cavalier, rector of the University of Toulouse, and a well-known authority on metallurgical chemistry, who divided his time during the current academic year among the seven cooperating institutions, namely, Columbia, Cornell, Harvard, Johns Hopkins, Massachusetts Institute of Technology, Pennsylvania and Yale.

The American universities selected as their first outgoing representative for the first year Dr. Arthur E. Kennelly, professor of electrical engineering at Harvard University and the Massachusetts Institute of Technology. He has met with great success in his undertaking in France, and in addition to lecturing before numerous French technical schools was assigned by the French educational authorities, through M. Petit Dutaillis, minister of public instruction in France, to spend several weeks at the Universities of Paris, Grenoble, Lyons, Marseilles, Toulouse, Bordeaux, Nancy and Lille, giving in each a course of lectures, some technical and others of a more general character.

Dean Frazer in the course of his work of lecturing in French before the various universities and scientific societies of France, will have favorable opportunities of studying at close range French educational methods, especially as applied to science.

Dr. Frazer represents the fourth generation to be graduated from the University of Pennsylvania, and the third generation to be connected with its faculties. His grandfather, John Fries Frazer, from 1844 till his death in 1872, was professor of natural philosophy and chemistry in the University of Pennsylvania and vice-provost from 1855 to 1862. He was one of the incorporators of the National Academy of Sciences in 1863. His father, Dr. Persifor Frazer, became professor of chemistry in 1872, which chair he held until his appointment to the Second Geological Survey of Pennsylvania. He died in 1909. Dr. John Frazer was born in Paris, France, on February 5, 1882. In 1904 he was appointed instructor in chemistry, being later promoted to assistant professorship and subsequently to a professorship. In 1912, upon the reorganization of the old college, he became dean of the Towne Scientific School, which position he has held since, except while on leave of absence when in the service in 1918.

SCIENTIFIC NOTES AND NEWS

Sir Auckland Geddes was given the honorary degree of doctor of laws by the University of California at the recent Charter Day exercises celebrating the fifty-fourth anniversary of the university. The British ambassador was the main speaker on Charter Day, the subject of his address being 'Some of the effects of increasing scientific knowledge upon constitutional government."

ON May 1 a number of the friends of Colonel Fielding H. Garrison gave a dinner in his honor in Washington. Dr. Harvey Cushing presided and Dr. William H. Welch gave an account of Dr. Garrison's work in medical history and bibliography. Dr. Garrison will leave shortly for work in the Philippines.

PROFESSOR FREDERIC S. LEE, of Columbia University, has been elected vice-president of the International Association of the Institut Marey of Paris.

To fill the place of the correspondent in geometry in the Paris Academy of Sciences, vacant by the death of Professor Noether, of Erlangen, M. René Baire, of Dijon, has been elected.

THE Bessemer Gold Medal of the British Iron and Steel Institute for the year 1921 has been awarded to Mr. Charles Fremont, in recognition of his services in the advancement of the metallurgy of iron and steel and the technology of the testing materials.

AT the fifth annual meeting of the British Society of Glass Technology held on April 26, Professor W. E. S. Turner was elected president.

DR. A. PULLE, professor of systematic botany in the University of Utrecht, Holland, has become director of a second botanical garden presented to the university by the heirs of the late August Janssen, who founded his garden in 1905 near his country residence about fifteen kilometers from Utrecht.

DR. L. R. WILLIAMS, formerly deputy commissioner of health of New York State and for the last four years director of the Rockefeller Commission on the Prevention of Tuberculosis, has been appointed managing director of the National Tuberculosis Association in the place of Dr. Charles J. Hatfield, of Philadelphia, who resigned to give most of his time to tuberculosis work in Philadelphia.

ON May 1, R. T. Stull was relieved of the superintendency of the Ceramic Experiment Station of the Bureau of Mines at Columbus, Ohio, and made supervising ceramist for the bureau as a whole. He will act under the direction of the chief mineral technologist and will have supervision in technical matters in ceramics, and such related investigations of non-metallic minerals as may from time to time be assigned to him.

E. R. SHEPARD, known for his work in electrolysis at the Bureau of Standards, has resigned to engage in private practice.

THE Universities of Melbourne, Sydney and Adelaide have united to invite Professor Einstein, should he visit Java, to continue afterwards to Australia and visit the principal cities.

O. P. Hood, chief mechanical engineer of the Bureau of Mines, will spend the summer in Europe investigating recent developments in fuels.

DR. R. B. MOORE, chief chemist of the Bureau of Mines, sailed on May 6 for England, preparatory to spending two months in various European countries for the purpose of obtaining data on chemical and mineral technology. Dr. Moore will visit England, Germany, France, Austria, Czechoslovakia, Holland and Belgium.

DURING the summer Messrs. C. O. Peak, O. A. Plunkett, C. L. Porter and P. A. Young will be employed in plant disease survey work in the State of Illniois. This survey is under the general direction of Professor F. L. Stevens and under the special direction of Mr. L. R. Tehon.

THE committee on the C. M. Warren Fund of the American Academy of Arts and Sciences voted the following grants at its meeting held on May 4: \$500 to Professor C. James, New Hampshire College, to assist a research on the ytterbium earths; \$500 to Professor Charles A. Kraus, Clark University, to be used to continue his investigations on the constitution of metallic substances. Applications for grants should be made to the chairman of the committee, Professor James F. Norris, Massachusetts Institute of Technology, Cambridge, before the next meeting of the committee, which will be held on October 1.

PROFESSOR WILLIAM H. HOBBS, of the University of Michigan, gave a lecture at the Sorbonne, University of Paris, on April 29, on

"Les guirlandes insulaires du Pacifique et la formation des montagnes." On May 1 he lectured at the University of Grenoble. Professor Hobbs has now sailed for the West Indies and South America, with the intention to return to Ann Arbor at the end of August.

Dr. Irving Langmuir, of the General Electric Company, spoke before the Delaware section of the American Chemical Society in Wilmington on April 19 on "Molecular structure and its relation to chemical valence."

Professor H. A. Wilson, of the Rice Institute, Texas, will lecture at the summer session of the University of Chicago on "The electrical properties of gases."

The following public lectures will be given at University College, London, during the present term: "Atoms, molecules and chemistry," three lectures by Sir J. J. Thomson; "Insects and disease," four lectures by Sir Arthur Shipley; "Recent discoveries in Egypt," by Professor Flinders Petrie; and "The expansion of European civilization," four lectures, by Professor W. R. Shepherd, of Columbia University.

The Linacre Lecture of the University of Cambridge was delivered on May 6 by Sir Humphry Rolleston, on the subject of "Medical aspects of old age."

The *Journal* of the American Medical Association states that the National Academy of Medicine of Venezuela has decided to hold a celebration of Pasteur's centenary. A prize, consisting of a gold medal and 2,000 bolivares, will be granted to the author of the best work presented. A portrait of Pasteur will be placed in the assembly room of the academy and a special medal will be engraved.

The sixteen hundred volume library of the late George Trumbull Ladd, professor of moral philosophy and metaphysics at Yale University, has been given to the Hatch Library of Western Reserve University. Professor Ladd was a graduate of Western Reserve College in the class of 1864.

Carl Lumholtz, born in Norway in 1851, formerly engaged in anthropological exploration and research for the American Museum of Natural History and other institutions, died at Saranac Lake, N. Y., at the beginning of the present month.

Sir Alfred Pearce Gould, late vice-chancellor of the University of London, and president of the Medical Society of London and of the Röntgen Society, died on April 19 at the age of seventy years.

Professor René Bohn, a director of the Badische Anilin u. Sodafabrik, and one of the pioneers of the German coal-tar dye industry, has died at the age of sixty years.

The death is announced of Dr. Isoji Ishiguro, the Japanese engineer.

There will be a meeting of the Society of Plant Physiologists with the American Association for the Advancement of Science at Salt Lake City from June 22 to 24. Papers to be presented before the physiological section should be mailed to E. T. Bartholomew, School of Tropical Agriculture, Riverside, California, before June 1.

Owing to serious flood conditions of the Mississippi River, the annual meeting of the American Oil Chemists' Society, which was to have been held at the Grunewald Hotel, New Orleans, on May 8 and 9, has been postponed to June 5 and 6 at the same place.

The alumni members of Sigma Xi of Southern California held a meeting on the evening of May 24, at the Norman Bridge Laboratory of Physics, Pasadena, California, and organized the 'Sigma Xi Club of Southern California." About fifty members, representing sixteen institutions, were present. The following officers were elected: Dr. W. L. Hardin, Los Angeles, *president;* Dr. Paul W. Merrill, Mt. Wilson Observatory, Pasadena, *secretary;* Dr. E. E. Chandler, Occidental College, *treasurer.* There are more than a hundred alumni members of Sigma Xi in Los Angeles, Pasadena, and near-by towns.

The British Institute of Physics, of which Sir J. J. Thomson is president, has arranged for the delivery of a course of public lectures with the view of indicating the growing importance and place which physics now holds in industry and manufacture. The first of these lectures was delivered by Professor A. Barr of

Glasgow, on April 26, in the Hall of the Institution of Civil Engineers.

AT a meeting of the advisory council of the Phipps Institute, Philadelphia, April 29, gifts totaling $150,000 were announced. The sum of $25,000 will be given yearly for five years by the Carnegie Corporation, for research purposes. Dr. Josiah H. Penniman, acting provost of the University of Pennsylvania, stated that the board of trustees had voted $25,000 to be given during the next two years to the institute. The family of Henry Phipps announced that they pledged $500,000 to the endowment fund, provided an additional $2,500,000 be raised.

THE fund for the establishment of the Harvard School of Public Health will be entitled the Henry Pickering Walcott Fund in honor of the senior member of the Harvard Corporation. As has already been announced, the Rockefeller Foundation has agreed to contribute at once $1,500,000 and eventually $500,000 in addition; these amounts will be increased by a fund of $1,000,000 provided by the university and also by the income of more than $3,000,000 which is now being expended by the university in various departments which will be incorporated in the school. It will probably open next year for instruction and research in the field of public health. It will be closely allied to the Harvard Medical School, and Dr. David L. Edsall will serve as dean of both schools. Certain departments now organized under the Medical School, such as those of industrial hygiene and tropical medicine, will become part of the new school, which will also develop and enlarge the work of the School of Public Health now jointly conducted by Harvard and the Massachusetts Institute of Technology.

THE Board of Research Studies of the University of Cambridge, in a report on the admission of research students, records that steps have been taken to concentrate in the board the power of admission of research students, and it is hoped that this will tend towards the preservation of a uniform standard of qualification. Secondly, they record that it has been decided to institute the degrees of M.Litt. and M.Sc. The regulations for these degrees appear in the current number of the *Reporter*. The number of research students admitted when the last report was presented was 72. Since then 71 have been admitted, making in all 143. These figures, however, hardly represent the comparative number of admissions this year and last, for at the beginning many already at work under the old regulations for the B.A. degree were permitted to transfer. During the year two students withdrew their names. The proportion of Cambridge graduates among the students now admitted has risen. The large number of graduates of other universities within the British Isles remains a feature. Those from Canada and the United States are fewer than may be anticipated when the degree is better known, their combined number—25—being approximately that of those coming from the Indian Empire.

THE British Board of Trade has issued an order exempting certain German scientific and other periodicals from the provisions of the German Reparation Act of 1921. Any article is exempted "being a publication in the German language which is proved to the satisfaction of the commissioners of customs and excise to be a periodical publication of a German learned society, or other scientific or philosophical periodical publication."

UNIVERSITY AND EDUCATIONAL NOTES

PROFESSOR EDWARD H. ROCKWELL, after twenty years of service on the faculty of the Engineering School at Tufts College, has accepted a call to Rutgers College to be dean of the Engineering School.

ANNOUNCEMENT is made by the Rensselaer Polytechnic Institute that Professor Edwin A. Fessenden, of Pennsylvania State College, will become, at the beginning of the next collegiate year, professor and head of its department of mechanical engineering.

PROFESSOR HERBERT R. MOODY, for seventeen years connected with the department of chemistry of the College of the City of New York as professor of industrial chemistry and chemical engineering, has been appointed director of the department to fill the vacancy caused by the death of the late Professor Charles Baskerville.

DR. GEORGE DOCK has resigned his position as professor of medicine at Washington University Medical School, St. Louis.

AT Columbia University, Dr. James P. Southall, physics, and Dr. James Kendall, chemistry, have been promoted to professorships. Dr. Robert H. Bowen, zoology, Dr. Roy J. Colony, geology, Dr. John A. Northcott, mathematics, and Dr. Hugh Findlay, agriculture, have been promoted to assistant professorships.

PROMOTIONS in psychology and educational psychology at Columbia University are announced as follows: At Barnard College, Dr. H. L. Hollingworth to a full professorship; at Columbia University, Dr. A. T. Poffenberger to an associate professorship; at Teachers College, Dr. Arthur I. Gates, Dr. William A. McCall and Dr. Leta S. Hollingworth to associate professorships.

DR. EDWIN G. BORING and Dr. Herbert S. Langfeld have been appointed associate professors of psychology at Harvard University. Dr. Boring has since 1919 been professor of experimental psychology at Clark University. Dr. Langfeld has been promoted from an assistant professorship.

DISCUSSION AND CORRESPONDENCE

DECEREBRATION IN BIRDS

THE recent observations of Shaklee[1] on decerebrate pigeons serve to emphasize some features of the physiology of the central nervous system of special interest to workers in this line. The long period of survival—nearly twelve months—and the new features of decerebrate behavior recorded, again call attention to the possibilities of this method of experimentation as well as to some of the dangers of its interpretation.

The positive result of the return of the drinking reaction, not hitherto obtained in similar work, points to a greater flexibility in the neural mechanism than we have usually ascribed to it and falls into line with some of the newer conceptions that have been gaining foothold in the field of brain function. Whatever interpretation of the results may be made regarding the process by which such restoration of function is accomplished, everyone must be impressed by its extent and adaptative importance.

The differences between the present work and the results of Martin and Rich[2] to which Shaklee refers deserve a word of comment. Aside from the difference in species used, which may or may not have influenced the results, it should be emphasized that Martin and Rich operated on newly hatched chicks, thus excluding the influence of individual habit or experience prior to decerebration, while Shaklee used adult pigeons. Another factor is the distinctly longer period of survival in the pigeons.

The highly speculative interpretation placed upon these very interesting results may be passed over with the exception of one or two points. It seems surprising that, if the arc upon which the drinking reaction depends is of the deeply ingrained type postulated, it did not show activity for 32 days. In considering the feeding reaction the importance of taste seems strangely overstressed. A hard grain in the tip of the beak could give rise to very little more taste than do the bits of gravel which are also normally swallowed by birds.

The interpretation of work of this nature must be cautious. The facts of re-education (I use the term without implication as to the method by which restoration or substitution is accomplished) in man and animals show that many things can be done which are never normally done in the lives of the vast majority of the individuals or of their ancestors. As when storms damage telephone and telegraph lines, communication can be effectively established by routes never normally used, so in the nervous system possible and efficient arcs and

[1] *Am. Journ. Physiol.*, Vol. lv, p. 65, 1921.

[2] *Am. Journ. Physiol.*, Vol. xlvi, p. 396, 1918.

pathways may exist which are never normally traversed.

Only one explanation of the restoration of function is offered in the article under consideration, *i. e.,* that the subcortical arcs are the more primitive and are sufficiently retained in adult pigeons after decerebration to make possible the carrying out of normal drinking reactions.

Another explanation is also possible. Many writers have claimed that certain habits, arising in the first instance through activities involving the cortex, later are passed on completely to subcortical centers. As Herrick[3] points out, these acquired automatisms may so closely resemble inherited reflexes as to be indistinguishable in the absence of the history of their development. If it is here assumed that the drinking reaction established during the life of the pigeon is transferred in large part to subcortical structures, its retention after decerebration would seem to be expected, while in the case of the chick, decerebrated before such reactions were built up, no such appearance could be looked for. It might also be argued that the feeding reaction, being more complicated, was not so completely transferred from the cortical region as to be effective after decerebration.

That such an assumption may be justified is indicated by the work of Franz and Lashley[4], who found from numerous careful experiments with white rats that extensive cortical lesions did not usually affect the retention of most habits due to previous training, nor did they prevent the formation of new habits. The authors also report that in the cat and monkey where the frontal portion of the cortex is normally utilized in the formation of certain habits, these habits, if long practiced, are still carried out in the ordinary way after the ablation of the frontal cortex. This work as well as its continuation by Lashley[5] clearly shows that the classical picture of the decerebrate animal is in large measure erroneous and must be carefully revised and with it the entire conception of the physiology of the central nervous system. Any contribution to this promising and important field is to be welcomed.

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STANFORD UNIVERSITY,
CALIFORNIA

[3] *Introduction to Neurology,* 2d ed., p. 336.

[4] *Psychobiology,* Vol. 1, p. 71, 1917.

[5] *Psychobiology,* Vol. 2, p. 55, 1920.

THE BITE OF LACTRODECTUS MACTANS

IN SCIENCE for January 13, F. R. Welsh writes on "Poisonous Spiders." In regard to the "Black Widow," *Lactrodectus mactans,* he quotes Dr. McCook as of the opinion that the bite of this spider is "in most instances of small consequence." During the past two years the writer has had called to his attention four cases of attacks by this spider on human beings. These were all reported by practising physicians who sent in the spiders for identification. All four cases were those of men who were bitten on the penis while using outside closets. In every case the results were of a very serious nature. The patients suffered intense pain accompanied by severe abdominal disturbances, convulsions and delirium. In one case the abdominal pain was so intense and pronounced that the patient who had been sent to a hospital in a distant city was, upon arrival, promptly operated upon for appendicitis. The severe symptoms lasted from twenty-four hours in one man to over a week in the case of another. In a third case the physician reported four days after the patient had been bitten that he was "not yet out of danger." However all ultimately recovered. Two of these men were bitten the same day in the same closet and presumably by the same spider, indicating that the spider does not exhaust her venom by one bite.

These experiences would indicate that the bite of this species, at least when administered in a tender part of the body, is very serious, exceedingly painful, and even dangerous.

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UNIVERSITY OF FLORIDA

WATER-IMMERSION OBJECTIVES

I WISH to call the attention of those biologists who use the microscope to the value of the much neglected water-immersion objective. Its inferiority to the oil-immersion in the matter of numerical aperture, and consequently in power of resolution, has led many microscopists to lose sight of its peculiar advantages for certain kinds of work. The lower angular aperture obtainable with water contact as compared with cedar oil, is compensated for in several ways: first, it gives a longer working distance, due to the necessarily narrower angle of illumination,—a very important thing in high magnification. Second, it gives correspondingly better penetration of the object examined. Third, there is the ease with which both the slide (*i. e.,* the object) and the objective are cleaned. A bit of blotting-paper touched to the objective and the slide is all that is necessary and the mount is ready for further examination with lower magnification. But with an oil-immersion the oil must be first removed before a clear image can be had with lower powers, and this takes time and skill. In fact, if the mount is a temporary one and the cover-glass not held in place by a cement ring or hardened balsam, the cleaning is no job for a careless man. Fourth, where the mount is in water the water-immersion objective is free from the annoying habit of dragging the cover-glass over the specimen when the slide is moved,—a fault of the oil-immersion due to the greater viscosity of the oil connecting objective and cover-glass over that of the water connecting cover-glass and slide. In freshly studied marine mounts this is a big item. Finally the lower cost of the water-immersion objective is a factor well worth consideration.

It should be added, where oil contact between substage condenser and slide is omittted, a very frequent oversight with microscopists, the superiority of resolution of an oil-immersion objective, due to its greater N. A., is lost and the difference between it and a water-immersion disappears.

The only excuse for any immersion objective is that very high magnification and resolution are impracticable with dry objectives because of the working distance and the angle of illumination involved. For this reason it seems to me there is little excuse for immersion objectives below the one twelfth inch English scale or the 2 to 1.8 mm. standard scale.

Albert Mann

Carnegie Institution,
Washington, D. C.

QUOTATIONS

HEALTH ORGANIZATION OF THE LEAGUE OF NATIONS

An important branch of the work of the League of Nations is that of its health organization. The International Health Conference which was held in London in April, 1920, declared that the epidemic situation was menacing to all Europe, and that the task of fighting epidemics was beyond the strength of voluntary associations. The conference urged, therefore, that the task should be entrusted to the League of Nations as the only official international organization with sufficient authority and power to undertake the work. In accordance with this recommendation an Epidemics Commission was set up by the Council of the League, and since the end of 1920 this commission has cooperated with the Polish health authorities in their campaign against epidemics. The commission, at the head of which was Dr. Norman White, formerly sanitary commissioner with the government of India, had complete autonomy, but was responsible to the Council of the League. The funds placed at its disposal by the governments which are members of the league were not large enough to make possible an anti-epidemic campaign on the scale originally planned, so the commission began its work in Poland, and delivered to the Polish health authorities the motor transport, soap, clothing, medical stores, etc., most needed at the outset of the campaign; it also provided funds for the repair and equipment of bathing and disinfecting establishments, quarantine stations, and hospitals, and gave fifty complete fifty-bed hospital units. The work of this commission was the first experiment in international sanitary cooperation on a large scale, and it has been a success. Last autumn, however, the epidemic situation in Russia, and the consequent danger to her western neighbors, became greatly aggravated on account of the famine, and more drastic measures were found necessary to deal with the situation. An all-European anti-epidemic conference was therefore convened by Poland at Warsaw, with the approval of the Council of the League of Nations, and twenty-seven different nations took part. It was notable as being the first general

European conference in which Soviet Russia and Soviet Ukraine were represented. The conference drew up a general report of the situation, and the lines were laid down for a series of sanitary conventions, which are now being negotiated between the states of central and eastern Europe as a first defence against epidemics. Finally, the conference prepared a detailed plan for an anti-epidemic campaign in Russia and in the border states, and recommended that the conduct of this campaign should be entrusted to the League of Nations health organization and the epidemics commission. The conference requested the Council of the League to transmit its recommendations to the Genoa conference, on the ground that the latter was to deal with the economic reconstruction of Europe, and because an epidemic campaign in eastern Europe was in its opinion the indispensable preliminary to the work of economic reconstruction. It is hoped that the Genoa conference will dceide upon the measures to be taken with reference to the anti-epidemic campaign, and whether they shall be carried out by the health organization of the League of Nations. This health organization consists of, first, a committee appointed by the Council of the League, which acts as the executive body of the organization; second, the Office National d'Hygiène Publique in Paris, a body in existence before the war, which, though not a League organization, acts in close cooperation with the latter, and in practice serves as its general committee, drawing up draft conventions and laying down general lines of policy; third, a secretariat, which forms the health section of the Secretariat-general of the League. The epidemics commission—originally, as has been said, an independent body—is now also attached to the health section, and is therefore really a part of the health organization. An epidemiological intelligence service has been organized to keep the health authorities of all nations informed as to the incidence of epidemic diseases, and a monthly bulletin is being issued containing statistics and charts of the incidence all over the world of cholera, typhus, dysentery, small-pox, and other infectious diseases. Another branch of the work of the health organization was the conference held in London in December, 1921, on the standardization of serums and serological tests, when, as reported at the time, a program of inquiry and research was elaborated, to be carried out by the various laboratories and centralized in the Copenhagen Institute. The results will be examined at a forthcoming conference to be held at the Pasteur Institute in Paris.—*The British Medical Journal.*

SPECIAL ARTICLES

THE DOMESTIC FOWL AS A SOURCE OF IMMUNE HEMOLYTIC SERA

DURING the last three years we have obtained abundant evidence which refutes Citron's[1] claim that the chicken is one of the best adapted animals for the production of hemolytic sera. Citron gave no evidence to justify the inclusion of the domestic fowl among the species best adapted to produce hemolytic sera and so far as known to me, none exists. In point of fact, we find this animal one of the poorest hemolysin producers that has come within our experience.

It was known to Bordet[2], Sachs[3], Metchnikoff[4], and P. Müller[5] long before the appearance of Citron's book, that a difficulty was involved in demonstrating the sensitizer or amboceptor content of the serum of this animal[6], and Citron's unsupported claim should have been regarded with suspicion. In spite of this fact, the statement from Citron is still taken at its face value. Thus, Guyer and Smith[7] have recently made

[1] Citron, J., 1912, *Immunity.* Translation by A. L. Garbat.

[2] Bordet, J., 1899, "Agglutination et dissolution des globules rouges," *Ann. de l'Inst. Pasteur,* 13: 273.

[3] Sachs, Hans, 1902, *Berl. klin Wochen,* Nos. 9 and 10.

[4] Metchnikoff, E., 1907, *Immunity in infective Diseases,* Cambridge Press.

[5] Müller, P., 1901, *Uber Anti-hämolysine Centralbl. f. Bakt. u. Parasitenkunde,* 29: 175.

[6] Hyde, R. R., 1921, "The reactivation of the natural hemolytic antibody in chicken serum," *Am. J. Hygiene,* 1: 358-362.

[2] Guyer, M. F., and Smith, E. A., 1918, "Some prenatal effects of lens antibodies," *J. Exper. Zool.,* 26: 65-82.—1920, "Transmission of induced eye defects," *Ibid.,* 171-215.

use of it in support of their contention of having produced in the chicken a serum lytic for the eye lens of the rabbit, with which results of great biological significance were obtained.

The serum of chickens which had been treated with rabbit lens was injected into the circulation of pregnant rabbits. A few of the young of these rabbits had an eye defect which was passed on to succeeding generations. It was contended that the eye defect was in all probability due to the cytolytic action of the chicken serum since chickens are known to be good cytolysin (hemolysin) producers.

We have treated chickens with the red corpuscles from a number of animal species. In no case was any marked increase in the lytic properties of the serum from the treated birds evident. It was found in fact that fresh chicken serum renders rabbit corpuscles nonantigenic for guinea pigs, which accounts for the failure to produce any marked increase in the sensitizer content of the chicken.

In the light of our observation on the production of hemolysins in the chicken, it seems improbable that Guyer and Smith produced in this species a serum lytic for the eye lens of the rabbit. At least the conclusion that cytolysins must have been formed in the chickens treated with the rabbit lenses because of the readiness with which this species produces cytolytic sera, is not tenable.

ROSCOE R. HYDE

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

TUCSON MEETING OF THE SOUTHWESTERN DIVISION

THE second annual meeting of the Southwestern Division of the American Association for the Advancement of Science was held at the University of Arizona on Thursday, Friday and Saturday, January 26, 27 and 28, 1922. The meeting was opened by President A. E. Douglass in the chair, who, after a welcome and announcements, proceeded with the papers of the physical science section in open meeting. These were followed by biological papers in the afternoon. In the evening the president's address was given upon the subject, "Some aspects of the use of annual rings of trees in the study of climate." This meeting constituted the formal opening, with addresses of welcome from the acting mayor of Tucson, the president of the Chamber of Commerce, and the acting president of the university. These were responded to by Dr. E. C. Prentiss, the chairman of the executive committee of the Southwestern Division, who was followed by Dr. D. T. MacDougal, introducing the speaker of the evening. This address was followed by the reception to the visiting members given by the Faculty Club of the University of Arizona.

On Friday morning a special reception was given to Señor Ing. Ignacio Salas and his secretary, Señor H. Irigoyen, representatives of the minister of public works of the Mexican government. These guests were introduced by Dr. D. T. MacDougal, general secretary of the American Association. They responded by speeches in Spanish and in English.

The papers of Friday morning dealt with the social sciences, including history and archeology.

The biological papers were continued at 1:45 P.M., and at 2:45 Dr. Henry B. Ward, of the University of Illinois, gave a lecture entitled "The struggle between man and wild life in North America" before a joint meeting of the Sigma Xi Club of the University of Arizona with the Southwestern Division, to which also a special invitation had been extended to the Pima County Teachers' Institute then in session. This was followed by a trip about the campus of the university with visits to the observatory, engineering, physics and research exhibits, and the museum. In the evening Dr. Edgar L. Hewett of Santa Fe gave an illustrated lecture upon "Native American artists" to a joint meeting of the Arizona Archeological and Historical Society with the Southwestern Division. This was followed by a reception in the museum and an exhibit of wireless telephone.

On Saturday morning the three sections were in session simultaneously throughout the morning, except that at 11 o'clock a business meeting was held in which Dr. D. T. MacDougal was elected president of the division for the coming year, and Dr. A. E. Douglass was elected a member of the executive committee. A Yaqui Indian dance was presented in the Yaqui village near Tucson from 2 to 4 in the afternoon, followed by visits to the Desert Laboratory of the Carnegie Institution and to the Mission of San Xavier near Tucson.

The visiting members were entertained at lunch by the University of Arizona on Thursday in the new Maricopa Hall. They were also entertained at lunch on Friday by the Tucson Chamber of Commerce, at which the Mexican representatives and Dr. Ward were introduced and made addresses.

On Thursday evening a Sigma Xi banquet was held with Dr. Ward and the Mexican representatives as guests of honor.

The executive committee met each morning at 9 and held its final session on Saturday morning. Resolutions were passed in favor of the limitation of the use of radium in the form of radiolite. The next meeting was decided to be held in Santa Fe, New Mexico, September 11-14, 1922.

In arranging the program of this Tucson meeting the special effort was made to give to each section a certain amount of exclusive time during which its papers of widest interest could be presented. This was followed by simultaneous meetings of the sections at which the more technical papers were given, thus assuring abundant time for all papers. The program had been prepared by Dr. V. M. Slipher, chairman of the physical science section, Dr. C. T. Vorhies, chairman of the biological science section, and Dr. E. L. Hewett, chairman of the social science section in conjunction with the president.

On January 29 an ecological excursion was made to the Tucson mountains and lunch was served near the petrified trees, recently discovered by Dr. Sarle, of the University of Arizona.

ABSTRACTS

Chemistry

Flagstaffite, a new Arizona mineral, and its identity with terpin hydrate: F. N. GUILD. Dr. A. E. Douglass discovered on buried logs near Flagstaff, Arizona, a finely crystallized substance whose chemical and crystallographic analysis resulted in its determination as a new organic mineral with the formula $C_{10}H_{22}O_3$. This was named Flagstaffite. Afterwards a communication from Dr. Francis Dodge of Brooklyn led to the further conclusion that flagstaffite is identical with terpin hydrate, a substance easily synthesized in the laboratory, but hitherto never found occurring naturally. The author emphasizes the importance in chemical research of accurate crystallographic measurements, pointing out that in this case, the identity of flagstaffite with terpin hydrate was established largely through crystallographic data.

Demonstration of the Goldschmidt crystal model machine: F. N. GUILD.

The ionization of strong electrolytes in the light of recent theory: T. F. BUEHRER. The author sets forth that an explanation of the anomaly of strong electrolytes as evidenced by their failure to obey the Ostwald dilution law must be sought for in the arrangement of electrons within the molecule, according to the Lewis theory of molecular structure. It also demands a more rational definition of the idea of dissociation of an electrolyte. Various tables showing the activity-coefficients and ionization-constants of potassium chloride, a typically strong electrolyte, and acetic acid, a typically weak one, were given for illustration.

Critical solution temperatures of white phosphorus: T. F. BUEHRER. The theory of solubility worked out by Professor Hildebrand of the University of California is discussed and illustrated by a table, showing the varying conditions of solutions of white phosphorus in different substances.

The development of the tungsten lamp: PAUL CLOKE.

Some new beryllium alloys; their preparation and properties: M. G. FOWLER. Beryllium is a rare element and difficult to separate from Al. It resembles Al, but is lighter and has greater tensile strength. Experimenting on methods of preparation, it was first attempted to electrolyze beryllium into molten lead from fused BeF_2NaF; and then into mercury from an aqueous solution. In the first case, beryllium was found to be sparingly soluble in lead; and in the second case the amalgam was readily decomposed by water. However, since a pure alloy of beryllium was required, electrolysis was abandoned as unsuccessful. Then oxides of copper and beryllium were reduced in the electric furnace and an alloy containing considerable carbide was obtained, and a similar reduction of BeF_2 with an excess of magnesium produced an alloy of Be and Mg. This method promises more success. The intention is to study phase rule diagrams of alloys of beryllium with copper, aluminum, magnesium, cadmium and zinc.

The potential of the gold electrode: F. S. WARTMAN. The present values of the potential of the gold electrode—the measure of its tendency to pass from the metallic to the ionized condition—are found in error, due to the effects of variations in the physical form of the metal, temperatures and solutions of very soluble salts used by previous investigators. The present work undertakes to eliminate these sources of error by the measurement of the cells:

(1) Au, AuCl, KCl, (XM), AgCl, Ag.

(2) Au, AuCl, HCl (XM), H_2 (1 atom.)

The direct value obtained for the second cell will be checked by an indirect method which employs Cell (1). Cells employing Au_2O in KOH solution are also being measured.

A study of some unusual habits of wulfenite: F. S. Wartman. This paper briefly discussed an extremely flat third order pyramid found to be somewhat common on wulfenite crystals in the Southwest. It is characteristic, although its symbol varies from 1-7-75 to 1-7-98. Another unusual crystal having the prism faces well developed was also described.

A study of the catalytic effect of metallic copper upon the evolution of hydrogen from acids by base metals: Dorothy G. Andrews.

Geology

Sketch of the geology of the Dos Cabezas Mountains of southwestern Arizona: C. J. Sarle. The range is described as a homoclinal fault-block structure, dipping southwestward, with northwest-southeast trend, about 25 miles long, with greatest width midway of nearly 10 miles and maximum height of approximately 8,300 feet in the centrally situated twin peaks from which it takes its name. Residuary piedmont gravel slopes incline away from the range to the broad waste-filled Sulphur Springs valley on the southwest, and to the similar San Simon valley on the northeast. The Dos Cabezas range forms a common orogenic structure with the larger Chiricahuas to the south. The relations and character of the formations and structures reveal a history extending back, possibly to Archean time, and seem to show four periods of mountain making; two pre-Cambrian, and distinctly batholithic; one at the close of the Paleozoic, of marked warping, and possibly with faulting; and a fourth of marked volcanicity and profound faulting, with some batholithic intrusion. The last produced the present Dos Cabezas range. The first three were followed by planation and subsequent sedimentation. Tertiary erosion developed a rock pediment and piedmont gravel slopes, mature dissection extending to the heart of the range. In turn Pleistocene erosion deeply sculptured the piedmont area. The sedimentaries include a heavy, pre-Cambrian quartzite, Cambrian including an upper limestone member, Ordovician (Beekmantonian), Mississippian, Pennsylvanian, Comanchean (with marine leaf), Tertiary piedmont gravels and recent alluvials (fan and stream flat deposits). (Preliminary and with permission of the director of the Arizona Bureau of Mines).

Astronomy

The application of spectrum analysis to studies of the planets: V. M. Slipher. A discussion of the use of the spectroscope in studying rotation and motion of the plants and the constitution of their atmospheres. Evidence of water vapor in the atmosphere of Mars was presented.

Martian polar rifts: G. H. Hamilton. A discussion of rifts in the polar cap of Mars, observed during the successive oppositions of 1916, 1918 and 1920; and accompanied by lantern slides of drawings illustrating rifts. The belief was expressed that these rifts confirm Lowell's contention that there is vegetation on Mars, since it is assumed that they are caused by the heat given off from growing vegetation. This conclusion is drawn from the apparent similar condition produced on the earth by vegetation growing under the snow.

Methods used at the Lowell Observatory in studying Mars and other planets: E. C. Slipher. The technique of astronomical photography was explained. The necessity for enlarging the image, correcting for chromatism with the yellow filter, and using specially sensitized plates was pointed out. The speaker also discussed the time exposure necessary, which varies from one third of a second to 25 or 30 seconds. In closing, it was declared that if due allowance be made for the limitations of the two methods, each is useful as a check on the other.

Progress in photographic observations of nebulæ with the 40 inch Lowell reflector: C. O. Lampland. The modern telescope has increased greatly the number of stars and nebulæ, and dark nebulæ have also been identified. Among astronomers considerable difference of opinion exists as to the depth of our stellar galaxy, some placing its greatest diameter at 300,000 light years; others at about one fifth of that. It was pointed out that spiral nebulæ may be stellar systems—island universes—outside our own galaxy. Various arguments for and against the "Island Universe" theory were offered, among the former being the discovery by V. M. Slipher in 1912 of high space velocity and axial rotation. Yet, despite these high space velocities, their proper motion is very small. Also, their spectrum differs from the spectra of the stars in our system, it resembling the coalesced light of many stars at such great distances that the light of one star can not be distinguished from the others. An argument against the Island Universe theory was drawn from a series of photographs of a spiral nebula, taken over a space of five years and showing marked changes in the nebula from year to year. It was argued that changes in a whole universe so marked as to be plainly visible at such enormous distances, and occurring within the time space of five years, would be very extraordinary. A similar argument was found in the prominence of the central star in spirals.

A recording micrometer: A. E. DOUGLASS. A description and demonstration of a portable micrometer, which records its readings directly to scale on cross section paper. This instrument was developed in connection with researches on the rings of trees and their relation to climatic cycles, but can be used equally in telescopes.

The spectrum of the night sky and of the aurora of May 14, 1921: V. M. SLIPHER. In observations made by the author, the auroral line is easily determined in the spectrum of the night sky. It shows up at Flagstaff even on cloudy nights. Careful observations made there determined the wave length of the auroral line to be 55.78 instead of 55.71, the previously accepted value. This new value shows a further departure from any known substance than does the old. The auroral line shows in the spectrum, no matter what part of the heavens the camera is pointed at; it is, however, weakest near the zenith. Lord Rayleigh, the great English scientist, is now at work upon this problem of the auroral line in the spectrum, the object of this study being to gain additional information concerning the upper limits of the earth's atmosphere. The work of Dr. Stuerman, a Norwegian scientist, who has spent many years in the study of auroral phenomena, shows that most of the auroral streamers take place about 100 kilometers above the earth's surface, but some are as high as 500 kilometers. If we can learn what the auroral line corresponds to, our knowledge of the upper limits of the earth's atmosphere will be greatly increased. The author showed many photographs taken with a hand camera, of the remarkable auroral display of May 14, 1921, the most brilliant ever noted at the Lowell Observatory.

Observations on the magnetic storm of May 14, 1921: WILLIAM CULLOM. Mr. Cullom described briefly the U. S. Magnetic Observatory and the appliances used, noting especially the variometers which records the horizontal and vertical intensity of the earth's magnetic field. He discussed quiet days—or days of normal magnetic activity—and disturbed days—or days of magnetic disturbance; and exhibited a typical variometer record of each. He described how the great magnetic storm of May 14, 1921, was preceded by a violent preliminary disturbance and the storm proper was divided into three phases—one from 6 P. M., May 13, to 4 A. M., May 14; another from 3 P. M., May 14, to 2 A. M., May 16; and the third from 3 P. M., May 16, to 5 A. M., May 17. The two last were about equal in violence; the first was less violent than the other two.

Report of a daylight meteor seen in Prescott, Arizona: MILTON UPDEGRAFF. The author mentioned a report which reached him in the spring of 1921 of a meteor which passed over Prescott from the east to the west, and of such brilliancy that it was plainly visible about noon. He himself did not see it, but was told of it by several reliable people. Later reports reached him which led him to believe that the meteor struck in the neighborhood of the Harcuvar Mountains, in Mohave County, somewhat southwest of Prescott, and 30 or 40 miles from the California line. He mentioned the advisability of having a search made of that region, to try to find some traces of the meteor on the place where it struck.

Biological

The preservation of natural areas in the national forests: G. A. PEARSON. The writer was requested by the chairman of the Committee of Preservation of Natural Areas of the Ecological Society to list the areas of the national forests of Arizona and New Mexico where plant and animal life and natural features in general may remain undisturbed by human activities. Within these two states are 15 natural forests whose combined area is nearly 22 million acres. Under the existing methods of management it is interesting to consider whether the national forests will answer the requirements for "natural areas." The general policy governing the handling of national forests is that of highest use to the public. The primary purpose is the production of timber and associated with this is the utilization and development of grazing, agriculture, water, mining, recreation and other resources. One or two areas, even though of large size, would probably not represent a sufficient variety of conditions to satisfy foresters and botanists. Their needs could be met by selecting small supplementary areas of from 80 to 640 acres.

The relation of research to agriculture: D. W. WORKING. A reaffirmation of the necessity for research in agriculture looking toward increased production even at the present time when there seems to be an overproduction along many lines; but also, a plea that agricultural research workers broaden the field of their endeavor, and work out new methods of farm management and marketing, in order to enable farmers to dispose of their products more readily and at a fair profit.

A study of the grasses of Arizona: J. J. Thornber. This paper includes a study of the 260 species of grasses of Arizona with comparisons of the grass floras of New Mexico and Colorado. The grasses of northern and southern Arizona were compared in numbers, species and the origin of species, typical species of these two grass floras being noted. The grass flora of Arizona was stated to consist of 55 per cent. of southern and southwestern species, 25 per cent. of northern species and 20 per cent. of introduced species. The largest genera of grasses in Arizona in order of number of species are as follows: Muhlenbergia, 23; Panicum, 19; Bromus, 19; Bouteloua, 14; Sporobolus, 12; Aristida, 10.

Forces concerned in the enlargement of cells during growth: A new artificial cell: D. T. MacDougal. The protoplast in its earlier stages is a solid cylindrical or globoid mass of jellies. Enlargement or growth in this stage is by the addition of new material and its swelling by the imbibition of water, which constitutes growth by *accretion.* The formation of cavities or vacuoles in the protoplasm filled with substances which attract water sets up osmosis which pulls in additional water and causes a stretching or enlargement of the entire mass, which is designated as growth by *distension.* The protoplasmic mass was described as including all substances in the cell which may take the form of a reversible gel, that is, which liquefies or dissolves in water or by heat, and which sets or solidifies at low temperatures or on dehydration.

The course of growth of potato tubers: D. T. MacDougal. The growth of potato tubers has been followed in 22 examples measured at Carmel, California, by means of the auxograph. A diagram exhibited showed the course of enlargement of the tuber during its development which might cover a period of 60 to 80 days. The highest rate of enlargement of diameter of the tuber was in its earliest stages when it was less than one cm. in diameter. The highest rate of increase in volume, however, ensued at a much later stage, when the tuber had reached perhaps three fourths of its final size.

An ecological system of plant relationships: Edith Clements. This is an account of the application of ecological principles to the evolution of flowering plants, as exemplified in the Besseyan system. The evolutionary processes are assumed to be insect-pollination and wind-pollination, and to have brought about fundamentally similar results by divergent methods.

Changes of climate and life in the Southwest: Frederic E. Clements. A comprehensive attack upon the problems of climatic cycles in the Southwest has disclosed a large amount of evidence drawn from various sources. The most direct evidence has been obtained from weather records of rainfall, in following up the clue afforded by Douglass's studies of tree rings in this region. The operation of larger cycles is indicated in land-forms, such as shore-lines, bajadas and dunes, but is seen with especial clearness in vegetation. This is particularly true of the Mohave Desert and the Santa Cruz valley at Tucson, in both of which grassland communities exhibit cyclic changes in harmony with those found elsewhere in the West.

An improved form of the quadratograph: Gorm Loftfield. The Hill quadrat pantagraph has been greatly improved in the past year. These modifications are described, and the apparatus demonstrated. In addition, the present system of staking and photographing quadrats is discussed briefly.

Influence of texture on the limit for black alkali: C. N. Catlin. Wheat, barley, milo maize and hegari were grown in soil so compounded from actual field soils as to contain 0.20 per cent. sodium carbonate, the only variable being texture, which ranged from heavy clay to high sand. A table of weights of crops shows the maximum growth in the finer textured soils at this "black alkali" concentration.

The effect of intercultural practices on temperatures and humidity in citrus orchards: F. J. Crider. Comparative meteorological data obtained from adjoining cover-cropped and cleanly cultivated citrus orchards in the Salt River Valley of Arizona showed that the mean soil temperature of the cover-cropped orchard one foot below the surface was two degrees higher during winter and eight degrees lower during summer than the cleanly cultivated orchard. It was further shown that the mean minimum atmospheric temperature of the cover-cropped orchard was three degrees lower during winter, and the mean maximum atmospheric temperature seven degrees lower in summer than the cleanly cultivated orchard. Humidity and evaporation records revealed equally valuable data in that the humidity of the cover-cropped orchard for a period of six months was 12.44 per cent. greater and the evaporation 33 per cent. less than the cleanly cultivated orchard. These temperature, humidity and evaporation relationships have a distinct economic bearing in suggesting the avoidance of cover crops in citrus orchards during winter as a means of preventing cold injury, and in indicating the value of such crops in equalizing the environmental factors of the citrus plant.

Physical and chemical factors in the growth of asparagus: E. B. WORKING. Observations on the great asparagus plantations of the Sacramento islands were brought to bear on the particular problems being studied. Charts shown included growth curves illustrating particularly the relation of temperature to growth rate. Reactions to chemical environment, as indicated by hydrations under the MacDougal precision auxograph, were discussed.

Distribution of Arizona wild cotton (Thurberia thespesioides): H. C. HANSON. A summary of all information on distribution and abundance of the wild cotton and the wild boll weevil. Present knowledge shown to be inadequate. (Paper will be published as a bulletin of the Agricultural Experiment Station of the University of Arizona.)

The native wild cotton bollworm, Thurberiphaga catalina Dyar, and its relation to cotton cultivation: C. T. VORHIES. The Thurberia bollworm is the larva of a native noctuid moth, recently described, and known only in Arizona wild cotton, *Thurberia thespesioides.* In its larval stages it is a destructive bollworm of wild cotton. A study of its life history now in progress has shown that it can complete its larval life in the bolls of cultivated cotton and it is therefore a potential pest of that crop. Further observations will be made to determine its adaptability to field conditions of cultivated and irrigated land. Restriction of cotton cultivation to areas non-adjacent to wild cotton is a desirable precaution.

Some observations of alfalfa girdle: FREDERICK GIBSON. A disease of economic importance to alfalfa growers of the Southwest, which was first noticed and recorded in 1909, by Freeman and McCallum. No description of symptoms have been previously published. Osborn mentions a girdle of alfalfa, due to a Membracid (*Strictocephala sp.*). The complete paper with illustrations has been accepted by the Phytopathology publishers and will soon be distributed.

The use of cat tail (Typha latifolia) as a feed: L. E. FREUDENTHAL. In a feeding experiment with forty Duroc-Jersey pigs the writer demonstrated on his own farm that cat-tail (*Typha latifolia*) is a satisfactory feed. Its feed value, composition and possible economic importance are discussed.

Suppression of molds during the incubation of certain parasitic fungi: R. A. STUDHALTER. The suppression of molds during the incubation in a saturated atmosphere of certain parasitic fungi in vitro may be accomplished by treating with certain chemicals. Powdered sulphur, various concentrations of mercuric chloride, formaldehyde and copper sulphate, and the use of a dry atmosphere are effective during the incubation of *Pestalozzia sp.* on the needles of *Pinus radiata,* particularly if the chemicals are applied after one to four days of presoaking of the infected needles in water. In the controls the molds appeared to the unaided eye more than five days before the *Pestalozzia* tendrils were pushed through the ostioles; after the treatments mentioned, this advantage of the molds was reduced, the tendrils appearing after some of them from one to five days before the molds. The mycelial growth of the molds was also retarded to a greater extent than was the development of the *Pestalozzia.* No chemical or treatment was found which is able to suppress the molds without seriously hindering the proper development of *Lophodermium sp.* on the needles of *Pinus radiata,* in part probably because the open and more exposed fruiting body of this fungus permits the easy and rapid penetration of toxic agents.

An undescribed fungus on the pepper tree: J. G. BROWN. The pepper tree (*Schinus molle*) grown as an ornamental in the warmer parts of the Southwest, is attacked by a fungus which causes extensive rotting of the wood, eventually resulting in death. Symptoms are gradual death of the branches, or sudden death of the entire tree preceded by wilting. The latter symptom is likely to occur during the hot dry summer months. It is due to the growth of the mycelial hyphæ in the tracheæ. In the case of gradual death of the branches, sporophores appear on the trunk or on branches during the summer rainy season. The sporophores are bracket-like, brown to almost black, azonate, annual, and they usually have a maximum breadth of 12 to 15 cm. The pores are hexagonal to subcircular, occasionally elongate. The context is brown and is continued into the trama unchanged. Spores are light-brown, oval. The name *Inonotus Schini n. sp.* is proposed. The infection results from frost and wind storm injury and from improper pruning methods. Histological studies indicate that the fungus has few if any new features in connection with the development of the club and the basidiospores.

Some aspects of the use of the annual rings of trees in climatic study: A. E. Douglass. The ring is primarily a climatic effect. Surplus rings, which are rare, come from too great seasonal emphasis. Missing rings come mostly from excessive dryness of climate. These errors are readily located by comparing many trees together from the same region. The number of trees so far used is about 450 and the number of rings whose date of growth has been identified is over 100,000. The sequoias of California carry an excellent record for more than 3,200 years. The growth of dry climate trees depends on the topography which controls their water supply. Automatic measuring instruments and an analyzing instrument have been constructed. In dry climates the trees show variations which match the rainfall with remarkable exactness. In certain wet climates they show variation that corresponds to the solar activity as denoted by the number of sunspots. The sunspot cycle of 11 years is very common, together with its multiples, 22 and 33 years. The rings of trees are now giving us important information in the chronology of the prehistoric ruins of the Southwest.

The life history of a pine tree as read from a longitudinally bisected trunk: Forrest Shreve. A vigorous individual of *Pinus radiata* 38 years of age was felled and the trunk cut away so as to expose a median longitudinal section. Transverse sections were taken at intervals of one meter. The annual rings were then identified and dated in each cross section, using the longitudinal surfaces to confirm the dating. Measurements of the individual rings were made at each of the transverse sections, showing a very considerable irregularity in the thickness of the layer of wood laid on in any one year at different heights on the trunk. The period of most rapid growth in height and diameter was between the ages of 7 and 14 years and between the heights of 3 and 8 meters. There is a tendency for the growth in diameter to be greater toward the top of the tree than toward the base. There was a marked slackening in growth rate after the thirty-fourth year. Double rings of growth are frequently formed in a single year, due to the resumption of growth in the autumn, and they can usually be readily distinguished from the growth rings of successive years. The autumnal thickening also varies with height and is sometimes recognizable at certain heights and apparently absent at others. The results indicate that in *Pinus radiata* a true measure of the annual growth performances should be based on several cross sections at different heights and not on data from the stump section alone.

Effect of tree transpiration on the groundwater table: G. E. P. Smith. Some efforts made primarily to determine output of groundwater supply through transpiration seems to offer a new method of learning much concerning the quantity and character of transpiration of phreatophytes. Output method of measuring safe annual yield of groundwater useless without knowledge of transpiration of forests and botanical literature silent on this subject. Investigations began in 1916 but discontinued until 1921. Full year's record in 1921 in mesquite forest and in cottonwood forest. Well pits excavated in selected locations and equipped with water-stage recorders of two types. Movements of water table in winter very slight, but correlate closely with daily barometric cycle and with approach and departure of storms. Budding period shows little effect but, after leaves start, draught on groundwater very pronounced. Daily cycles in fair weather uniform, and of two parts—the daily transpiration curve and nocturnal recharge curve, with very little lag. Effects of cloudiness, rains, warm evenings and other conditions plainly marked. Transpiration from mesquite forest almost ceased in August due to disease of trees which caused defoliation, but became rapid again in October after growth of new leaves.

Changes in the composition of Salton Sea with an interpretation: A. E. Vinson. The series of annual analyses showed that $CaCO_3$ had not concentrated as rapidly as total solids. This loss took place as a deposition of tufa. Phosphorus practically disappeared from the water and an analysis of the tufa showed that this may have been deposited with the tufa. Potassium has not concentrated as rapidly as sodium but the potassium in the tufa would account for not over three per cent. of that lost. The conclusions drawn are that most of the potassium had been absorbed in the heavy mud deposits to be seen on the shores.

Medical

Observations on non-surgical drainage of the liver and gall-bladder: ELLIOTT C. PRENTISS. The emptying of the liver and gall-bladder by means of the duodenal tube, whose tip is at, or just below, the papilla duodenalis, after a solution of $MgSO_4$ has been injected into the duodenum, is the subject dealt with in this paper. The Refuss tip is used, as it is heavy enough to drag the tube to the pylorus after insertion into the stomach, and the openings in it are large and well placed. It is easily swallowed and requires an average of one to one and one half hours to pass into the duodenum. Condition of patient causes some variations in this time interval and passage in some cases is impossible. With tube in position run in 15 per cent. to 30 per cent. $MgSO_4$, using one ounce at a time, and allow to remain five minutes. Therapeutic results are satisfactory in conditions such as chronic cholecystitis even when gall stones are undoubtedly present. Valuable for treatment of gall-bladder infections—such infections as usually progress to formation of gall stones and other complications ultimately requiring operations. Thus, by repeated drainage of liver, cures are frequently obtained and many operations prevented.

The cause of hay fever in Arizona and the Southwest: DR. SAMUEL H. WATSON and DR. CHARLES S. KIBLER. This paper presents the results of the first research work ever done as to the cause of this disease in this section of the country—a complete list of all the plants which grow here, that can possibly cause the disease, is given, and the relative importance of the various plants as a cause is indicated.

Radium, its actions on human tissue cells: W. WARNER WATKINS. The discovery of, and developments in connection with, radium, represent one of the best illustrations of cooperative work of different branches of science. In these branches the applications of radium by the medical sciences is the most interesting. To understand radioactivity, the fundamental structure of the atom must be borne in mind and the phenomenon of ionization. Of the different particles discharged by disintegration of radium atoms, the alpha particle, which is a positively charged helium atom nucleus, has limited application in medicine, since its penetration into the tissues is so slight; the beta particle, which is a negatively charged electron, is usually filtered out when radium is used biologically, because the gamma ray, which is a very short wave light ray, is exceedingly penetrating, and ionizes the atoms of the tissue molecules, producing beta rays which are the real therapeutic rays in radium treatments. Radium may be used either to destroy foreign growths in the body tissue, or, by limiting its application, to stimulate the normal cells of glands of the body. This latter effect will, eventually, be the important field of application of radium.

The supply of radium: ARTHUR L. FLAGG. The principal sources of radium are from the ores of carnotite and pitchblende. The carnotite ores of the United States are the largest known deposits of uranium-bearing ores. The carnotite occurs in sandstone as grains or incrustations, usually in irregular lenticular masses which are mined by simple methods. The sorting of the ores entails much waste which can be eliminated with proper care. The total production of elemental radium in the United States since 1913 amounts to about 184.9 grams. Much of this has been exported and a too large amount used as an illuminant on cheap watches and other novelties of short useful life. Mesothorium is a valuable and practicable substitute for radium in making luminous paints and its use should be encouraged in order to conserve the radium for its more legitimate uses in therapeutics and in scientific research.

Archeology and Anthropology

Discovery of three skeletons of the Hohokam race in southern Arizona, a prehistoric desert people of the Southwest: C. J. SARLE. Three human skeletons were recently found near Tucson, buried face down, without reference to direction and without personal belongings, which seem from their associations to be referable to a prehistoric people designated Hohokam by Russell (1905). That the grounds for this reference may be understood the paper describes the culture of these ancient people, stating in substance that they were pueblo dwellers, agricultural, and weavers. The pueblos were built of clay and wattle and often included large community houses. This people cleared land and tilled the soil, wove, used edged stone implements, mainly eolithic in simplicity (little modified by secondary flaking), and were excellent potters, decorating their ware with colored designs which exhibit a high degree of artistic skill. They etched the numerous pictographs so common on rock surfaces near the village sites, and seem to have adhered closely to the practice of cremation, a fact that gives special interest to the skeletons described. Burial pots are seldom accompanied by personal effects. The published paper will contain a diagnosis of skeletons by some anthropologist. Dr. Edgar L. Hewett stated that the skulls were of cliff dweller type, and that the doliochocephalic shape had been disguised by pressure of the cradle board.

A prehistoric skull excavated near Tucson: Robert F. Gilder. The author described objects found in excavating prehistoric ruins west of St. Mary's Hospital, Tucson, Arizona. Special attention was called to a skull uncovered some five and a half feet beneath the surface, under a floor.

Orientation of prehistoric house outlines near Bear Canyon, Tucson, Arizona: H. B. Leonard and A. E. Douglass. The work was done in 1920-1921. Some five compounds were surveyed and plotted: notes, directions and levels taken. The longest walls point about a dozen degrees to the west of south. This work of mapping and surveying ruins in the southwest should be undertaken by more people with engineering skill. As the material is rapidly disappearing all possible notes should be made so that in the future students may substantiate any claims.

Yaqui ceremonial dances: Mrs. Phebe Bogan. About two miles northwest of Tucson, Arizona, there is a settlement of some two hundred Yaqui Indians who were driven from Sonora, Mexico, by the Indian wars following the overthrow of Madero in 1913. The ceremonial dances of these Indians, particularly those held during Easter or Holy week each spring since their settlement in this locality, furnishes the material for this paper. Lantern slides showing the dancers, their costumes, and the location of the dances were used to illustrate the talk.

Native American artists: Edgar L. Hewett.

Life forms in the pottery decoration of the Pueblo area: Kenneth M. Chapman. The decoration of ancient pueblo pottery is geometric in form, and this geometric treatment is also found in the drawing of life forms. Later types of Pueblo ware were developed in various areas within the Pueblo region. In some of these areas the decoration broke away from the limitations of geometric art. Life forms became more realistic, but were combined with a new and more varied symbolism. Following the Spanish invasion, there appeared a still greater diversity of decorative styles, until now each Pueblo community has its own distinctive decorative art in which various life forms still persist. Of all the life forms the bird predominates throughout this transition from ancient to modern.

Progress report in research in Jamez region: Wesley Bradfield. The beginning of a series of excavations and studies in the Jamez culture region in New Mexico was begun in 1921 by the School of American Research. The two sites chosen for the first more intensive study were Un-shagi and Guiusewa—four miles above, and at the site of the old Jamez Mission, near Jamez, Hot Springs. Work in the large burial place was described and tentative plans for the coming season's work. These sites are under the control of, or are owned by the School of American Research.

Some archeological studies in the neighborhood of Flagstaff: L. F. Brady. The occurrence of pottery fragments and other artifacts at depths varying from four to nearly twenty feet in undisturbed stratified alluvial at the north of Flagstaff, together with the presence of semi-fossilized stumps of yellow pine at similar depths, suggested a method for computing the date of the nearby "small-house" ruins in the neighborhood. The pottery fragments and other articles suggested an early stage in the development of the "small-house" culture, which is perhaps one of the earliest forms of the proto-pueblo culture of the Southwest. Much field work still remains to be done.

A half century of archeological research in the Southwest: Paul A. F. Walter.

History and Sociology

Pueblo land tenures in New Mexico and Arizona: R. E. Twitchell.

The arms conference at Washington: H. A. Hubbard.

Some sociological characteristics of the Southwest: Fred D. Merritt.

Beginning of representative government in New Mexico: Lansing B. Bloom. From Rome and Spain, New Mexico received the form of municipal government which she exercised from the founding of Santa Fe, about 1609, down to the American occupation in 1846. Under Spain also she elected deputies to the Cortes of 1810, 1820 and 1822-3. With the coming of Mexican independence, she chose deputies to Durango, Chihuahua, and for twenty-five years to the Congress in Mexico City. And during the same period deputies of her own election served in successive deputations of the territory. New Mexico had received the form of representative government from the outside, but, thrown almost entirely upon her own resources, she made these forms her own by adaptation and use.

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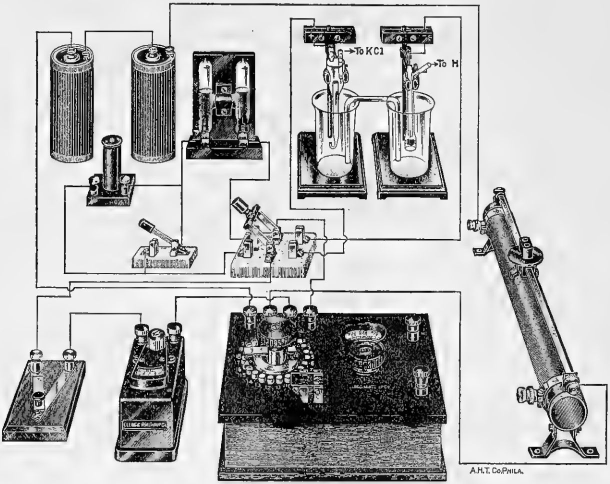

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CONTENTS

THE AIMS AND BOUNDARIES OF PHYSIOLOGY[1]

Physiology, as the passing generation has known it, took shape and established its boundaries in this country just fifty years ago, when, shaking off its long subordination to anatomy, it was brought to a new life of recognition and progress. The seventeenth century had seen England famous for her school of physiologists, leading the rest of the continent in experimental results and in new ideas. Working upon the foundations laid by Harvey, that brilliant group at Oxford—Boyle, Lower, Mayow, Willis—had brought new light to the study of the living body. Nor was their service only recognized by fellow-workers abroad or by those that came after. Their names and fame were on fashionable lips; like that of their predecessor Harvey himself, under Charles I, and of that other Cambridge philosopher Glisson, their immediate contemporary, their work was aided by the direct interest and favor of the sovereign. But, during the eighteenth century and the earlier part of the nineteenth, eclipse fell upon the light that had thus burned so brightly, though isolated gleams shone here and there. James Jurin, under George II, applied the Newtonian principles to calculating the work done by the heart and to other problems of the body, but his efforts to lay true and exact foundations for the study of disease were premature in the absence of experimental data. Stephen Hales, chaplain to the future George III, made the first measurements of blood pressure in his garden at Teddington, and made many far-reaching observations of the first importance; but, as he wrote, there was indeed "abundant room for many heads and hands to be employed in the work,

[1] From the address of the president of the Section of Physiology at the Edinburgh Meeting of the British Association for the Advancement of Science.

for the wonderful and secret operations of Nature are so involved and intricate, so far out of the reach of our senses . . ."; and it was not then or till much later that many heads and hands were ready to be employed. Neither of these men had effective influence upon the thought or practical affairs of their day, either within the universities or outside them.

Physiology, as we know it now in this country, took its shape in a new revival which may be reckoned as beginning half a century ago. All our chief schools may be said to derive their lineage from that new home of active and unshackled inquiry—I mean University College, in Gower Street, London—and from the influence there of an Edinburgh graduate, William Sharpey, who at the age of thirty-four was taken from the Edinburgh school to be professor of anatomy and physiology. Here, from 1836 to 1874, Sharpey was inspiring a group of younger minds with his eager outlook. Already in France the new experimental study of the living functions was being established by Claude Bernard—that true "father in our common science," as Foster later called him; already in Leipzig Ludwig, transmitting the impulse of Müller's earlier labors, had founded that school of physiology which moulded the development of the subject in Germany and other countries, and had very strong early influence upon several of those who were later to become leaders with us. England had lost the pre-eminence that Stuart kings at all events had valued and promoted. Learning had become identified in English society with the mimetic use of the dead languages, and progress at the two universities—even at the Cambridge of Newton, where mathematics kept independence of thought alive—was still impeded by the grip of ecclesiastical tradition and by sectarian privilege. But at University College learning had been unfettered. Here Sharpey and his colleagues were in touch with the best progress in France and Germany, and here the organized study of physiology as a true branch of university study may be said to have begun. Its formal separation from anatomy came later and irregularly; a separate chair of physiology was not created at University College until 1874, nor at Cambridge or at Oxford until 1883.

We ought in piety to recognize that this tardy reflection of continental progress in our own subject, like parallel movements in other subjects, had in its early stages received invaluable aid from the Prince Consort, who, familiar with the progress of other countries, had lent his influence and sympathy to many men of science in their struggle against the insularity and apathy of the wealthy and governing classes of the earlier Victorian days. The curious may take note that the first outward mark of recognition given by the official and influential world to the existence of physiology as such was given not, as in other and poorer countries much earlier, by the endowment of some chair or institute for research and teaching, but by an act of symbolic representation. For, when the expensive statuary of the Albert Memorial was completed in 1871, it was found that "Physiology," betokened by a female figure with a microscope, had been given its place among the primary divisions of learning and investigation acknowledged in that monument to the Prince.

From Sharpey himself and his personal influence we may trace directly onwards the development of all the chief British schools of physiology whose achievements have in the past half-century restored Britain to more than her old pride of place in this form of service to mankind. We here fittingly acknowledge first the close link with Sharpey which we find here to-day in Sir Edward Sharpey Schafer, who, after fruitful years in his old teacher's place at University College, brought that personal tradition back to this great school of Edinburgh from whence it originally came. At University College itself the line has been continued with undimmed lustre by Starling and Bayliss and their colleagues to the present day. From Sharpey's school again are derived the great branches which have sprung from it, both at Oxford and at Cambridge. Burdon Sanderson, Sharpey's immediate successor at University College, proceeded thence to Oxford and founded there, against many difficulties of prejudice and custom, the school of physiology which Gotch, Haldane, and Sherrington have nevertheless maintained so brilliantly in succeeding years. To Cambridge, Michael Foster, one of Sharpey's demonstrators, was invited in 1870 by Trinity College to be prælector in physiology and fellow of the college. This enlightened and then almost unprecedented act, no less than the personal qualities of Foster that so aboundingly justified it, I would, as in private duty bound, hold here in special remembrance. Under Foster's influence there came into being at Cambridge a strong and rapidly growing school of physiologists, from Langley, Gaskell, Sherrington, Hopkins, to numerous successors. There sprang from him, too, a new impetus to other subjects, through his pupils Francis Balfour and Adam Sedgwick to embryology and zoology, through Vines and Francis Darwin to botany, through Roy to pathology. From Foster again through Newell Martin, who, coming with him from London, had caught not only inspiration from him but some of his power of inspiring others, and who left Cambridge for a chair at Baltimore in 1876, we may derive a large part of the growth and direction of physiology since that time in the United States and in Canada. The rapid progress of all these biological sciences at Cambridge within a single generation, and the volume of original work poured forth depended, of course, upon two necessary conditions. The first is one which has never failed in this country—the existence of men fitted by temperament to advance knowledge by experiment. The second has been the supply of living necessities through the ancient endowments of the colleges, and these in the Cambridge of the last half-century have been freely and increasingly used in catholic spirit for the increase of any of the borders of knowledge.

If these have been the chief lines of descent along which our present heritage has come to us, as mind has influenced mind and the light has been passed from hand to hand, what has been the outcome as we look back over the half-century to those small beginnings?

Truly we can say that the workers in this country have in that short space of years laid the whole world under a heavy debt. In whatever direction we look we seem to see that in nearly all the great primary fields of psysiological knowledge the root ideas from which further growth is now springing are in great part British in origin, and based upon the work of British experimenters. If we consider the blood circulation we find that our essential ideas of the nature of the heart-beat were established by Gaskell, and that other first principles of its dynamics and of its regulation have been laid down by successors to him still with us; that the intricate nervous regulation of the arterial system has had its chief analyses here, and that here have been made more recently the first demonstrations of the part played by the minute capillary vessels in the regulation of the distribution and composition of the blood. Of the central nervous system the modern conceptions of function in terms of the purposive integration of diverse impulses along determined paths have sprung direct from British work, while the elementary analysis of the structure and functions of the sympathetic nervous system has been almost wholly British in idea and in detail. As with the nervous regulation of the body, so with the chemical regulation of function by traveling substances —the so-called "hormones," or stimulants from organ to organ—this, too, is a British conception enriched by numerous examples drawn from experimental work in this country. In the study of nutrition, of the primary "food-stuffs," proteins, carbohydrates, fats, salts and water, whose names in their supposedly secure sufficiency were written with his own hand by Foster upon the blackboard shown in his portrait by Mr. John Collier, to typify, as we may imagine, a basal physiological truth, we have come to learn that these alone are not sufficient for growth and life in the absence of minimal amounts of accessory unknown and unstable substances, the so-called "vitamins," which are derived from pre-existent living matter. This conception, undreamt of to the end of the nineteenth century, has fundamental value in medicine and in agriculture, and has already begun to bear a harvest of practical fruit of which the end can not be seen or the beneficence measured. This discovery stands to our national credit, and large parts of its development and application have been due to recent British work. If we turn to the regulation of respiration and its close adaptation to body needs, that also, as it is now known to the world, is known as British labors have revealed it, just as the finer analyses of the exchanges of gas between the air and the blood and between the blood and the body substance have been made with us. The actual modes by which oxygen is used by the tissues of the body, its special relations to muscular contraction, the chemical results of that contraction, the thermal laws which it obeys—all these fundamental problems of living matter have seen the most significant steps to their solution taken within the past generation in this country.

Work of this kind brings permanent enrichment to the intellectual life of mankind by giving new and fuller conceptions of the nature of the living organism. That we may think is its highest function; but it does more than this. Just as all gains in the knowledge of Nature bring increase of power, so these discoveries of the past fifty years have their place in the fixed foundations upon which alone the science and the arts of medicine now or in the future can be securely based. The special study of disease, its cure and prevention, has had notable triumphs here and elsewhere in the same half-century, and these as they come must make as a rule a more spectacular appeal to the onlooker. Yet it is the accumulating knowledge of the basal laws of life and of the living organism to which alone we can look for the sure establishment either of the study of disease or of the applied sciences of medicine. As we have seen, there are few indeed among the fields of inquiry in the whole range of physiology in which the British contributions to the common stock of ascertained knowledge or of fertile idea do not take a foremost place. It would be impiety not to honor, as it would be stupidity to ignore, these plain facts, which, indeed, are now perhaps more commonly admitted abroad than recognized at home. There is no occasion here for any spirit of national complacency—rather the reverse, indeed. British workers at no time earlier than the war have had the menial assistance or other resources which their colleagues in other countries have commonly commanded, and too often the secondary and relatively easy developments of pioneer work done in this country have fallen to well-equipped and well-served workers elsewhere. If in the past half-century better support had been available from public or private sources, or at the older universities from college endowments, it is impossible for any well-informed person to doubt that a more extended, if not a more diversified, harvest would have been won.

We stand too near to this remarkable epoch of progress to appraise it fairly. In the same span of years Nature has yielded many fresh secrets in the physical world under cross-examination by new devices which have themselves been lately won by patient waiting upon her. So great a revelation of physical truth has been lately made in this country, bringing conceptions of space and of matter so swiftly changing and extending, that our eyes are easily dimmed to the wonders of that other new world being unfolded to us in the exploration of the living organism. Only the lapse of time can resolve the true values of this or that direction of inquiry, if indeed there be any true calculus of "value" here at all. We seem to see in the progress of physiology, not at few but at many points, that we stand upon new paths just opening before us, which must certainly—as it seems—lead quickly to new light, to fuller vision, and to other paths beyond. The advances of the next half-century to come must far exceed and outshine those due to the efforts of the half-century just closing; that is probably the personal conviction of us all. Yet we may still believe that through all the history of mankind recognition will be given and honor be paid to the steps in knowledge which were made first and made securely in the period we now review. The men who have done this work will not take pride in it for themselves; they know that their strength has not been their own, but that of the beauty which attracted them, and of the discipline which they obeyed. They count themselves happy to have found their favored path. Other and more acute minds might have usurped their places and found greater happiness for themselves if, under a social ordering of another kind, they had been turned to the increase of knowledge instead of to the ephemeral, barren, or insoluble problems of convention and competition. By how much the realized progress towards truth and the power brought by truth might have been increased under a changed social organization we can never know, nor can we guess what acceleration the future may bring to it if more of the best minds are set free within the state for work of this highest kind, what riches may be added to intellectual life, or what fuller service may be given to the practical affairs of man and to the merciful work of medicine.

WALTER FLETCHER

TETRACHROMATIC VISION AND THE DEVELOPMENT THEORY OF COLOR

IT would seem to be time for the poor children in the kindergarten to be taught that the number of different "colors" in the spectrum (and in the whole world of natural objects as well) is not seven, nor six, but simply four —red, yellow, green and blue. We have been told lately by Dr. Jennings, in the *American Journal of Physiological Optics,* that the number is seven, and by U. S. Public Health Bulletin No. 92 (prepared by direction of the Surgeon General) that the number is six. The Milton Bradley Company, which furnishes countless delightful kindergarten objects for the children, follows the customary delusion that there are six. But every psychologist knows by this time, thanks to the life-long labors of Hering, that the number of different chromatic sensations (chromata) furnished by the spectrum, and by all of nature too, is four. No physicist, however, is as yet aware that there are more than three; I am in the habit of saying that the physicists are all psychically blind to both yellow and white, all save one, Professor Robert Wood, who in his *Physical Optics* explicity recognizes the existence of a "subjective" yellow. In course of time, no doubt, even the physicists will recognize the fact that *all* the color sensations are "subjective"—that there are no reds, greens, etc., in the extra-corporeal world, but that there are simply the erythrogenic, xanthogenic, chlorogenic and cyanogenic light rays—and that any ray-combination that looks white (as, for instance, a mixture of "yellow" and "blue" light) is a leucogenic combination and due to a "leuco-base."

The reason that led Newton to find seven colors in the spectrum was an æsthetic one—the spectrum is, counted in wave-lengths, about an octave long; in the music octave we recognize seven notes, so why not assign seven tones also to the color octave? In this way what was common knowledge in regard to the number of colors in the world from the time of Leonardo da Vinci became vitiated for a hundred and fifty years by an error which it is still hard to recover from. Hering, in opposition to Helmholtz, recognized that there are four chromatic sensations, but he too was led astray by a logico-aesthetic consideration; he thought it would be nice if, since red and green are, like blue and yellow, a "disappearing" color pair, they were also a white-constitutive color pair. So he said we will assume that they *are* a white-constitutive color pair, and to make the situation still more pleasing we will assume that black and white too are at least a disappearing color pair. But I have shown that when you take the exact red and green (or, in fact, anything near them) you get, on mixing, not white but yellow. My contention on this point has been accepted by Westphal, by v. Kries and others; the colors which are complementary, or white-constitutive, are, as Titchener, with a degree of honesty which is unusual in the followers of Hering, admits, not red and green, but crimson and verdigris,—in other words, white is here, as elsewhere, made out of red, green and *blue*.

Normal, mid-retinal, vision is tetrachromatic. It is to be hoped that we may sometime persuade the Milton Bradley people (whose red, green, yellow and blue papers are, as I have shown, very near to the exact, unitary, Red, Green, Yellow and Blue—I write these color-names with capitals when the colors are exact), and the United States government as well, that the *different* colors in the spectrum are four in number, and that if one adds to one's papers two of the dual color-blends, red-blue and red-yellow (the so-called purple and orange), one should add also the remaining dual color-blends, green-blue and green-yellow. (The fact that these last two color-blends have no misleading unitary names is so much to the good). Attention should be called at the same time to the curious fact that though you may easily have the *physical* conditions (the proper light-ray mixtures) for the two other possible dual color-blends (the red-greens and the yellow-blues), these are *sensations* that never occur—their places are taken, respectively, by yellow and by white.

I should like to mention that the color theory which I have proposed (the development color theory) is the only one in existence which holds together (the function of a theory), and makes reasonable, the three fundamental color-sensation facts (and the other, subsidiary, facts as well). These are:

A. The Helmholtz fact: the basis of color-vision is a *three-receptor* (chemical) process,—the "red," "green" and "blue" light-rays *are sufficient* (on mixing) to reproduce the whole gamut of the color sensations.

B. *Nevertheless* (the Hering fact) yellow and white are also unitary sensations and not any sort of sensational color blends, although they may be produced by physical light-ray mixtures. Hering thus corrects what I have called the psychical color-blindness (to yellow and to white) of the Helmholtz school, but at the cost of concealing from his followers all the facts which are mapped out in the Helmholtz triangle, or what the metallographers call when they make a diagram of their ternary alloys—a less frightening word perhaps—the "tri-axial diagram." The color-triangle, in other words, is nothing more than the representation of mixed color-constitution in terms of trilinear coordinates; what could be more natural when the variables which are both sufficient and indispensable are three in number?

C. Of equal importance is the fact of the order of phylogenetic development of the light-sensations (achromatic and chromatic). It is, in its three successive stages, as has been perfectly well made out, this:

(1) A white-sense only, achromatic vision (furnished by the more primitive retinal elements, the rods), which occurs (*a*) in the lower animals, such as lived, for instance, in carboniferous times (when colored flowers and colored birds did not yet exist)[1], (*b*) in those defective individuals who have achromatic vision only, and (*c*) in the far periphery of our own retina.

(2) Dichromatic vision—the spectrum is yellow at one end, blue at the other (but in place of what should be the yellow-blues appears white). This is the vision (*a*) of the bees (v. Frisch), (*b*) of the partially color-blind, and (*c*) of our own mid-periphery.

(3) Complete, tetrachromatic, color-vision,—the red and green sensations have been added; but where we have the *physical* conditions for seeing the red-greens, or the red-green-blues, *yellow* and *white*, respectively, take their places.

The theory of Helmholtz is (as Professor Cattell has well said) both pre-psychological and pre-evolutionary. That of Hering (besides being otherwise impossible) is pre-evolutionary: there is no question that red and green (which *revert* to yellow) are *developed out of* yellow. But worse than this—each of these theories is utterly contradictory to the facts which the other theory is expressly built up upon. This circumstance has not hitherto been sufficiently noticed; this Mr. Troland says ("The Enigma of Color Vision," American Optical Society, p. 8): "The Young-Helmholtz theory is preferred by physicists because it lays emphasis primarily upon the stimuli to vision, while the Hering theory receives more attention at the hands of the psychologists because its fundamental conceptions are derived from introspective analysis." This is true, but it is very far from being an adequate account of the situation. (1) The Young-Helmholtz school not only assumes but *proves* (not, as is often said, by means of the König-Dieterici spectral distribution curves by themselves, but by the complete coincidence of these curves with those, respectively, of the

[1] We have no means of knowing whether our own background sensation, the non-light sensation, that of blackness (which exists for the purpose of filling up our visual field), came in with the first, non-specific, light-sensations, or only later. There is some ground for thinking it arose later. I discuss this question in my coming article on "The Sensation of Blackness."

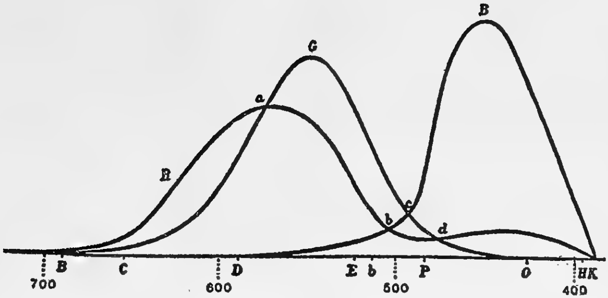

Fig. 1. *R*, *G*, and *B*, resonance curves. These are the curves of König and Dieterici corrected to new determinations of the points of section, *a*, *b*, *c*, *d*. Abscissæ, wave-lengths of the interference spectrum of the arc light; ordinates, arbitrary scale. (F. Exner.)

two types of yellow-and-blue vision)[2] that the number of "primary" colors is *three* and not four. (Fig. 1). This is fact. (2) The Hering school has only to ask for the most cursory examination of the gamut of color-sensations to show that the number of its different chromatic constituents is four, not three. This is fact. But the group of facts subsumed under (1)—the facts of "matching by mixture" (Fig. 2)—is absolutely incompatible with the theory of Hering,[3] and the group of facts subsumed under (2) is absolutely incompatible with the theory of Helmholtz. It is little to the credit of any association of scientists (for instance, the Optical Society of America) that they still solemnly discuss the theories of Helmholtz and of Hering. The situation is simple: each of these theories is absolutely refuted by the *facts* which are the groundwork of the other.

I have devised a simple diagram by means of which one can keep in mind the impossibility at once of the Helmholtz and of the Hering theory. Color diagrams are immensely more illuminating if they are done up in color.[4] But lacking that one can make shift with appropriately striated surfaces. I call this diagram my Quadrigeminal Color Body (a term suggested by the *corpora quadrigemina*), but it is at the same time triaxial. (The triangle should always be drawn with the YB line a horizontal (fundamental) line, as indicative of the fact that yellow and blue were developed first—that red and green were a later addition. (The actual spectral line approaches nearer to the point W in the green region on

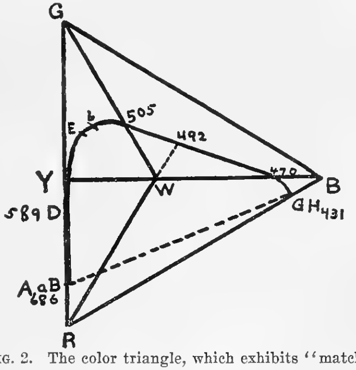

Fig. 2. The color triangle, which exhibits "matching by mixture."

[2] *Dictionary of Philosophy and Psychology*, Art Vision, II, 788.

[3] The attempt of v. Kries to supplement the Helmholtz theory by supposing that the three colors resolve themselves into four at a higher level of the visual nerve system is a purely *ad hoc* hypotheses, and without significance. See my articles on "The Theory of Color Theories," *Comptes rendus du VIe Congrès intern. de Psychologie*, Genève, 1909, and *Psychological Review*, May, 1922.

[4] Stoelting is putting on the market for me my complete set of colored color diagrams.

account of the fact that the three chroma[5] curves overlap here, as is represented in Figure 1).

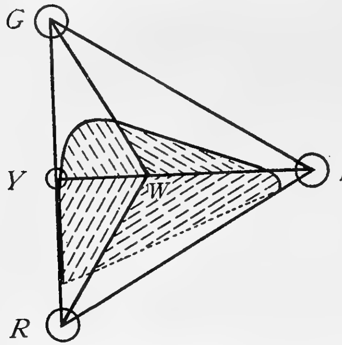

Fig. 3. The *quadrigeminal* color area—*triangular* in shape.

This figure illustrates the fact that while the color field is a function of three variables when you reproduce it by the mixing of specific lights, you no sooner look at it than you see that it consists of *four* distinct regions—the whitish yellow greens, the reddish bluish whites, etc. It suffices to upset at once the two "antiquated" (as they call them at the University of Chicago) current theories. I make the yellow circle small to indicate (*a*) that yellow occupies a very narrow region in the spectrum, (*b*) that it is the result of a secondary retinal process, and (*c*) that it has been for a hundred years invisible to the physicists. It is this color curve, representing facts and not imaginations (like the color-curves of Hering), which should, of course, always be drawn as the belt-section of the color-pyramid.

To meet the difficulties of these antiquated theories I have devised a theory (the development theory) "which takes into account both sets of fundamental facts which the other theories were respectively devised to explain," facts which do however in reality collectively refute them both. (You will not find even a picture of the color triangle in any of the writings of the followers of Hering). It is a perfectly simple theory (the theory of Hering is far from simple—see Parsons, p. 673), and it is wholly in line with the most recent conceptions of the chemists—Harkins, Bohr, Soddy, Rutherford (who are now engaged in working out the evolution of the atoms), Mathews, Willstäuer (chlorophyll and hæmoglobin, Bayliss, p. 252) and many others. This theory has been pronounced to be unobjectionable by the chemists, and it is now practically accepted by most of the psychologists.

The theory in brief is this:

There is probably no other organ in the body in which the record of development has been preserved in such a remarkable fashion as in the organ of vision. We have, *pari passu* with the successive stages of specificity of response to the visual spectrum, represented in Fig. 3,

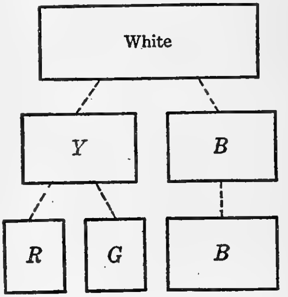

Fig. 4. Stages 1, 2 and 3 of the actual development of the color sense.

(1) an anatomical development of rods into cones, and (2) a chemical development of the rod-pigment sensitizer such that in man only there is an intermediate stage, the visual yellow, between the "visual purple" and the final leuco-base (König, Garten). What more natural than to suppose that there has been also a development of the light-sensitive receptor substance in the receptor organs (rods and cones) of the retina? This developing substance must, however, be at the same time of such a nature as to account for the singular fact (unknown in any other region of sense) that the colors successively developed are dis-

[5] I have been constantly urging, since 1913, the use of the word *chroma* (plural, *chromata*) to obviate the shocking ambiguity in the present meaning of "color."

appearing color pairs—they produce a more primitive white, or yellow (see above). If these facts are held distinctly in mind, the appropriate chemical conception almost forms itself. I represent, purely diagrammatically, of course (Burdon-Sanderson[6] especially noted this point when my theory first came out) that portion of a molecule which is capable of being dissociated out of light in the way indicated in Figure 4.

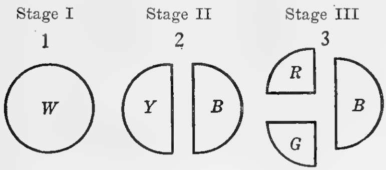

FIG. 5. The cleavage products in the three stages of the color sense. This diagram does not represent the entire light-sensitive molecule, but only the specific cleavage products which, according to the Ladd-Franklin theory, constitute the several nerve excitants for the color sensations (From Woodworth's *Psychology*). For other diagrams, see *Psychological Review*, 23: 247, 1916; *Zeitschrift f. Psychologie*, Bd. 6, etc.

The development required is that of a greater and greater *specificity* to the electro-magnetic vibrations of the visible spectrum. A portion of a molecule which at first is broken off indifferently by the whole spectrum becomes in a second stage more specific,—by a fresh aggregation of atoms a portion Y responds to the yellow end of the spectrum, a portion B to the blue end of the spectrum. But what happens when yellow and blue light fall at once on this chemical substance? The Y and the B (since they are the chemical constituents of W, because the assumption is that they were segregated out of it) will chemically unite and will produce W, the nerve-excitant of the sensation white. In the same way in the third, and latest, stage, the newly segregated R and G, when torn off from the molecule by light of low and of high middle frequency, will revert to the mother substance Y; and if light of high frequency, "blue," is now added, we shall again have the nerve-excitant of white. That is to say, just as when we have in a test-tube the chemical constituents of HCl (namely, H and Cl) they chemically unite, under proper conditions, and produce HCl, so in a cone we have

$$R + G = Y$$

$$Y + B \ (= R + G + B) = W$$

Observe that we have now, quite incidentally, explained how it happens that lights of only *three* specific, homogeneous wave-lengths ("red," "green" and "blue") are sufficient to reproduce the whole gamut of color sensations, including yellow and white, which the psysicists have never noticed the existence of.[7] Yellow is a secondary product, and so is white, but they are both perfectly good unitary sensations. The theory explains at the same time, of course, how it is that the primitive white mediated by the rods is the same sensation as the white made out of (in the highly developed cones) yellow and blue, or red and green and blue. There is no reason, of course, as Professor Carr has pointed out to me, why there should not be also some of the more primitive chemical substances in the cones of the central retina.

Since the interesting work of Hecht, it seems to be quite certain that the first effect of light on the retina is photo-chemical (which is, of course, the same thing as electrical). It is here, without question, that is found that "transformer mechanism," as I have called it, by which what should look to us like 165 *different* colors in the spectrum is replaced by a paltry four—the best that Nature could accomplish with only one small cone to work in. Five unitary colors (including white) and mixtures of them—the color blends—are all that we can see in the 30,000 *discriminable* sensations that are given us by light. It is nerve impulses produced by retinal chemical stimuli of the character which I have described (or of some other character) that mediate the processes which take part in the final "neuro-

[6] Presidential Address, British Association, *Nature*, Vol. 48, p. 469.

[7] Crowther, a prominent English physicist, actually says that the white produced by mixing homogeneous yellow and blue light-rays is not a "real" white—that, he thinks, *must* be a whole-spectrum white. Professor Titchener, on the other hand, has called my attention to the fact that on my view white is *always* (aside from the most primitive stage) due to a union of yellow and blue constituents.

psychic correlation"—a term which I have proposed as much preferable to psychophysical parallelism—in the domain of color.

In a recent discussion of my color theory (*Am. J. Physiol. Optics,* 1920-21) it is maintained that it would be more "advanced" to regard as of "prime importance" the cortical processes: "It appears to me that the Ladd-Franklin theory postulates the existence in the retina of conditions of sensation of the sort required for the processes in the cerebral cortex which directly underlie the visual consciousness, but which are not required and probably do not exist in the case of the retina." In reply to this it is only necessary to point out that if a "mechanism of defect" (such as would result in loss of consciousness for the red-greens and the yellow-blues) is found to occur in any part of the light-sensation chain (rods and cones, bipolar cells, third neurons, corpora quadrigemina, optic thalamus, cortex) that defect cannot be recovered from in any one of the later stations of the nerve impulse—if R and G have once reverted into Y, and Y and B into W, anywhere in the visual circuit, it is not necessary to provide for their doing it again in the cortex; on the other hand, if this defect has *not* happened lower down—if a separate "blue" and "yellow" have successfully reached the cortex—it is improbable that Nature, out of pure *Bösartigkeit,* should have introduced in the cortex a mechanism for their extinction.[8]

v. Kries has objected that in my theory it is not explained how the same sensation of whiteness should be mediated directly in the rods and in the more highly developed cones out of a physical mixture of red, green, and blue lights, but, as I have pointed out above, this is exactly what my theory does explain.

It has been called to my attention that several of the psychologists, while practically adopting my theory of color sensation, express the opinion that I have given no explanation of the sensation of black. But that is not the case; I have not, it is true, discussed black very frequently, and that, I believe, for two reasons. (1) It is very simple—it has no connections with any other of the color-sensations. The reason that color "theory" is so important, and has been so contended over, is that the facts of color (excluding black) are so very mysterious: why do we fail to see the yellow-blues and the red-greens, and why do we get, respectively, *white* and *yellow* in their place? Blackness stands by itself—it has no such queer relations with any of the other colors. Black and white, for instance, are *not* a disappearing color pair; they give us the series of black-whites, or greys. Black, being a sensation attached to zero stimulation—not a light sensation but a non-light sensation—is naturally (since zero has one value only) a sensation of only one degree of subjective intensity; the series of greys comes from changing the subjective intensity of their white constituent only. A blue-green of a given proportion of blueness and greenness we can see in dozens of different intensities; not so a grey. Give a certain grey a higher illumination and you change the quality as well as the brightness of your black-white blend. Professor G. E. Müller has dwelt upon this latter fact, but he has given a wrong interpretation of it; Wundt also, although his theory of color is negligible (and has been neglected), puts this situation correctly. It is easily accounted for on my theory.

A fuller account of the Development Theory of Color Sensation will be found in most of the recent books on psychology,—as Calkins, Judd, Angell, Breese, Watson, Warren and Woodworth. I have discussed it also in the *Psychological Review,* 23, 1916, and 29, 1922; in the *Am. Cyclop. of Ophthalmology,* 1913; in the *Dictionary of Philosophy and Psychology;* in *Mind,* 1892, 1893, and in SCIENCE, 22, pp. 18-19. In the last two places I have discussed its fundamental difference from the theory of Donders. My theory has been taken over by Schenck without due acknowledgment, as has been pointed out for me by v. Brücke (*Zentrlbl. f. Physiologie,* 1905). It has suffered from not having been criticised enough; some criticism of it by v. Kries and by Troland I have discussed very fully in *Practical Logic and Color Theories* (*Psychological Review,* May, 1922).

CHRISTINE LADD-FRANKLIN
COLUMBIA UNIVERSITY

[8] I discuss this point more fully in the *Psychological Review,* May, 1922.

SCIENTIFIC EVENTS

STATISTICS OF THE ALASKA FISHERIES FOR 1921

STATISTICS of the Alaska fisheries for 1921 have recently been completed and are summarized as follows: The total active investment in the fisheries was $39,001,874, a decrease of $31,984,347 from 1920. The industry gave employment to 15,070 persons, or 12,412 less than in 1920. The products of the fisheries were valued at $24,086,867, a decline of $17,405,257. The pack of canned salmon in 1921 was 2,596,826 cases, a decrease of 1,832,637 cases, or approximately 41 per cent. Southeast Alaska produced 803,071 cases, a decrease of almost 65 per cent. from the pack in 1920. In central Alaska the production was 643,099 cases, a decrease of almost 52 per cent. In western Alaska the pack was 1,150,656, an increase over 1920 of 283,652 cases, or over 32 per cent. The total value of canned salmon was $19,632,744. Other products of the salmon fisheries were mild-cured, pickled, fresh, frozen, and dried and smoked salmon, which had an aggregate value of $1,335,818. Salmon by-products, consisting of oil and fertilizer, were valued at $18,022. The total catch of salmon in Alaska in 1921 was 37,905,591 fish, as compared with 65,080,539 in 1920, a decrease of approximately 41 per cent.

The number of salmon canneries operated in 1921 was 83, or 63 less than in 1920. Of this number the southeastern district was credited with 30 (decrease of 52), the central district with 25 (decrease of 11), and western Alaska with 28 (the same as in 1920). Comparisons of figures as to gear used are as follows: 180 traps, of which 127 were driven and 53 floating, were used in 1921, a decrease of 318 driven and 155 floating traps from 1920. Seins decreased from 712 to 213, representing a reduction of 82,048 fathoms of webbing. The total length of gill nets was 375,320 fathoms, a decrease of 85,627 from 1920.

Values of products of the other fisheries were as follows: Halibut, $1,476,450; herring, $934,044; cod, $457,320; shrimps, $132,077; crabs, $33,180; whales, $19,950; trout, $18,925; sablefish, $17,985; clams, $9,940; red rockfish, $362; and smelts, $50.

FELLOWSHIPS OF THE NATIONAL RESEARCH COUNCIL

The National Research Council announces for the next academic year a number of fellowships for fundamental investigations on agricultural applications of sulphur. The funds for the fellowships have been provided by a grant from the Texas Gulf Sulphur Company.

These fellowships, each carrying an annual stipend of approximately $1,000, will be administered by a special sulphur fellowship committee of the advisory board of the American Society of Agronomy, in conference with the executive committee of the division of biology and agriculture of the National Research Council. Inquiries and appplications should be addressed to the Sulphur Fellowship Committee, National Research Council, Washington, D. C.

It is proposed that the work to be prosecuted under these fellowships will include investigations on the value of sulphur in the control of potato scab, nematodes, soil insects and sweet potato disease; also the value of sulphur as a fertilizer for alfalfa and other legumes and the effect of sulphur on alkali soils.

Applicants for the fellowships must be graduate students in universities and colleges or competent members of experiment station staffs. Fellows are expected to devote practically their entire time to the investigations, excepting only such course work as may be necessary to meet the requirements for an advanced degree. While no definite assurance can be given, it is expected that support for the fellowships will be extended from year to year for a period as the results may warrant.

In order to prevent possible confusion, it is pointed out that these fellowships are entirely distinct from the two sulphur fellowships recently announced (SCIENCE, March 24) by the Crop Protection Institute and administered by it in cooperation with the National Research Council.

REVIEW OF APPLIED MYCOLOGY

THE Imperial Bureau of Mycology has undertaken the publication of a monthly abstracting journal, the *Review of Applied Mycology,* for the purpose of supplying, month by month, a summary of the work published in all countries on the diseases of plants and various other aspects of economic mycology. The first number was issued in January, and it is hoped to complete a volume of between four and five hundred pages annually. The announcement says:

Mycologists and plant pathologists often find it difficult to keep themselves informed of the progress of work in other countries. The publications in which an account of current work is given are very numerous and are scattered through a large number of journals, many of which only occasionally contain an article of interest. There are few, if any, libraries in which all these publications can be found, while the working mycologists in the overseas part of the British Empire often have access to only a small proportion of them. The committee of the Imperial Bureau of Mycology has accordingly felt that it is desirable to start the publication of a compact yet comprehensive survey of current literature dealing with the various aspects of applied mycology, on the lines of the *Review of Applied Entomology* published by the Imperial Bureau of Entomology in London. While *Botanical Abstracts* remains the only journal that aims at giving a complete citation of the literature in all branches of botanical science, the present *Review* will be specially directed to supplying to workers with restricted library facilities, sufficiently full abstracts of papers on the diseases of tropical crops and other similar matters of interest to mycologists in the overseas parts of the British Empire to enable them to keep informed of the progress of current work.

Though the chief object of the new journal is to give an up-to-date summary of work bearing on the practical application of the study of plant diseases to the reduction of the wastage due to such diseases in agriculture, the fundamental researches on which most progress in this direction is based have a wider appeal. The *Review* will enable all those who are interested in the progress of science to follow the development of one of its younger branches; the student of pure science will, it is hoped, find many side-lights on the wider problems on which he is engaged; while the practical grower will be able to learn the experience in other countries with improved methods for controlling plant diseases.

Subscriptions, orders and all communications respecting the publication should be sent to the editor, Imperial Bureau of Mycology, Kew, Surrey, England.

THE PUBLICATION OF SCIENTIFIC PAPERS

In view of its general interest to contributors to scientific journals, we are permitted to print the following letter addressed by Professor Ross G. Harrison, of Yale University, managing editor of the *Journal of Experimental Zoology*, to its contributors:

Owing to the high cost of printing and the consequent large deficit incurred in the publication of its journals, the Wistar Institute has notified the editorial board of the *Journal of Experimental Zoology* that, unless financial support is forthcoming, it will not be possible to print during the present year more than two volumes or one thousands pages of the *Journal*, instead of the three volumes of five hundred pages each published in 1921. Since the war material for publication has been coming in at a rapidly increasing rate, so that there is now on hand more than sufficient to fill the two volumes to be issued this year. This means that, under present conditions, manuscripts now received can not appear much earlier than eighteen months from date. It is hoped that before long conditions in the printing trade will become more favorable or that some method of financing the deficit may be devised. In the meantime, the editorial board find it necessary to ask your cooperation in meeting the present difficulties. This can best be done by making papers as concise as possible, by using the simplest form of illustration—such as can be reproduced by zinc engraving, by omitting tables as far as is consistent with clearness, and by avoiding duplication in publication.

The editors do not wish to set any arbitrary limit to the length of papers that can be accepted; for some are concise at fifty pages and others verbose at five. A colored plate may be a necessity in some instances and a useless expense in others. It is felt, however, that almost every paper would be improved by judicious pruning, and the authors, as the best qualified persons to do this, are asked to undertake the task. It is scarcely to be expected that even the utmost self restraint on the part of contributors will entirely meet the exigencies of the situation, so that the editors will probably have to exercise their judgment as regards the space that can be allotted to each paper submitted. Nevertheless, if contributors are willing to undertake drastic measures themselves, it will frequently spare the editorial board the necessity of declining papers which, under other circumstances, they would like to accept, and it will serve the greatest good to the greatest number by giving every one a fair share in the use of our present limited facilities for publication.

THE GRANTS FOR RESEARCH OF THE NATIONAL ACADEMY OF SCIENCES

PROGRESS has been reported as follows on grants made by the National Academy of Sciences:

BACHE FUND

The researches of Carl H. Eigenmann, for which grants 214 and 220 were made, have been published in the *Memoirs of the Museum of Comparative Zoology*, Vol. 43, Parts 1 and 2, and in the *Proceedings of the American Philosophical Society*, the *Journal of the Washington Academy of Sciences*, and the Indiana "University Studies." The research on fishes of the upper Amazon basin and Lake Titicaca is still in progress.

A preliminary paper on the work of H. W. Norris on cranial nerves of amia and lepidosteus will be published shortly in the *Proceedings* of the Iowa Academy of Science.

Star counts have been made by H. Nort, of Gouda, Holland, for more charts of the southern hemisphere. Additional counts have been made to find distance correction for the Franklin Adams charts. Formulæ have been derived to compute the equatorial coordinates of the fields counted from the declination and the R.A. of the center of the plate and the focal length of the telescope used. The limiting magnitude for ten additional charts of the northern hemisphere has been derived.

Preliminary results of the research of J. C. Jensen, grant No. 218, have been published in the *Proceedings* of the Nebraska Academy of Science for 1919.

Results of the research of H. G. Barbour, of McGill University, grant No. 219, have been published in the *Proceedings* for Experimental Biology and Medicine, 1920; *The Journal of Pharmacology and Experimental Therapeutics*, 1921; and *The American Journal of Physiology*, 1921.

Preliminary results of the research of T. H. Goodspeed, of the University of California, grant No. 224, have been published in the University of California Publications in Botany, Vol. 5.

SMITH FUND

There was issued in 1921 as a publication of the Leander McCormick Observatory of the University of the University of Virginia, "349 parabolic orbits of meteor streams and other results," by Charles P. Olivier, a discussion of 22,000 observations of meteors made by members of the American Meteor Society. It is a comprehensive report of results of an investigation which has been aided by several grants from the J. Lawrence Smith Fund at various times since 1913 to Professor S. A. Mitchell, director of the McCormick Observatory, under whose supervision the work has been done.

SCIENTIFIC NOTES AND NEWS

DR. E. A. DE SCHWEINITZ, professor of ophthalmology at the University of Pennsylvania, gave the presidential address at the opening session of the American Medical Association held at St. Louis on May 23.

DR. E. W. RICE, JR., has been elected honorary chairman of the board of directors of the General Electric Company. He will devote his time particularly to the supervision of the scientific, engineering and technical work of the company in this country and abroad.

DR. ROSS AIKEN GORTNER, professor of agricultural biochemistry at the University of Minnesota, has been elected to the office of national president of Phi Lambda Upsilon, the honorary chemical society. He succeeds Dr. Harold A. Fales, of Columbia University.

THE annual meeting of the Iron and Steel Institute, under the presidency of Mr. Francis Samuelson, was held on May 4 and 5 at the house of the institution. The Bessemer Medal was presented to Professor Kotaro Honda.

DR. MURK JANSEN, of Leyden, has received the Umberto I prize awarded every five years by the province of Bologna for the best work or discovery in orthopedics.

AT the recent annual meeting of the American Academy of Arts and Sciences the election of the following fellows and foreign honorary members was reported by the council: Class I. The Mathematical and Physical Sciences: Walter Sydney Adams, Pasadena; Gano Dunn, New York; Thomas Alva Edison, Orange, N. J.; Edwin Crawford Kemble, Cambridge; Richard Chase Tolman, Washington; Arthur Stanley Eddington, Cambridge, England. Class II.

The Natural and Physiological Sciences: Nathan Banks, Cambridge; Thorne Martin Carpenter, Boston; Stanley Cobb, Canton, Mass.; Joseph Lincoln Goodale, Boston; Robert Williamson Lovett, Boston; Alfred Clarence Redfield, Boston; Austin Flint Rogers, Palo Alto; William Henry Weston, Jr., Cambridge; Sir Thomas Clifford Allbutt, Cambridge, England; Emmanuel De Margerie, Strasbourg, France. Class III. The Moral and Political Sciences: Edward Channing, George La Piana, William McDougall, Arthur Kingsley Porter, Paul Joseph Sachs, Charles Henry Conrad Wright, all of Cambridge; Henri Pirenne, Ghent, Belgium.

At the recent annual meeting of the members of the Royal Institution, London, the report of the board of visitors was presented and showed that last year 57 new members were elected while 38 were lost by death. The total membership in July last was 826 against 831 in the same month of the previous year. The result of the ballot for new officers was as follows: President, The Duke of Northumberland; treasurer, Sir James Crichton-Browne; secretary, Colonel E. H. Grove-Hills.

Dr. Ludwik Silberstein, mathematical physicist at the Research Laboratory of the Eastman Kodak Company, has been appointed an associate editor of the Journal of the Optical Society of America.

Dr. Paul M. Giesy, formerly with the Calco Chemical Company, has become research chemist with E. R. Squibb & Sons at their Brooklyn, N. Y. plant.

A. W. Hickman retired on March 31 from the United States Bureau of Animal Industry after thirty-four years of service. For the last fifteen years he was chief of the Quarantine Division.

Dr. Donald D. Van Slyke, member of the Rockefeller Institute for Medical Research, has accepted an appointment as visiting professor in biological chemistry at the Peking Union Medical College for four months, beginning with the fall term of the next academic year. Dr. Harry R. Slack, of the Johns Hopkins Medical School, will be visiting professor in oto-laryngology at the college for the academic year 1922-23.

Dr. Ernest Fox Nichols, who has been in Honolulu, returned on May 15 to his work as director of pure science in the Nela Park Research Laboratory of the National Electric Lamp Works at Cleveland.

Dr. Ruth Marshall, professor of zoology in Rockford College, will make an extended trip to Alaska this summer, visiting the Atlin Lake region, Cordova and Katchikan. She will collect water mites in these regions. Miss Patsy Hughes Lupo, associate professor of botany, will sail from Seattle to Nome on June 1, and will spend the summer in the interior, studying and collecting algæ and fungi.

Dr. Eloise Gerry, microscopist in the office of wood technology at the Forest Products Laboratory, left on May 20 for a field trip through Georgia, Florida and Louisiana. It is her purpose to make experiments and investigations that will assist in developing better methods of obtaining turpentine and rosin from living pine trees. Miss Gerry will work in coöperation with Mr. Austin Cary, of the Washington Office of the Forest Service, and Mr. Lenthal Wyman, of the Southern Experiment Station, members of the Florida National Forest organization and local timber owners.

Dr. Ross Aiken Gortner, professor of agricultural biochemistry at the University of Minnesota and national president of the honorary chemical society, Phi Lambda Upsilon, recently lectured at the Armour Institute of Technology and the University of Wisconsin on "The Colloid Chemistry of Wheat and Flour," and at the University of Michigan, Ohio State University and Purdue University on "Vital Phenomena as Colloid Processes." Both lectures were given at the University of Illinois.

Dr. C. E. K. Mees, director of the Research Laboratories of the Eastman Kodak Company, gave a lecture entitled "A photographic research laboratory" before the Northeastern Section of the American Chemical Society on May 12.

Professor E. Mellanby delivered the Oliver Sharpey lectures at the Royal College of Physicians of London on May 2 and 4, on "Some common defects of diet and their pathological signficance."

ON May 11, Professor F. Keeble delivered the first of two lectures at the Royal Institute on "Plant sensitiveness;" and on May 13, Professor O. W. Richardson began a course of two lectures on "The disappearing gap between the X-ray and the ultraviolet spectra." The Friday evening discourse on May 12 was delivered by Dr. H. H. Dale on "The search for specific remedies."

AMONG five busts unveiled in the Hall of Fame for Great Americans at New York University on May 20 was one of Maria Mitchell, the gift of her nephew, William Mitchell Kendall, and the work of Emma S. Brigham. President Henry Noble McCracken, of Vassar College, where Miss Mitchell was professor of astronomy from 1865 to 1888, unveiled the bust.

HENRY MARION HOWE, professor-emeritus of metallurgy in Columbia University, died on May 14 at his home in Bedford Hills, N. Y., in the seventy-fifth year of his age.

DR. JOHN SANDFORD SHEARER, professor of physics at Cornell University since 1910, died on May 18 at the age of sixty-six years.

GEORGE SIMONDS BOULGER, the well known English writer on botany, died on May 4, at the age of fifty-nine years.

SIR ALFRED BRAY KEMPE, president of the London Mathematical Society in 1894, for many years treasurer of the Royal Society, died on April 27, at the age of seventy-three years.

C. L. A. LAVERAN, professor at the Pasteur Institute, Paris, died on May 18, at the age of seventy-seven years. Dr. Laveran, then a French army surgeon serving in Algeria, discovered the parasite of malaria in 1880. He received the Nobel prize for medicine in 1907.

ATHERTON KINSLEY DUNBAR, of Cambridge, fellow for research in cryogenic engineering at Harvard, and William Connell of Cambridge, a carpenter, were instantly killed on May 20, by the explosion of a tank of liquid oxygen in the basement of the Jefferson Physical Laboratory.

SIR CHARLES PARSONS, F.R.S., has conveyed to the trustees of the British Association for the Advancement of Science a gift of £10,000 five per cent. war loan stock, which he has placed unreservedly at the disposal of the council. The London Times writes: "This generous gift comes at an opportune time, as the finances of the association have, like those of other institutions, suffered depletion during the past seven years, and there was a danger that the activities of an association which has rendered notable services to science in the past might suffer restriction. The total grants in aid of research made by the association since its foundation in 1831 exceed £83,000."

THE International Congress of Ophthalmology met in Washington on April 25 and 26. The congress was greeted by Vice-president Coolidge. During the first session, Dr. William H. Wilmer, of Washington, presided. Representatives of many foreign countries attended the meetings. The following officers were elected: *President,* George E. de Schweinitz, Philadelphia, and *secretary,* Luther C. Peter, Philadelphia.

THE Rockefeller Foundation has offered to Indian medical graduates, selected by the scientific board of the Indian Research Fund, five scholarships of $1,000 each, for the purpose of graduate public health work in America.

THE Royal Academy of Belgium has established a prize of 1,000 francs, which will be awarded biennially, under the name of the Prix O. van Ertborn, for the best work on geology.

UNIVERSITY AND EDUCATIONAL NOTES

UNDER the will of the late Mr. Henry Musgrave sums amounting to £57,000 have been bequeathed to Queen's University, Belfast. A Musgrave Research Studentship will be established.

A CONFERENCE of Representatives of the Universities of the United Kingdom was held on May 13 in the Botanical Theater, University College, London. The subjects for discussion were the urgent need for the provision of enlarged opportunities for advanced study and research; the increase of residential accommodation for undergraduate and other students; specialization in certain subjects of study by certain universities; and the organization of adult education as an integral part of the work of the universities.

Dr. David P. Barrows, president of the University of California, on May 16 presented his resignation as president.

Dr. George P. Cutten, president of Acadia University, Nova Scotia, has been elected president of Colgate University at Hamilton, N. Y.

Dr. Alan Mara Bateman has been appointed associate professor of economic geology at Yale University, with assignment to the Sheffield Scientific School.

DISCUSSION AND CORRESPONDENCE

THE CYTOLOGY OF VEGETABLE CRYSTALS

The title of this note involves, especially to those of mechanistic outlook, an apparent contradiction in terms. It is very generally asserted that crystals of calcium oxalate, the commonest type found in plants, are formed by the ordinary processes of crystalization in the fluid of the cell sap, occupying the vacuolated center of the mature vegetable cell. It is the intention of the present preliminary statement to call attention to the fact that this description of the mode of formation of vegetable crystals is in all respects profoundly inaccurate. The commonest type of crystal of calcium oxalate is the compound crystal or druse which prevails from the Ginkgoales to the Angiospermæ. The most favorable object for study is Ginkgo. Longitudinal and transverse sections through the mature tissues as well as through the growing points show the presence of druses in great numbers, and often of large size, particularly in the pith, cortex, and phloem. In spite of the presence of such crystals, sections as thin as five micromillimeters can easily be cut off the tissues. When these are stained and mounted the crystals stand out with particular clearness as occupying practically the entire lumen of the cell.

When measures are taken to remove the calcium oxalate by the use of solvents, the presence of an organic matrix in the crystals becomes obvious, as a residuum maintaining the form of the crystals after the lime compound itself has disappeared. If sections are made in proximity to the growing point, a very interesting situation becomes apparent. The cells in this region are densely filled with protoplasm and those which are to produce crystals are easily recognized from the first. They contain, as do other young cells, a central nucleus and it is obvious in demineralized sections that the crystals are laid down about the nucleus, when the protoplasm of the element is still dense and unvacuolated. From the very beginning the crystals occupy practically the whole lumen of the cell and more or less protoplasm surrounds the nucleus which is the organic center of the druses. The crystals in fact constitute an irregular spiny casing, which surrounds the nucleus and protoplasm. Even in very large and old crystals indications of the presence of a nucleus can frequently be demonstrated by appropriate methods.

Similar observations have been made in the case of crystals of oxalate of lime, so commonly present as a metabolic byproduct in the Dicotyledons. Particularly favorable objects for such studies are the Juglandaceæ, Cactaceæ, Begoniaceæ, Gerianiaceæ, etc. In angiospermous species the nucleus becomes obscured at a very much earlier stage of development of the crystal and not infrequently the latter does not occupy the whole lumen of the cell as in Ginkgo.

Apparently the most interesting fact in the present connection is that compound crystals or druses are not formed in plants by the ordinary routine of crystallization in the watery fluid of the cell sap, as has been universally stated and supposed; but by the action of living protoplasm and under the influence of the nucleus, which is central to the crystal itself. Corresponding to this fact there is only one druse in each cell. A further surprising fact is that the cell-wall in many cases grows in size to accommodate the crystal under the influence of protoplasm contained within the crystal itself. This condition constitutes a very serious problem for those mechanists who attempt to explain all the properties of living beings by the so-called artificial cell and colloidal chemistry. The crystal-containing cells of the seed-plants do not appear to fit into this conception in even an approximately satisfactory manner.

E. C. Jeffrey
Laboratories of Plant Morphology,
Harvard University

RIVER-BANK MOVEMENTS DUE TO THE EARTH'S ROTATION

To the Editor of Science: In Science, March 17, Mr. O. E. Jennings calls attention to a difference between the east and west banks of one of the short streams flowing across the almost flat southern slope of Long Island: "An almost imperceptibly sloping eastern bank and a western bank rising quite steeply." Mr. Jennings says, "This peculiar situation has long been accepted rather generally by geologists and physiographers as due to the *westerly deflection* of streams by the earth's rotation" (italics mine). The statement just quoted is doubtless an accidental slip. The fact is that because of the earth's rotation longitudinal rivers in the northern hemisphere erode their right banks—whether they flow south or north.

In offering another hypothesis for those Long Island banks Mr. Jennings makes the justifiable suggestion that the stream in question—as regards length and velocity—is incompetent for securing through the earth's rotation the effects observed. If it has a narrow channel and carries a small volume of water these items should be added to its other disqualifications. And finally, the latitude of Long Island—less than half the distance from the Equator to the North Pole—is none too favorable for river-bank movement due to the earth's behavior as a heavenly body.

In this connection reference may here be made to the unquestionable evidence of the earth's rotation afforded by the Yenisei. There is probably nowhere else in the world any other stream so favorable for the study of bank movement on a vast scale. This for three reasons: This Siberian river is closely longitudinal; of great size; and so far north that a considerable section of it lies within the Arctic Circle. Dr. Fridtjof Nansen, who has sailed up this river from its mouth to Yeniseisk—a distance of more than a thousand miles—writes of the very pronounced contrast between the east and west banks. "Every one going up the Yenisei must be struck with the remarkable difference between the east and west sides of the river. While the flat land on the east is comparatively high and falls abruptly with a steep bank to the river, a steeply sloping beach and relatively deep water outside, the land on the west is strikingly low. The steep river bank is not high, and the bare sandy beach slopes quite gently to the water, with a shelving bottom far beyond it, so that as a rule it is not easy to approach this shore in a ship or boat." And again, "It is striking how much higher and steeper the east bank is than the west everywhere along here."

Dr. Nansen's observations[1] of this northern river and his discussion of what he saw forms a distinct contribution to the literature of the subject of such river-bank movements as are to be referred to the rotation of the earth.

Ellen Hayes
Wellesley, Mass.

THE DECOMPOSITION OF TUNGSTEN

Sir Ernest Rutherford, in the statement copied from *Nature* in the April 21 issue of Science, was in the very difficult position of being "asked to say a few words" in comment on a brief cablegram to the London *Times* which was itself based on an exaggerated Associated Press dispatch to American newspapers concerning the preliminary and oral but as yet unpublished report of Mr. Clarence E. Irion and myself on the apparent decomposition of tungsten at extremely high temperatures. He mentions the need of a complete report before intelligent comment is possible, but proceeds to make three points which are properly conservative and entirely correct but, as will be seen from the complete paper upon its publication in the *Journal of the American Chemical Society,* which are all irrelevant. In view of the publicity given to Sir Ernest's comments in *Nature* and in Science, however, a few words in reply are needed.

The first point is that the appearance of helium has often been observed in electrical

[1] Nansen, Fridtjof: *Through Siberia, the Land of the Future,* 71, 72, 73, and 157, 158, etc.

discharge tubes during the past ten years but that "it has been generally assumed that this helium has in some way been occluded in the bombarded material." True; we have a list of no less than 37 papers, most of them published in the years 1912 to 1915, engaged in this inconclusive argument. In spite of the application of the best experimental skill no agreement was reached and Rutherford's conclusion is the general one. Yet there are some of the final experiments, particularly those of Collie, which challenge that conclusion and the problem is still one of the most attractive and important of recent times. Certainly it urges conservatism and the most rigorous criticism, yet not one of the papers shows that helium can not be produced and all call for the application of some entirely new method to the same problem. That we have now accomplished.

The second point is that a measure of the energy produced by the atomic decomposition, as predicted by modern theories of atomic structure, would be "a much more definite and much more delicate test of disintegration of the heavy elements into helium than the spectroscope." This is a rare example of the preference for theory over fact, though saved by the use of the word "test" instead of "proof," and the chemist will be slow to accept it. Our work has not gone far enough to permit the measurement of the energy evolved but the latter is certainly not as large as would be expected from the energy liberated in the disintegration of radium. Yet lack of the theoretical energy does not explain away the formation of a cubic centimeter of permanent gas from half a milligram of tungsten wire, though it demands careful scrutiny and, if confirmed, some explanation. Perhaps a lesser energy content accompanies the greater stability of the permanent metals, for even among the radioactive elements the violence of disintegration varies inversely with the stability.

Finally Sir Ernest points out that no helium has been observed in X-ray tubes operating at 100,000 volts, where electron impacts are even more violent than in our experiments. But the quantity of energy impressed on the target is here minute, the tube current being measured in milliamperes or less, whereas it is the essence of our method to introduce as much as a coulomb of electricity into the wire within 1/300,000th of a second, or many millions of times as much in terms of power. We suppose that it is temperature as such, *i. e.,* the high velocity collisions of the atomic nuclei with one another, that effects the atomic decomposition.

We appreciate and welcome the spirit of Rutherford's criticisms. Indeed it is for the purpose of eliciting such criticism and stimulating the laboratory study by other investigators that we are publishing our work in its present preliminary form. The importance of the problem warrants it.

The real question now raised concerns the broadcasting of the results of scientific researches by our publicity agencies. This is an important function and science has suffered from its neglect. Yet our experience shows that it can be overdone, for here is a research heralded as "transmutation" to millions of newspaper readers in at least six countries: it is not transmutation in any proper meaning of that term, it is merely a preliminary report by no means accepted by, or offered to, the scientific world as conclusive, and it must still wait months before it can be properly published in the appropriate scientific journal for the study of those who are competent to appraise it. Meanwhile it is the duty of scientists to urge prudence and conservative judgment, as Sir Ernest Rutherford has done. Our publicity problems are not solved when we have increased the effectiveness of contact with the press.

GERALD L. WENDT

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SCIENTIFIC LITERATURE

RECENT WORK ON SOIL ACIDITY AND PLANT DISTRIBUTION

WHEN three independent investigators, living in different countries, and not knowing of one another's activities, hit upon a similar method of study and reach essentially the same conclusions concerning a set of natural phenomena, it is not unreasonable to infer that a correct understanding of the relations has been reached. For many years it has been customary to regard soil acidity as having no particular bearing on the distribution of native plants. The Danish ecologist Warming, it is true, distinguished a group of "oxylophytes"—acid place plants—but he had few followers. Coville[1] was successful in cultivating the wild blueberry and other *Ericaceæ* by maintaining the soil in an acid state, but this was looked upon by most botanists as anomalous and exceptional. Because supposed oxylophytes were occasionally found growing with supposed "calcicoles"—lime dwellers—ecologists in general have been inclined to discredit the existence of any definite relation between native plants and soil acidity. During the last few years, however, newly developed methods of interpreting and determining acidity have been applied in several widely separated regions—Sweden,[2] Denmark,[3] the northeastern United States,[4] (and subsequently in India and in England[5]), with the same result in all cases: recognition of the great significance of the acidity of the soil in controlling the growth and distribution of native plants.

The three investigators in question have found independently that the active acidity of a soil can be definitely determined by stirring up a sample with pure water and testing the extract with indicators adapted to show by their color changes the hydrogen-ion concentration. Arrhenius and the writer take their soil samples from the roots of the plants under study, while Olsen takes his at a uniform depth of 10 cm. His samples are therefore representative only of the plants rooting at that depth, and not of the shallower or deeper rooted ones. This renders his data as to some plants uncertain, since most soils show a marked acidity gradient, which may amount to as much as 0.1 p_H unit (equivalent to a factor of 1.25 in specific acidity) per centimeter in depth.

In a recent review, Clements[6] has shown that the production of acidity in bog soils is connected with lack of aeration; but it does not follow that the same is true of upland soils. In the writer's experience the highest acidities in them occur among rock fragments at the summits of mountains, in the dry sands of pine barrens, and in the most loosely packed and thoroughly aerated vegetable débris. This acidity is presumably due chiefly to the development in the soil of such acids as acetic, citric, and lactic, which, like their production for food purposes, is an aerobic oxidation process. In bogs, therefore, there is likely to be an increase of acidity with depth, in dry-land soils a decrease.

Before determining the acidity of a soil, Arrhenius and Olsen allow the water suspension to stand for as much as 24 hours, and then filter. The writer feels that long standing of a soil in contact with excess water may enable reactions, with resulting acidity changes, to take place which would not occur when the soil is in its natural condition, so that fairly prompt testing seems preferable. Moreover, filtration removes fine material which may well contribute to the effect of the soil on a plant, and therefore should be allowed to affect the indicators also. Arrhenius and Olsen make their determinations of the acidity of the modified and purified soil extracts with great precision, using a comparator, the former recommending, however, that a method of determination should always fit the sample. The writer, finding that the variation from one root to another of a single plant, or from one individual to another of the same species, often amounts to 0.5 p_H unit, or a factor of 3 in

[1] "Experiments in Blueberry Culture," 1910, *United States Department of Agriculture Bureau of Plant Industry Bulletin No.* 193.

[2] Olof Arrhenius: *Œcologische Studien in den Stockholmer Schaeren.* Stockholm, 1920. Review in *Ecology,* II, 223-228, 1921.

[3] Carsten Olsen: *Studier over Jordbundens Brintionenkoncentration og dens Betydning for Vegetationen, saerlig for Plantefordelingen i Naturen.* Copenhagen, 1921. Abstract in Science, LIV, 539-541, 1921. English edition promised.

[4] Edgar T. Wherry: A series of papers on ferns, orchids, Ericaceæ, etc. 1916 ——; also: "Soil Acidity and a Field Method for Its Measurement." *Ecology,* I, 160-173, 1920; to be published in collected form in the Appendix to the *Smithsonian Annual Report* for 1920. (In 1922).

[5] W. R. G. Atkins: "Relation of the Hydrogen-ion Concentration of the Soil to Plant Distribution." *Nature,* CVIII, 80-81, 1921. Also *Sci. Proc. Royal Dublin Acad.,* XVI, 369-413, 1922.

[6] "Aeration and Air-content; the Rôle of Oxygen in Root Activity." *Carnegie Institution of Washington Publ.,* 315, 183 pp., 1921.

specific acidity, developed his method so that it would yield just this degree of precision. These points are mentioned specially because Olsen, in the Danish paper, criticizes the writer's method severely on the basis of "inaccuracy." But if a soil, the acidity of which varies in general by a factor of 3, is sampled at an arbitrary depth and then altered by long soaking and filtration, there is certainly nothing to be gained by making highly precise acidity determinations on the resulting extract. Indeed, both Arrhenius and Olsen, upon assembling the results obtained on given species or associations of plants, also find that there is always a range of at least 0.5 in p_H (a factor of 3 in specific acidity). The fact that all three come to recognize the same range indicates that it is of fundamental significance.

All three investigators find that the soils of native plants in general extend from a specific acidity of a few thousand to a specific alkalinity of about 10. All find that the greatest number of species as well as of individuals occur in soils lying just to the acid side of the neutral point. And, most remarkable of all, it turns out that many individual species of plants have essentially the same soil acidity preferences in Europe as in America, indicating that this is not a question of location, climate, or surroundings, but a physiological feature of the species. For illustration: the lily-of-the-valley, *Convallaria majalis*, grows in Denmark in soils of specific acidity 1000 to 400. Isolated colonies of this plant in the southern Appalachian Mountains have been studied by the writer and found to have specific acidity 500 to 300, practically the same range. Hepatica (*Hepatica triloba* or *Anemone Hepatica*) shows in Denmark preference for soils ranging from neutral (specific alkalinity 1) to specific alkalinity 8. In America a near relative of the European plant thrives best in black leafmold with an average specific alkalinity of 3.

How soil acidity affects plants is a subject requiring further investigation. Olsen's data led him to infer that the action may be direct, but others have found that it is usually indirect. There is evidence both for and against the view that the acidity affects primarily symbiotic organisms, and only indirectly through them the higher plants. Recent American work has indicated that the effect of acidity is produced largely through the agency of aluminium or iron salts, although Olsen is unable to find evidence of their toxicity. But in view of the general agreement of the results of the three independent investigators as above outlined, it can no longer be questioned that soil acidity is of fundamental importance in controlling the distribution of native plants.

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SPECIAL ARTICLES

THE EINSTEIN EQUATIONS FOR THE SOLAR FIELD FROM THE NEWTONIAN POINT OF VIEW

1. ABOUT a year ago I determined the law of attraction from the Newtonian point of view of action at a distance which gives the equations of planetary motion obtained in the Einstein theory. Two months ago Professor Birkhoff, of Harvard, told me that he had obtained similar results in his class this year, and suggested that I publish my results. In doing so I am not advocating the rejection of the Einstein point of view which seems to me the correct one, but I am merely indicating a modification in the Newtonian law which will account for the motion of the perihelion of Mercury and the deflection of light rays. It may be also that by means of this formulation of the law it will be possible to solve, with sufficient accuracy, problems which are not readily handled by means of the equations of general relativity.

2. The Schwarzschild form of the linear element of the Einstein field of gravitation of a mass m at rest with respect to the space-time frame of reference is

$$(1)\quad ds^2 = \left(1-\frac{2m}{r}\right)dt^2 - \frac{1}{1-\frac{2m}{r}}dr^2 - r^2(d\theta^2 + \sin^2\theta d\varphi^2)$$

where r, θ and φ are the space coordinates as measured by astronomers, and t is the coordinate of time.

If we write

$$(2)\quad I = \sqrt{\left(1-\frac{2m}{r}\right)\dot{t}^2 - \frac{r}{r-2m}\dot{r}^2 - r^2(\dot{\theta}^2 + \sin^2\theta\dot{\varphi}^2)}$$

where dots indicate derivatives with respect to s, the world-lines of particles in the gravitational field are the curves in the 4-space for which the integral

$$(3)\quad \int I ds$$

is stationary. The conditions that (3) be stationary are four differential equations of the second order. From one of them it follows that the path is plane; the coordinates may be chosen so that the equation of the plane is $\theta = 0$. Two of the other equations admit as first integrals

$$(4)\quad \frac{dt}{ds} = \frac{A}{1-\frac{2m}{r}},$$

$$(5)\quad r^2\frac{d\varphi}{ds} = h,$$

where A and h are constants. It is readily shown that $I = k$, a constant, is a first integral of the four equations. When k is not zero, s can be chosen so that $k = 1$. Then we have $\theta = 0$, (4), (5), and

$$(6)\quad \left(\frac{dr}{ds}\right)^2 + r^2\left(\frac{d\varphi}{ds}\right)^2 = (A^2-1) + \frac{2m}{r} + 2m\frac{h^2}{r^3}$$

for the equations of a world-line of a particle in the gravitational field.

When $I = 0$, the integral (3) is stationary and the corresponding world-lines are those of light in accordance with the Einstein theory. Their equations are (4), (5) and

$$(7)\quad \left(\frac{dr}{ds}\right)^2 + r^2\left(\frac{d\varphi}{ds}\right)^2 = A^2 + 2m\frac{h^2}{r^3}$$

Some writers have obtained these equations by solving $I = 0$ for dt and expressing the condition that $\int dt$ be stationary, in accordance with the Fermat principle. The above method was given by Professor Veblen in his lectures, and appears also in Laue, *Die Relativitätstheorie,* Vol. 2, p. 225. Putting $I = 0$ in (2), we see that the units are such that the velocity of light is unity for $r = \infty$, and that it diminishes as the light approaches the sun. If the unit of length is taken as a kilometer, then the unit of time is 1/300,000 of a second.

3. In classical mechanics for a central force of attraction $f(r)$ the equations are

$$(8)\quad r^2\frac{d\varphi}{dt} = h$$

and

$$(9)\quad \left(\frac{dr}{dt}\right)^2 + r^2\left(\frac{d\varphi}{dt}\right)^2 + 2\int_\infty^r f(r)dr = E,$$

where h and E are constants. For planetary motion about the sun, whose mass in gravitational units is denoted by m, equation (9) assumes the form

$$(10)\quad \left(\frac{dr}{dt}\right)^2 + r^2\left(\frac{d\varphi}{dt}\right)^2 = -\frac{m}{a} + \frac{2m}{r},$$

where a is the semi-major axis. For the solar system m/a and m/r are of the order of 10^{-8}, for the units previously defined. Thus if we identify $A^2 - 1$ in (6) with $-m/a$ in (10), $A - 1 = \frac{1}{2}\,10^{-8}$ approximately. Then from (4), $\frac{dt}{ds} = 1 + 3/2\ 10^{-8}$ approximately, which shows the order of discrepancy so far as the solar system is concerned in interpreting ds and dt as the same in (5), (6), (8) and (9) (*cf.* Eddington, Report, p. 50).

It is well-known that it is the term $2mh^2/r^3$ in (6) which accounts for the motion of the perihelion of Mercury. Comparing (6) and (9), we see that from the point of view of action at a distance this is accounted for if we take

$$(11)\quad f(r) = m\left(\frac{1}{r^2} + \frac{3h^2}{r^4}\right).$$

From the preceding remarks it follows that if we put

$$(12)\quad \omega = \frac{d\varphi}{ds}$$

then ω may be interpreted as the angular velocity of the planet about the sun. Then from (5), (11) and (12) we have that

$$(13)\quad \text{The attraction} = m\left(\frac{1}{r^2} + 3\omega^2\right) = \frac{m}{r^2}(1 + 3v^2),$$

where v is the component of the velocity perpendicular to the radius vector.

We have remarked in the preceding that the velocity of light at ∞ is equal to 1 in the units chosen. If we denote it by c in any system of units, we may formulate the law as follows:

Two bodies attract one another inversely as the square of their distance and directly as the product of their masses and $(1 + 3v^2/c^2)$, *where* v *is the component of their relative velocity perpendicular to the line joining the bodies.*

The form (1) is obtained from the Einstein theory on the hypothesis that the planet is small in comparison with the sun. It may be that the above law applies only to this case. However, it may be that the law would work if the bodies were approximately of the same mass. As formulated the law enables one to set up the differential equations of n bodies in a manner analogous to the classical theory. It would be interesting to know whether known discrepancies in the motion of the moon would be overcome by the use of this law.

Although the term $3v^2/c^2$ produces an observable effect only in the case of Mercury, it may produce a significant effect in molecular motion.

4. When in like manner equation (7) is compared with (9) we find that for a ray of light the attraction is

$$3m\omega^2 \tag{14}$$

where ω may be interpreted as the angular velocity of the light about the sun. Thus it is the term $3m\omega^2$ in (13) which accounts for the deflection of light, and the term m/r^2 does not enter. Einstein and his followers have calculated the deviation of light by noting that the velocity changes in a manner analogous to that of a refracting medium, and by applying Huygen's principle. Since the same term appears in the attraction of a planet, it may very well be that the sun affects the medium through which both the light and planets pass, and that the difference between Newton's law and (13) is due to this situation. From this point of view one would expect that the law would not be accurate for two or more bodies of relatively the same mass, but it may lead to a sufficiently close approximation.[1]

Luther Pfahler Eisenhart
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[1] I have just found that A. V. Bäcklund in the *Arkiv för Matematik, Astronomioch Fysik*, Vols. 14 and 15 (just received) has made an extensive study of the relation between classical dynamics and the Einstein theory of gravitation. In the course of his three articles he obtains equation (11) and one similar to (13).

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION F—ZOOLOGICAL SCIENCES AND ASSOCIATED SOCIETIES

At the Toronto meeting of the American Association for the Advancement of Science, December 27-31, 1921, Section F (Zoology) offered no separate program, but met jointly with the American Society of Zoologists. The program was arranged by the latter society.

Six joint sessions were held, the program including 101 titles distributed by subject as follows: embryology, 4; cytology, 8; comparative anatomy, 7; evolution and genetics, 24; ecology and zoogeography (with the Ecological Society of America), 13; general zoology, 2; protozoology, 2; parasitology, 22; comparative and general physiology, 17; unclassified, 2.

The session of Friday afternoon, December 30, was devoted to a symposium on orthogenesis. A biologists' smoker was held Wednesday evening, December 28, and the zoologists' dinner Friday evening, December 30.

The business meeting of Section F took place at the morning session on December 29, with Vice-president Kofoid acting as chairman. M. M. Metcalf is vice-president for Section F for 1922. J. A. Detlefsen was elected a member of the section committee for four years in place of the retiring member, A. M. Reese.

F. R. Lillie presented the following resolutions drawn up by a conference of representatives of the biological societies in regard to a proposed federation of biological societies:

Resolved: 1. That it is the sense of this conference that an inter-society conference should be called to study and report upon the feasibility of federation of the biological societies and to develop plans for the said federation.

2. That for the purpose of effecting such an organization, each society, and Sections F and G of the American Association for the Advancement of Science, be requested to designate its president and secretary as members of an inter-

society council which shall be authorized (1) to deal with all matters of common interest, such as pooling of programs, that are consistent with the existing regulations of the constituent societies, and (2) to draw up proposals for a constitution and by-laws of a federation of the societies in question, and to present them for action at the next annual meeting.

The Section voted that the resolutions of the conference be adopted.

Independent programs were arranged by the following societies affiliated with Section F—The Entomological Society of America, The American Association of Economic Entomologists; and by the following societies affiliated with Sections F and G jointly—The American Society of Naturalists, The Ecological Society of America, The American Microscopical Society (business meeting only), The American Nature-Study Society.

HERBERT W. RAND,
Secretary, Section F

SECTION G—BOTANICAL SCIENCES AND ASSOCIATED SOCIETIES

SECTION G held its session on Wednesday afternoon, December 28, 1921, in conjunction with the Botanical Society of America and the American Phytopathological Society. There was a large attendance at this meeting, and the symposium, though involving several papers, was not unduly long. Professor Rodney H. True, retiring vice-president for Section G, delivered his address on "The physiological significance of calcium for higher green plants," which has been published in SCIENCE, Vol. LV, p. 1, January 6, 1922. The vice-presidential address was followed by a symposium on "The Species Concept," at which the following papers were read: (1) "From the viewpoint of the systematist," Charles F. Millspaugh; (2) "From the viewpoint of the geneticist," George H. Shull; (3) "From the viewpoint of the morphologist," R. A. Harper; (4) "From the viewpoint of the bacteriologist and physiologist," Guilford B. Reed; (5) "From the viewpoint of the pathologist," E. C. Stakman. The writers of these papers cooperated splendidly, both in division of subject matter and in time of presentation. The results seem to confirm the expressed belief of many botanists that a symposium of general interest, making appeal to workers in all the principal fields, is well worth while.

At the business session of Section G, John T. Buchholz, of the University of Arkansas, was elected to be a member of the section committee, his term of office to end January 1, 1926. Professor F. E. Lloyd of McGill University, was selected as vice-president for Section G for 1922.

Botanical Society of America.—This society held sessions beginning Wednesday morning, December 28, 1921, and continuing through Friday. On Thursday afternoon the Mycological Section held a joint session with the American Phytopathological Society, and on Thursday afternoon the Physiological Section met in conjunction with the American Society for Horticultural Science and the Ecological Society of America. At the sessions of the Botanical Society of America, eighty-seven scientific contributions were read. The dinner for all botanists was held on Friday evening. After the dinner Dr. Marshall Howe read "A Communication from the Retiring Vice-president," Dr. N. L. Britton.

American Phytopathological Society.—Sessions of this society were begun on Wednesday morning, December 28, and continued until Saturday morning. At the business sessions of this society the following officers were elected: *President,* E. C. Stakman, University of Minnesota, St. Paul, Minn.; *vice-president,* N. J. Giddings, University of West Virginia, Morgantown, W. Va.; *secretary and treasurer,* G. R. Lyman, Bureau of Plant Industry, Washington, D. C. One hundred and seven scientific contributions were read during the sessions. The Phytopathologists' dinner was held on Thursday evening, the dinner being followed by a discussion of important topics, and a short business session.

Board of Control of Botanical Abstracts.—Business meetings of the Board of Control were held on Tuesday, Wednesday and Thursday. During these meetings various matters were given attention including the election of editors and various considerations in connection with the publication, financial support, and circulation of *Botanical Abstracts.*

The Toronto meeting, from the viewpoint of the botanists, was a very successful gathering, and the attendance of plant workers was greater than had been anticipated.

Robert B. Wylie,
Secretary

SECTION I—PSYCHOLOGY

The meeting of Section I (Psychology) at Toronto was a very successful one. Although the affiliated society was meeting elsewhere, a considerable number of American psychologists attended the sessions, and to these were added several Canadian psychologists and a good many professional men and women who are interested in psychology from the point of view of its practical applications to education, business, criminology and related fields. The program was enriched by contributions from a number of men who represented these interests. The discussion of the papers was lively and in some sessions had to be limited for lack of time. The attendance at the meetings averaged about 25 and reached 125 at one session.

As is usual, there was at the Toronto meeting an intimate relation between the sessions of Sections I and Q (Education). Sessions were held conveniently in the same building, and two were joint sessions. The papers in these sessions dealt with mental tests or with psychological studies in education. There was apparent in the discussions of mental tests a disposition to examine somewhat more critically the conclusions to be drawn from the results of mental tests than has prevailed in the past. Of the other papers special mention may be made of one by Professor Thorndike in which he distinguished two types of equation—the equation for solution and the equation which expresses relationship—and advised that special care be taken to avoid confusion between the two.

The first session was devoted to general papers. Professor Dale discussed the place of psychology in university curricula, emphasizing the need of giving it reality by relating it to the practical problems of life. Professors Brett and Pillsbury discussed a number of the important issues on which modern psychologists differ, and Professor Weiss discussed variability in behavior as a basis of social interaction.

One morning session was devoted to applied psychology. The problems in this field were discussed from the point of view of employment relations, of job analysis, and of dealing with the handicapped in occupation, by Mr. George W. Allen, Professor E. K. Strong, Jr., and Mr. Norman L. Burnett, respectively. Dr. Alfred E. Lavell, chief parole officer of Ontario, described the beneficial effects of supervised employment upon paroled prisoners.

The last session opened with two general papers on mental tests and their significance. Professor William D. Tait argued that education should be highly selective and adapted to intellectual capacity. Dr. R. M. Yerkes emphasized the need of other types of mental examination in addition to intelligence tests. The results of psychiatric and intellectual examination of Illinois prisoners were presented by Dr. Herman M. Adler. In agreement with the results of an Ohio study, his examination showed that prisoners are not a select group intellectually. He indicated, however, that they do exhibit anomalies of behavior. Psychiatry in the public schools was discussed by Dr. Eric K. Clarke. A study of the divergence between the color preferences of Indians and whites was reported by Professor T. R. Garth.

The address of the retiring vice-president, Professor E. K. Strong, Jr., dealt with the problem of propaganda. He discussed and illustrated propaganda in business, politics, and social reform (or pseudo-reform), and raised the question whether it is possible to control it or neutralize its effects. Control he recognized as very difficult, but suggested that it might be necessary to modify the legal theory of refraining from interference until propaganda could be shown to issue in overt acts. The essential nature of propaganda is appeal to the emotions, and this makes control useless unless it takes effect when the general emotional foundation for overt action is being laid. The emotional character of propaganda also makes difficult its control through merely intellectual illumination.

A joint dinner and smoker with Section Q was held on Wednesday evening at which short speeches were made by Dr. R. M. Yerkes and Dr. H. Addington Bruce.

The vice-president of the section for next year's meeting, at Boston, is Professor Raymond Dodge, and the new section committeeman is Dr. Yerkes.

Frank N. Freeman
Secretary, Section I

SECTION O—AGRICULTURE AND ASSOCIATED SOCIETIES

Section O met on Wednesday afternoon, December 28, 1921, with six associated societies. The program of the meeting consisted of a symposium on "The Coöperation of Canada and the United States in the Field of Agriculture." Dr. E. W. Allen, of Washington, delivered the retiring vice-presidential address on "The Method of Science in Agriculture," calling attention to the importance of the utilization of the most accurate scientific methods in agricultural investigations, pointing out ways in which certain lines of study now under way may be made more comprehensive and urging that attention be given constantly to the improvement of methods and that the interpretaion of all results be based more directly upon the methods employed in the work.

Following the vice-presidential address, the following papers were read:

Marketing Conditions in Canada: Archie Leitch, Ontario Agricultural College, Guelph, Canada.

Organization for research in the United States: L. R. Jones, chairman, Division of Biology and Agriculture, National Research Council.

Cooperation in research: J. H. Grisdale, deputy minister of agriculture, Ottawa, Canada.

Some economic aspects of the wheat situation: (Illustrated with lantern slides): Carleton R. Ball, Bureau of Plant Industry, Washington, D. C.

History and development of the Canadian Society of Technical Agronomists: F. H. Grindley, Gardenvale, P. Q., Canada.

The attendance at the meeting was very gratifying, over 50 persons being present. The addresses which were given were extremely interesting, and each was followed by considerable discussion. Particular interest was evidenced in the suggestions regarding organized research and greater cooperation between the United States and Canada in the development of research activities.

At the business session of the section, R. W. Thatcher, of the New York Agricultural Experiment Station, Geneva, N. Y., was elected vice-president, and E. W Allen, of the United States Department of Agriculture, Washington, D. C., was elected a member of the section committee, his term of office to end January 1, 1926.

At the conclusion of the meeting a dinner was held at Queen's Hall; a large number of the members of the section were in attendance. This proved to be a most enjoyable occasion, and it is hoped that a dinner for Section O and all associated societies may be arranged at subsequent meetings of the association.

The meeting and dinner of Section O were highly successful in every way, and all those in attendance were enthusiastically in favor of having similar arrangements made for later meetings. The associated societies all have their programs; it is conceded that Section O should give a more general, somewhat introductory, program and one which will be of interest to all agricultural organizations. This feature of the program at Toronto was particularly successful, the dinner being an innovation which everyone felt had added materially to the success of the meeting.

The American Society of Agronomy.—This society held a meeting on Thursday, December 29, 1921, at which a general program of agronomic interest was prepared. Ten scientific contributions were presented; each was followed by considerable discussion. About 40 agronomists from Canada and the United States were in attendance, and the meeting was a most successful one in every way. Matters of general interest to both crops and soils men were discussed, and the exchange of ideas between the Canadian and United States investigators was particularly valuable. Since this was not the annual meeting of the society, no business was transacted. Resolutions were adopted, however, urging the continuation of the publication of the *Experiment Station Record* and the *Journal of Agricultural Re-*

search, by the United States Department of Agriculture.

The American Society for Horticultural Science.—This society held sessions beginning on Wednesday and continuing through Friday. The scientific contributions, of which there were 31, were given in groups under the heading of "Breeding," "Fruit Setting," "Nutrition," "Growth Studies," and "Extension."

On Thursday afternoon a joint session with the Botanical Society and the Ecological Society consisted of a symposium on "Frost Resistance, Hardiness, and Winter Killing of Plants." At the symposium the following papers were read:

Geographical distribution of low temperature conditions: Forrest Shreve, Tucson, Ariz.

Observation on hardiness in Canada: W. T. Macoun, Ottawa, Canada.

Relation of water retaining capacity to hardiness: J. T. Rosa, Jr., Columbia.

Effect of low temperature storage and freezing on fruits and vegetables: L. E. Hawkins, Washington, D. C.

A colloidal chemical basis for resistance to low temperatures: R. Newton, St. Paul, Minn.

Physiological and chemical studies of fruits in storage: J. R. Magness, Canton, Pa.

Hardiness from the horticultural point of view: M. J. Dorsey, Morgantown, W. Va.

There was a large attendance of horticulturists, and much interest was evidenced in the program at all sessions.

On Thursday the annual dinner of the society was held; this proved a very enjoyable occasion, the discussion following the dinner centering around the proposed horticultural journal.

The Society of American Foresters.—A joint meeting of this society was held with the Canadian Society of Forest Engineers on Tuesday and Wednesday. Thirty-three scientific papers were presented at the various sessions, being grouped under: "Fire Protection and Forest Administration," "Silviculture and Forest Pathology," "Utilization and Wood Technology," "Regulation and Management," and "Forest Botany."

The members of the society were entertained at dinner on Tuesday evening at the Hart House by the Canadian Society. After the dinner, the retiring presidential address was given by Frederick E. Olmsted, on "Professional Ethics." Other informal addresses were made on this occasion. There was a large attendance of foresters. The program was very much appreciated, and the various papers aroused considerable discusson.

Association of Official Seed Analysts.—This society met on Wednesday, Thursday and Friday, with a general program at each session. Thirty scientific papers were presented; there was considerable discussion of the various papers. One of the most outstanding features of the meeting was the report of the president, Mr. George H. Clark, on the Copenhagen Conference.

Geneticists Interested in Agriculture.—This society met on Tuesday with a program consisting of a symposium on "The Genetics Curriculum in the College of Agriculture." Four papers were presented, and each was followed by a general discussion among the members present. About forty were in attendance, and great interest was evidenced in the methods which are being followed at various institutions in the teaching of genetics to agricultural students.

Potato Association of America.—This society met on Friday with a program consisting of reports of standing committees of the society on "Varietal Nomenclature and Testing," "Market Standards and Marketing," "Transportation," "Educational," "Judging Standards," "Relation of Varietal Type to Yield," "Investigations on Immature Seed Potatoes," and "Seed Potato Certification Standards."

There was a large attendance at the meeting of the society, and keen interest was evidenced in the papers presented. An exhibit of seed potatoes proved of particular interest, many of the states being represented, as well as the Province of Ontario. At the business session of the society, the following officers were elected: *President,* J. G. Milward, Madison, Wis.; *vice-president,* C. A. Zavitz, Guelph, Ont.; *secretary-treasurer,* Wm. Stuart, Washington, D. C.

P. E. Brown,
Secretary, Section O, Agriculture

SCIENCE

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CONTENTS

CONTEMPORARY DETERRENTS TO THE PROCESS OF CLINICAL MEDICINE[1]

INTRODUCTION.—It has been said that "Methods and view points rather than men determine periods in the history of medicine." Following an era dominated by the study of structural pathology and of those physical signs expressive of structural change, there occurred a rather abrupt transition to a period characterized by investigation of the *function* of the various organs of the body in health and disease. Within the past fifty years there has been an increasing utilization of the sciences of chemistry, physics, biology, and mathematics, employed by investigators in their endeavor to measure function in exact ways, to estimate the degree of functional impairment in an organ diseased, to establish diagnosis upon a functional basis, and to institute therapy along lines calculated to prevent *functional* deterioration. By some, the contemporary period is termed "the golden age in medicine." That period will have come more truly when there is a more appropriate correlation between functional impairment and structural change. Contemporary medicine has lost somewhat by its neglect of pathological anatomy.

This "functional" period in medicine has been marked by numerous well recognized trends. It has witnessed the development of an enormous number of laboratory tests and procedures. Many mechanical devices and instruments of precision have been introduced, designed to detect the slightest deviation from the so-called normal. The period has been associated with the sub-division of medicine into a great number of specialties, and a marked re-

[1] Presidential address read before the American Congress on Internal Medicine, at Rochester, Minnesota, April 7, 1922.

placement of the general practitioner by specialists. Changes have been so varied and rapid that medical education has been unable to keep pace with the growth of new theories, new methods, and new ideas of practice: with a result that the medical student of the day is subjected to a type of education which is, in the words of a well known college president, "about half a century behind other forms of higher instruction." Research and prematurely published articles are dominant features of the time. Progress during this era of "specialized functional-diagnosis" has unquestionably been great, yet humanity comes very far short of getting out of the medical profession the aid which it is capable of furnishing.

An analysis of these dominant factors in contemporary medicine reveals a timely and merited attempt to reduce medicine to the realms of a pure science, or, as one particular enthusiast states it, "Medicine should now be generally recognized as an independent science, dealing with the phenomena of disease." This statement may be accepted if by science is meant *knowledge* gained by systematic observation, experiment and reasoning. Reason, however, must always operate within experience, never beyond it. Science is experience becoming rational. Rationalized science becomes an art through the skillful application of knowledge to practice.

Clinical medicine will always remain an art expressing itself by the practical application of all scientific experience toward the cure, alleviation or prevention of disease; in this pursuit it does and must enlist in its service all of the sciences. "A good internist will be a better one if he is well trained in the so-called medical sciences, but the sum total of all the sciences does not make internal medicine, nor is a brilliant scientific education a prerequisite, for a useful clinical career." The sciences give the true clinician some of his most useful tools, but they do not constitute his art. Many of the factors to which may be ascribed the brilliance of contemporary medicine in a scientific sense are, in part, at least, responsible for some well recognized defects in the practice of clinical medicine that may actually hinder its progress. A brief consideration of some of them would, therefore, seem timely.

(A) THE MENACE OF EXCESSIVE LABORATORY PROCEDURES

The elaboration and perfection of a large number of laboratory procedures has been a natural development in the evolution of contemporary medicine. To deny their usefulness would be absurd; to be forced to practice clinical medicine without laboratory facilities would be disastrous; to deny that important advances in clinical medicine have come from laboratory studies would be untrue. Every one admits that the patient dare not be studied at the bedside alone. It is certain that laboratories in the future will continue to play a dominant rôle in the advancement of medicine. It is equally true that medical investigation has gone more and more away from men engaged in clinical practice into the hands of laboratory workers, many of whom possess but a limited view of the problems which daily beset the practitioner. The enthusiasm for more accurate *diagnosis* characteristic of contemporary medicine, has, apparently, led many practitioners to believe that the laboratory simplifies everything; many actually seem to draw the inference from reading current laboratory advertisements, that clinical study can often be dispensed with in favor of containers for specimens, gratuitously supplied by commercialized laboratories. This excessive reliance upon laboratory tests has hindered the progress of clinical medicine in various ways as a result of:

(1) A tendency prematurely to accept and apply new laboratory tests of promise.

(2) The indiscriminate utilization of accepted laboratory procedures that are in reality of value only in a limited domain.

(3) An improper interpretation of tests of known value through ignorance of their clinical significance.

(4) An unwise reliance on positive laboratory findings to establish a diagnosis to the exclusion of other data, that may, perhaps, be much more important.

One witnesses examples of these and other errors almost daily. The total number of laboratory procedures or tests in themselves pathognomonically diagnostic is very small. There is practically none if diagnosis is understood to include, as it should, not only the cause of the disease, but also its location, and the degrees of resultant structural functional impairment.

Confusion obviously exists, particularly among general practitioners, as to the correct use of many current laboratory procedures. This must in some way be overcome if the dangers arising from their improper utilization are to be eliminated, chief among which is an incorrect or incomplete diagnosis, and therefore inefficient service to the patient. Ways must be found to control or to limit the widespread application of tests that should be confined to well organized medical clinics, until the results there obtained have been subjected to long and critical analysis. The same is true of procedures requiring a degree of special technical ability not possessed by the average practitioner or technician employed by him. Witness merely as one example the widespread and misapplied study of basal metabolism, an instance of the mischief that inevitably follows the random use of mechanical methods. As Sir James Mackenzie has well put it, "While it may be claimed that we have one hundred new methods for investigating disease in the living, it must also be recognized that we have one hundred more ways for going astray. The benefit to the patient is often doubtful, and the employment of many contemporary laboratory methods in the contemporary manner is often harmful." The unintelligent use of laboratory tests is one etiological factor for the contemporary fibrosis and atrophy of the emotion of wonder and its associated instinct of curiosity: together "they arouse the impulse to approach and examine more closely the object or difficulty which excites them. Demand for the solution of a perplexity is the steadying and guiding factor in the entire process of reflection. Laboratory tests have certainly encouraged the development of a certain "naïveté of diagnosis" which seriously threatens the cultivation of a healthy curiosity.

(B) Specialism and Specialists

Contemporary specialism has been unavoidable. It has been pointed out that specialism is calculated to increase productivity, to facilitate the acquisition of accuracy, speed and skill, to provide a better distribution of tasks, to economize material equipment and mental energy, and to accelerate discovery and invention. Barker refers to a "virtuous circle," "for on the one hand specialism increases knowledge, and on the other the growth of knowledge and technique creates new specialties. Human wants grow as knowledge and skill increase, and ever new types of medical men must emerge to supply the services that will adequately satisfy these wants." Viewed from this rather broad philosophic standpoint, as well as from a purely practical one, it is probably true that the "abolition of specialism would compel a return to a darker age of medical practice."

But, whether specialism with its increasing sub-division can be applied to clinical medicine in the same way that it has been to commerce and industry is a very debatable question. Certain dangerous aspects of specialism are thought by many to be responsible for admitted deficiencies in the practice of medicine of to-day. These dangers doubtless represent not so much arguments against specialism as against its indiscriminate or unwise use. In specialism one easily recognizes the lure for those whose ambitions are more for material reward than for human uplift. To specialism may be attributed the existing inequality of the financial compensation of the specialist and of the general practitioner, and hence the economic situation that explains in part the present inadequate supply of physicians in rural communities. A contemporary anonymous writer sees the origin of specialism in surgery. The degree of specialism that has developed in this one *branch of medicine* alone has been as extraordinary as it has been absurd. It is cheerful, therefore, to read from no less a pen than that of William J. Mayo: "Surgery should be put back where it belongs—a means of mechanical therapy in conjunction with medicine which should not continue in competition with the internist, as it has in the past." Specialism has been responsible for the development of what might be termed class discrimination in the profession, by which the so-called general practitioner has seemed to lose caste. Applied to patients, it has also fostered a feeling of class distinction, for many assume that the services of specialists are far beyond their means, when, as a matter of fact, such is not usually the case. The charge that the medical profession, as a whole, has rapidly become an organized financial institution is as untrue as it is unjust. Misapplied specialism is at least one explanation for the recourse of many misguided individuals to some one or other of the commercial cults, which prey like parasites upon their human victims. The greatest danger of all to clinical medicine lies in the fact that specialism carries with it the inherent danger of narrowness and monotony, potential foes of the faculty of concentration, the power of observation and decisive correlation. It tends fundamentally to destroy those intimate relations between physician and patient that constitute the very essence of the healing art. Osler, in 1919, wrote: "The extraordinary development of modern science may be her undoing. Specialism has fragmented the specialties themselves in a way that makes the outlook hazardous. The workers lose all sense of proportion in a maze of minutiæ." The profession and public, as a whole, appreciate the great services rendered by specialists. They are certainly indispensable. Specialism can probably not be checked, but unless its abuses are restrained a dark era in clinical medicine will have to be faced. Sanity and extremes never mix.

(C) Changes in Medical Practice

The development of "group clinics" is the most striking contemporary change in the practice of medicine and is a direct result of modern specialism. Group practice unquestionably has many definite advantages, but it is unquestionably destined to failure unless it consistently deals cooperatively and unselfishly with the general practitioner. All arguments that may be advanced in favor of group practice are outweighed if this fundamental consideration be neglected. This is but another way of saying that group medicine can justify its existence only in so far as its superior facilities for study and diagnosis can be directly transferred back to the patient through the medium of his family physician. The difficulties and dangers inherent in specialism become even more real in "diagnostic groups" unless there is the highest type of analysis and integration of the work done by the several specialists practicing together. Such analytical power is not possessed by many. It can be acquired only through long clinical experience, active clinical teaching and the opportunity to keep in touch with the advances in those specialties useful in clinical practice. It is rather hard to believe that men who possess these qualifications of the "diagnostic integrator" will serve the public and profession best by analyzing the reports of specialists. Granted that the work skillfully done is correctly analyzed and properly applied, failure none-the-less threatens "group medicine" if it be forgotten that impersonality in the practice of medicine inevitably foreshadows loss to the public.

(D) Changes in Medical Education

That there is something wrong with medical education almost every one will admit. Just where the defect lies, what the reasons are, and what constitutes the solution, remain somewhat obscure. Probably the most significant change in contemporary medicine from an educational standpoint has been the introduction of the so-called full-time system in the clinical departments. It is advocated by those who believe "that there exists, or can be created, such a thing as a science of medicine, which can best be fostered by giving it a place in which it can grow unhampered by the restrictions of practice." They claim that a close association between medical education and practice is by no means essential, and seem to resent the conception of clinical medicine as an application of the science to an art, or craft, or vocation. In these university medical schools with whole time clinical teaching, the number of students is to be limited and the selection of applicants would seem to favor most those of research tendencies and scientific trend. "The teachers should be carefully chosen young men who have shown ability not only to teach but also to aid in extending the boundaries of medical knowledge." The plan, as outlined by one author, whom I quote, "will not provide the student with the wide experience with disease in its various manifestations which would make him an able practitioner. Modern developments require for medical education a scientific basis with a final polish added by a preceptor system correctly applied."

There is such a thing as *impractical* idealism being carried too far. Every one admits the merits and advantages of full-time teachers, in medicine, as in any other science. Certainly no one could belittle the importance of research; only a traitor to the ideals of the medical profession would seek to hinder in any way the closest practical correlation between clinical teaching, research laboratories, and experimental studies. The whole basis for medical advance has been founded upon just this cooperation between the clinical practitioner, artisan if you will, and the research devotee, each serving and advancing the same science, but there never has been, and never can be, created a science of medicine apart from the practice of clinical medicine. If this be true, any educational movement designed to segregate one from the other will be disastrous to each. It is not implied that the advocates of full-time medicine actually have any such idea in mind, yet many believe their academic tendencies have made them lose sight of certain fundamental and practical issues. The so-called full-time movement probably is a step in the right direction. It is an experiment the results of which must be awaited with patience. If it is to be the best system applied to medical education, it is imperative that certain guiding principles be borne in mind as the scheme is worked out. To an active practitioner and teacher some of the most important points would seem to be these:

1. The fundamental *duty* and *moral* obligation of any medical school is to supply a needy public with an *adequate* number of alert, sane, and trustworthy practitioners as eager to prevent as to cure disease. This demands that they be well grounded in those essentials upon which the intelligent practice of medicine is based. To meet this need contemporary medicine must undertake a radical revision of both the pre-medical and the medical curriculum along lines that will better develop altruistic and humanitarian motives as the controllers of scientific ardor. The elective system should be encouraged in certain ways but discouraged in others; undergraduate specialism curtailed; and *research,* during student years, to the neglect of acceptable proficiency in the fundamental sciences and their practical application prohibited or at least critically limited. "Applying themselves early to research young men get into back waters far from the main stream. They quickly lose the sense of proportion, become hypercritical, and the smaller the field, the greater the tendency to megalocephaly" (Osler). It is believed that if medical schools would uniformly adopt such policies, the public would be the gainer, specialties would not lack for devotees, nor would scientific advancement be hindered. Wise education seeks to simplify and make clear—never to complicate and confuse.

2. The teachers employed in meeting this moral obligation must be qualified both to impart knowledge and to inspire enthusiasm. These requirements can not be met except by men who have demonstrated their ability to advance clinical medicine. Clinical teachers of this type can never be replaced, at least from the students' viewpoint, by younger men of great promise, but deficient in a most important attribute, namely, "responsible experience." It must be remembered that students are best stimulated by contact with clinicians of mature development and accredited success. Such men can neither be created merely by appointment nor developed by fiat. There is food for serious reflection as to the correctness of a contemporary system that fails to give to medical students the *best* teachers available.

3. A medical school does not completely fulfill its moral obligation to the community by the conferring of medical degrees. It is obligated to keep behind its graduates—and provide for them, as well as other practitioners, ready means for post-graduate instruction, for training in the various specialties, and for opportunities for higher research work. Facilities, money and teachers alone will not meet the demands. Of the greatest influence in a medical school is a harmonious whole, and enthusiastic cooperation of faculty, students, and alumni, in the performance of a common task, and a total abstinence from the slightest trace of intolerant cliquism. Regardless of the size or source of the budget, medical education is bound to fail in schools in which such an

atmosphere is not developed and maintained.

4. Finally, a medical school, both by precept and example, must seek to inoculate a sustaining philosophy in the souls of its graduates. The philosophy of medicine implies a cheerful acquiescence to the burdens of the day. It inspires the unfortunate and cheers the depressed. It teaches how to encourage the hopeless as well as to relieve the suffering. It provides courage and fortitude with which to meet sorrow and disappointment. Lived up to, it insures a geniality of soul and tolerance for the opinions of others. Dishonesty is its most hated foe. Such a philosophy is needed by every successful clinician: it is practical even though idealistic. It does not develop best in the materialistic atmosphere of a pure science not learned and pursued in love.

CONCLUSION.—Brief reference has been made to a few of the dangers inherent in some of the very factors that have made contemporary medicine so brilliant. To infer anything short of an attempt to be constructively critical is to misconstrue. It is hoped that every clinical practitioner and teacher will ponder deeply on these and kindred topics, for clinical medicine is destined to come into its own in the near future. This will be hastened if the entire profession takes a more active share in the direction of education and the enforcement of needed reforms.

Progress and optimism are the natural progeny of health; they wither in the face of disease. Preventive medicine, through domination of the forces of nature and their utilization in promoting the welfare of mankind, is the ultimate goal of medical science. Through science the facts are discovered, through clinical practitioners their application is effected. The prevention and cure of many diseases to which mankind is heir depends neither upon the acquisition of knowledge through scientific research alone, nor its proper application to patients in the limited domain of each practitioner. Medicine must have behind it the tremendous power of a concordant public opinion. To win this, scientists, teachers and practitioners must miss no opportunity to become active agents in the proper transmission of all useful knowledge to the public at large. In no other way can humanity be freed from the pernicious influence of quack remedies, cults of false pretenses, and a host of kindred delusions which drain the physical and financial and psychic resources of thousands every year. When fads and personal whims are kept constantly subservient to the weight of judiciously proved opinion, and if devotion to truth characterizes the daily life of student and physician—a grateful public will generously support all forms of needed medical investigation.

SYDNEY R. MILLER

PHOTOPERIODISM, THE RESPONSE OF THE PLANT TO RELATIVE LENGTH OF DAY AND NIGHT[1]

IN an article published in 1920[2] data were presented tending to show that the length of day may exercise a remarkable regulatory action in initiating or inhibiting sexual reproduction in plants. In a number of species studied it was found that ordinarily the plant can attain the flowering and fruiting stage only when the length of day falls within certain limits so that in such cases flowering and fruiting occur only at certain seasons of the year. In this respect some species and varieties respond to long days while others respond to short days. Moreover, some plants are much more sensitive to change in length of day than are others. Since the publication of this paper the investigations have been extended to cover various other features of plant activity as affected by the prevailing length of day, including increase in stature, aerial and subterranean branching, formation of tubers and bulbs, root-growth, leaf-fall, dormancy and rejuvenescence. In collaboration with C. W. Bacon of this office fairly extensive biochemical studies of the subject have been carried out to ascertain the nature of the internal chemical changes involved and their relationship to the observed responses

[1] The writers are indebted to Mr. O. F. Cook, of the Bureau of Plant Industry, for suggestion of the term *photoperiodism* to designate the phenomena in question.

[2] "Effect of the Relative Length of Day and Night and Other Factors of the Environment on Growth and Reproduction in Plants," in *Journal of Agricultural Research*, Vol. XVIII, No. 11, March 1, 1920, pp. 553-606.

of the plant. Inasmuch as publication of the details of these investigations has been considerably delayed it seems desirable at this time to briefly indicate the principal conclusions reached. The duration of the daily illumination period not only influences the quantity of photosynthetic material formed but also may determine the use which the plant can make of this material. In general, there is an optimal light period for maximum upward or apogeotropic elongation of the stem which for some species corresponds to the long summer days of higher latitudes, while for other species the intermediate length of day of spring and fall (or the equatorial day length) is optimal. Changes in the light period to sub-optimum conditions for stem-elongation, resulting from appropriate increase or decrease in length of day, as the case may be, may initiate a series of characteristic responses which are definitely associated with periodicity in plant behavior. Reference has already been made to flowering and fruiting. There seems to be an optimal light period for sexual reproduction which tends to direct the energies of the plant more or less quantitatively toward flowering and fruiting. Again, departure in day length from the optimal for increase in stature causes loss of dominance of the apical bud, thus promoting various types of branching. Leaf-fall and entrance upon the rest period, also, result from exposure to a certain length of day which is unfavorable for stem-growth. It has been found that there may be an intermediate length of day especially favorable to dormancy or death while under both longer and shorter days activity of the plant may continue. Further changes of the light period by a sufficient increment or decrement away from the optimal for increase in stature and beyond the optimal for sexual reproduction tend to induce intense tuberization, a feature marking the final stages in reduction of stem-elongation. Formation of bulbs is induced by excessively long days while formation of tubers commonly results from excessively short days. This deposition of carbohydrate in relatively condensed or dehydrated forms as a result of an unfavorable light period indicates marked loss of power to utilize the products of photosynthesis in elongating the stem or in developing flower and fruit, a condition well exemplified in the stemless or leaf-rosette form of foliage development. The opposite change toward the optimal day length for stem-elongation may rescue typical annual plants from impending death and effect more or less complete rejuvenescence. The evidence indicates that the degree of hydration of the living cell content is brought under delicate control by the ratio of the number of hours of sunlight to the number of hours of darkness in the 24-hour period. Well defined correlation has been established between the hydrogen-ion concentration of the cell sap and the observed responses of the plant to change in the length of the day. Thus, change from the purely vegetative to the flowering and fruiting stage may involve marked change in hydrogen-ion concentration in the apical bud and even a reversal of acidity relations between the apex and the base of the stem. Correlation also has been found between the content of "available" carbohydrate (the simpler sugars) and the responses of the plant to differences in length of day. Causal relationships, however, have not been definitely established. It seems probable that the annual cycle of length of day, affording as it does a consistently rhythmic feature of the external environment, is a dominant causal factor in phenomena of plant periodicity, subject, of course, to the modifying influences of temperature and other environmental factors.

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FISH PARASITISM IN ITS RELATION TO BIOLOGICAL PROBLEMS OF THE NORTHWEST[1]

In this great Northwest of ours fish afford a natural resource of importance to the welfare of a good many citizens. Not only do the commercial interests utilize fish for market purposes, but the sportsmen derive infinite

[1] One of the papers in a *Symposium* on "Biology in Its Relation to the Development of the Northwest," presented at the meetings of the Western Society of Naturalists at Corvallis.

pleasure from angling them in every stream and lake which they can conveniently approach. And yet, it is no exaggeration to say that aside from some limited fish-hatching operations, we have done practically nothing to intelligently conserve these creatures for future generations.

Although there are a good many sides to the program of fish conservation, yet this evening I wish to bring to your attention only one phase of it, namely, fish-parasitism and point out some of the biological problems with which it is intimately linked up.

During the last few years I have been devoting a good deal of attention to fish-parasitism in the Northwest and can say that this is a field which has hardly been touched. There are great numbers of fish parasites in this region: *bacteria, protozoa, cestodes, trematodes* and *crustacea* which are infecting the fish and killing off great numbers of them. These afford many fields of investigation which are not only thoroughly scientific, but of great practical value. We need good taxonomic keys of these parasites, their life histories and their effects on the various hosts.

Furthermore, this knowledge should be supplemented by a careful study of the conditions within our lakes and streams which are conducive to fish-parasitism. At present we are working entirely in the dark, and as a result of it much of our good time, effort and money are wasted. I will cite but one instance along this line to make my point clear.

It is a common practice among our game commissioners to stock a body of water with fish and then to close it down for purposes of allowing the fish to multiply, with the view of obtaining a plentiful supply of spawn for hatching operations. My observations along this line have convinced me that this is an erroneous practice. In the first place, closing down a stream makes for a rapid multiplication of fish so that the available food supply soon becomes inadequate to maintain all of them. A fierce struggle for existence ensues in which many of the weaker, but nevertheless desirable fish are killed off. Even those that remain appear to be starved for lack of food. In the second place, the congested conditions within the stream make possible a rapid spread of any parasitic infection which happens to make its appearance among the fish. And lastly, when a stream is closed down for any length of time its shores afford an ideal, undisturbed habitat for many fish-destroying birds and other animals. These not only kill off large numbers of fish, but they may also be the means of disseminating various parasitic organisms among them.

It seems to me that before we can even talk of cure and prevention, we must know the parasitic organisms as well as the conditions which make parasitism possible. But, without these facts we are powerless to do any good. What is greatly needed in this Northwest section is a number of biological surveys for the purpose of studying and mapping out the various ecological factors of the regions in which fish or game are to be planted. We ought to know a good deal about such factors as available food supply, oxygen content, temperature variations, predatory and parasitic organisms, etc., of a place before any kinds of animals or plants are introduced into it. Knowing these conditions we can then intelligently fit each organism into that particular environment where it will thrive best. While the initial expense involved in the establishment of such surveys will be considerable, yet the benefits derived in the long run will more than repay us for our efforts.

Nathan Fasten
Oregon Agricultural College

THE THIRD ASIATIC EXPEDITION OF THE AMERICAN MUSEUM OF NATURAL HISTORY

The Third Asiatic Expedition of the American Museum of Natural History, in cooperation with the American Asiatic Society and *Asia* Magazine, will leave Kalgan on the nineteenth of April for the continuation of its work in Mongolia.

During the last six months field operations have been conducted in various parts of China which have been extraordinarily successful. All the members of the expedition's staff have now arrived in Peking and the final preparations are being made for the coming summer's work.

The personnel consists of 25 men as follows:

Scientific Staff:

Roy Chapman Andrews, leader and zoologist.
Walter Granger, paleontologist.
Charles P. Berkey, geologist.
Frederick Morris, geologist and topographer.
J. B. Shackelford, cinematographer.
S. Bayard Colgate, motor transportation officer.
Persender, assistant transportation officer.
F. A. Larsen, field manager.

Native Personnel:

3 Chinese taxidermists.
3 Chinese cooks.
2 Chinese chauffeurs.
3 Mongol interpreters (Chinese-Mongol).
6 camel drivers.

AREA TO BE INVESTIGATED

Central and Western Mongolia from a line between Kalgan and Urga, west to the eastern extension of the Altai and Tian Shan Mountains and south to the frontier of Chinese Turkestan. This region, part of which lies between two old caravan trails, consists of the most arid section of the Gobi Desert, of rolling meadowlands and foothills at the bases of high mountains, some of which are covered with perpetual snow.

The Third Asiatic Expedition will carry on a reconnaissance of its zoology, geology, paleontology and geography. This survey will be preparatory to a more detailed study if the future of the region proves to be of sufficient scientific interest.

PLAN OF OPERATIONS

Due to the short summer advantage must be taken of the warm months when scientific studies can be carried on successfully. This is between April 15 and October 1. After these months snowstorms are of such frequent occurrence that effective work is difficult.

The expedition has purchased 75 camels which are already on their way to a point known as Turin, 175 miles south of Urga, transporting food, gasolene, motor equipment and scientific apparatus sufficient for six months. At Turin they will await the other members of the expedition.

On April 19 the remainder of the party will leave Kalgan in three Dodge motor cars and two Fulton one-ton motor trucks. They will begin scientific work immediately after leaving Kalgan and proceed slowly to Turin to connect with the caravan. From Turin the caravan will be sent westward towards a region known as Sain Noin Khan. The scientific staff will follow in the motor cars. After proceeding for perhaps a hundred miles a camp will be made and the smaller automobiles will be utilized by the scientific party to carry on their work. Horses and camels will be used to explore such regions as can not be reached by the cars. After working in a circle about the first camp the scientists will move a few hundred miles further and the same method repeated. The geologist, paleontologist and topographer will occupy one car, the zoologists a second and the photographer a third. Each party will be a complete mobile unit equipped with its own cook, driver and assistants and can remain away from the base camp as long as it is desirable.

By the use of motors for rapid transportation over the less interesting areas, it is believed that three seasons' work can be done in six months. The camel caravan will be sent ahead from place to place, thus acting as a movable base and as a reserve if the motor transportation does not prove as successful as is expected. The use of motor vehicles in this remote region is an experiment which should have considerable importance in demonstrating how accessible the country can be made in the future. The motors are equipped with all the latest devices and such a complete assortment of spare parts is being carried that it would be possible almost to construct a complete car if one was disabled. Mr. S. Bayard Colgate, who has charge of the motor transportation, is an expert in his line and has spent several weeks in the Fulton and Dodge factories familiarizing himself with every detail of the construction and repair of the cars.

Supplies of gasolene, oil, food and other essentials will be obtained every four or five days from the camel caravan which will be sent ahead from point to point as the field of operations is changed.

It is proposed to bring back a very complete record in motion pictures of the work of the expedition, the life and customs of the people and the interesting features of the country. Mr. J. B. Shackelford, who is perhaps the foremost cinematographer of the United States, is equipped with three remarkable cameras which were invented by Mr. Carl Akeley of the American Museum of Natural History for natural history work. This camera can be leveled instantly without reference to the position of the tripod and with a turn of the wrist can be swung up and down, from side to side, or in any direction, thus obviating the clumsy panoramic device which is one of the most cumbersome features of the ordinary moving picture camera. A battery of lenses of all descriptions, including powerful telephoto lenses, will make possible the obtaining of animal photographs at long distances. Antelope, wild horses, wild asses and wild camels can be run down in the motor cars, and these exciting chases, which are a feature of hunting on the Mongolian plains, can be brought home in all their details. The expedition hopes to lasso many animals from the cars and send some of them alive to America. A complete record of the lives and customs of the Mongols, historically one of the most interesting peoples of the world, has never been attempted and this field has almost unlimited possibilities of the greatest scientific and popular interest.

Dr. Walter Granger, paleontologist of the expedition, ranks high in his profession throughout the world. Possibly no man is more familiar with the difficult technique of discovering and preparing fossils in the field than Dr. Granger. His many years of work in America on the evolution of the Eocene horse has brought to the American Museum of Natural History the finest collection of fossil horse material in the world. He also conducted extensive explorations in the Fayum Desert of Africa on the famous expedition under the direction of the distinguished president of the American Museum of Natural History, Professor Henry Fairfield Osborn. Dr. Granger has only recently returned from Eastern Szechuan, where he has been spending the winter investigating a fossil field not far from Wan hsien on the Yangtze River. This expedition has brought together an extremely interesting collection of fossils among which the primitive elephant *Stegedon* is particularly well represented.

Dr. Charles P. Berkey, who is professor of geology in Columbia University, has beeen connected with so many important operations in America, and is so well-known to the geologists of the world that special mention of his activities would be superfluous. Dr. Berkey, who has charge of all the geological work of the expedition will carry on a reconnaissance of structural geology and physiography of the areas to be visited in Mongolia and lay out general plans for further geological work. His attention will be particularly devoted to the Tertiary features of the region in relation to its bearing on the problem of the development of primitive man.

Professor Frederick Morris is a former colleague of Dr. Berkey in Columbia University and until the first of March was professor of geology in Pei Yang University at Tientsin. Professor Morris is an expert topographer and will have charge of the mapping and survey work of the expedition as well as assisting in geological investigations. Probably no man in America is better equipped for this work because of his exceptional ability in sketching and his familiarity with map-making and all phases of topographical study. A wireless equipment has been obtained and the American Legation wireless station will send over the correct time each evening at 7 o'clock, so that the exact geographical position of the party will be obtained.

Mr. F. A. Larsen, who will act as field manager in Mongolia, will bring to the expedition the benefit of his thorough knowledge of the country and its people and be of the greatest assistance in helping to adjust the various difficulties, such as will inevitably arise.

Roy Chapman Andrews, the leader and organizer of the expedition as well as directing the general operations, will conduct zoological investigations in mammals, birds, fishes and reptiles.

The purpose of the Third Asiatic Expedition is to carry on a coordinated investigation of various areas in Central Asia which have remained scientifically unexplored. It is the consensus of scientific opinion that the Central Asian plateau, including Thibet, Chinese Turkestan and Mongolia, was not only the point of origin and distribution for many forms of animal life which exist to-day in America, Europe and many parts of the world, but was also the so-called "cradle of the human race." Although its important relation to human ancestry has long been recognized, no coordinated scientific investigation has ever been conducted on a large scale. Its zoology, paleontology, geology and botany bear the most intimate relations to the ancestry of man and it is with reference to this problem, which is of world-wide interest, that the expedition will conduct its work. It will furnish material for the Great Hall of Asiatic Life which is now being added to the buildings of the American Museum of Natural History in New York City. The expedition also proposes to present to the Chinese government a duplicate series of its collections which it is hoped will be used as the basis of a National Museum of Natural History in Peking.

The cordial support which all the officials of the Chinese government have accorded the expedition and the facilities which have been given to it for prosecuting its work, indicate what a keen appreciation of the value of scientific work there is in China.

The Chinese Geological Survey for a number of years has been carrying on geological and paleontological explorations in various parts of China and has already become an institution of recognized importance throughout the world because of the high standard of its work. The survey has cooperated in the most friendly and scientific spirit with the Third Asiatic Expedition and a plan of operations has been agreed upon which is proving of great mutual benefit.

The expedition expects to return from Mongolia about October 1, 1922. At that time Professor Henry Fairfield Osborn, president of the American Museum of Natural History, will arrive in Peking with his wife and daughter to inspect the results of the work and to plan for future investigations.

Professor Osborn is one of the greatest living authorities on the evolution of man. His visit to Peking can not but be an important event in the scientific life of China.

Mr. Clifford Pope, assistant in zoology, will not accompany the expedition to Mongolia but will continue his studies of the reptiles, fish and batrachians of China. He has already obtained more than 10,000 specimens and will visit all the provinces of China before his work is completed.

Mr. James Wong, interpreter, will make an expedition to Szechuan Province while the main party is in Mongolia. His work will be an examination and reconnaissance of the caves along the Yangtze River preparatory to paleontological studies for the winter of 1922-23.

Mr. Harry R. Caldwell, assistant in zoology, will continue his zoological survey of Fukien Province during the summer.

ROY CHAPMAN ANDREWS

PEKING, APRIL, 1922

SCIENTIFIC EVENTS

THE UNIVERSITY OF HALIFAX

DETAILS of the plan recently announced for amalgamating all institutions for higher education in the maritime provinces of Canada into a central university at Halifax, with the assistance of the Carnegie Foundation, have been made public. Alumni of the various colleges at present are considering the proposal. The plan proposes:

1. That there should be formed in Halifax an overhead university connected with all the colleges, but not particularly with any one, which should do the work of graduate and professional schools for the provinces; that is, the work now carried on by Dalhousie University in law, medicine, dentistry and pharmacy, and that carried on by the Nova Scotia Technical College in engineering, should be done by the university, together with the junior and senior years and the scientific portion of the freshman and sophomore years of each college.

2. That the various colleges situated outside of Halifax, namely, Acadia, Kings, Mount Allison, St. Francis Xavier and University of New Brunswick, should move to Halifax, erect buildings of their own, provide dormitory facilities, class rooms, dining rooms, chapel and other needed buildings for their own students, and in general conduct the work in English, French, German, Latin, Greek, mathematics and history for the first two years, caring for the housing and discipline of their students.

3. That all examinations should be conducted by the overhead university and all the degrees, with the exception of those in theology, be conferred by the university.

4. That financially the Carnegie Corporation would be willing to assist the colleges which would have to move, and perhaps also the overhead university, so that the general scheme might be well started, and then it was hoped the provincial governments would provide any money necessary for the overhead university; but all fees for classroom work should be handed over to the university, and that the colleges should only do such work as their endowments would permit.

ACTIVITIES OF THE ROCKEFELLER FOUNDATION

A review of the activities of the Rockefeller Foundation in 1921, written by its president, Dr. George E. Vincent, will be issued in a few days. The things done by the foundation directly and through its departmental agencies—the International Health Board, the China Medical Board, and the Division of Medical Education—are summarized as follows:

Continued a quarter-million annual appropriation to the School of Hygiene and Public Health of Johns Hopkins University;

Pledged two millions to Harvard for a school of health;

Contributed to public health training in Czechoslovakia, Brazil, and the United States;

Aided the Pasteur Institute of Paris to recruit and train personnel;

Promoted the cause of nurse training in America and Europe;

Underwrote an experimental pay clinic in the Cornell Medical School;

Formally opened a complete modern medical school and hospital in Peking;

Assisted twenty-five other medical centers in China;

Promised a million dollars for the medical school of Columbia University;

Contracted to appropriate three and one half millions for the rebuilding and reorganization of the medical school and hospital of the Free University of Brussels;

Made surveys of medical schools in Japan, China, the Philippines, Indo-China, Straits Settlements, Siam, India, Syria, and Turkey;

Supplied American and British medical journals to 112 medical libraries on the continent;

Supplemented the laboratory equipment and supplies of five medical schools in Central Europe;

Defrayed the expenses of commissions from Great Britain, Belgium, Serbia, and Brazil;

Provided 157 fellowships in hygiene, medicine, physics, and chemistry, to representatives of eighteen countries;

Continued a campaign against yellow fever in Mexico, Central and South America;

Prosecuted demonstrations in the control of malaria in ten states;

Cooperated in hookworm work in nineteen governmental areas;

Participated in rural health demonstrations in seventy-seven American counties and in Brazil;

Neared the goal of transferring to French agencies an anti-tuberculosis organization in France;

Provided experts in medical education and public health for counsel and surveys in many parts of the world, and rendered sundry minor services to governments and voluntary societies.

THE ANNUAL MEETING OF THE AMERICAN CERAMIC SOCIETY

The American Ceramic Society held its twenty-fourth annual convention at the Hotel Statler, St. Louis, Mo., February 27 to March 3. One and a half days were devoted to general sessions, one and a half days to divisional meetings, and two days to plant visits.

An organization of 1,575 members, it has seven industrial divisions, all of them strong and independent of one another, but united in one body, the American Ceramic Society.

On the program for the general sessions, there were nineteen papers and seven films. The Art Division had seventeen papers besides demonstrations. The Enamels Division had seventeen papers, four colloquiums, and one extensive report of their research committee. The Glass Division had fourteen papers, six colloquiums and two reports of their research committee. The Heavy Clay Products Division had eight papers and four colloquiums. The Refractories Division had twenty-five papers and twelve topics for discussion. The Terra Cotta Division had fifteen papers. The White Wares Division had sixteen papers and three colloquiums.

The society is governed by a board of trustees consisting of the president, vice-president, secretary, treasurer, and five trustees. The president-elect is Frank H. Riddle, of Detroit, Mich.

Mr. Riddle finished his course at the Ohio State University in 1904 and since that time has had broad experience in the manufacture of art pottery, terra cotta and heavy clay products. He is at the present time consulting engineer and chief chemist of the Champion Porcelain Company and the Jeffery-DeWitt Insulator Company. For two years prior to the war, as well as during the war, he was a member of the technical staff of the Bureau of Standards. It was he, more than any one else, who developed the spark plug used in the aeroplane during the war. The spark plugs made prior to that time would not stand the high tension and were a source of disastrous breakdown. Mr. A. V. Bleininger, then director of the Ceramics Division of the Bureau of Standards, assigned Mr. Riddle to this problem and with him made investigations of the composition and methods of manufacture that resulted in the spark plug of exceedingly low coefficient of expansion and of very high dielectric strength. Mr. Riddle has been associated with the society for several years and has been a member of the board of trustees for two years. The society has enjoyed a very large growth in membership under his direction as chairman of the membership committee.

The other members of the board of trustees for the coming year are:

E. W. Tillotson, Mellon Institute, Pittsburgh, Pa., *vice-president.*

R. K. Hursh, University of Illinois, Urbana, Ill., *Treasurer.*

R. C. Purdy, Columbus, Ohio, *General Secretary.*

R. H. Minton, General Ceramics Co., Metuchen, N. J., *Trustee.*

F. K. Pence, Knowles, Taylor & Knowles, East Liverpool, O., *Trustee.*

R. M. Howe, Mellon Institute, Pittsburgh, Pa., *Trustee.*

B. E. Salisbury, Onondaga Pottery Company, Syracuse, N. Y., *Trustee.*

THE ILLINOIS STATE ACADEMY OF SCIENCE

ONE of the most successful meetings ever held by the Academy of Science was the fifteenth annual meeting at Rockford on April 27, 28 and 29. A strong representation of members attended, and the Illinois Branch of the Mathematical Association of America held its annual meeting in conjunction with the academy for the first time. Fifty-seven new members were elected to the academy; the treasurer's report showed a good balance on hand; members took part in presenting strong papers at the general and section meetings; and thus the academy affairs were shown to be in good condition.

Committees on membership, on ecological survey, on high school science and clubs and on publications gave interesting and encouraging reports.

The following resolution was adopted, and copies have been sent to all Illinois senators and representatives in Congress:

RESOLVED: (*a*) That the Illinois State Academy of Science records its earnest hope that in the tariff legislation now under consideration by the Congress of the United States, provision may be made for duty-free importation of scientific apparatus for the use of educational institutions,—a privilege that has contributed in no small degree to the wonderful progress made in science and its applications in the educational institutions of this country during the past few decades.

(*b*) That this resolution be spread on the minutes of the meeting and that certified copies of it be sent to the Senate and House committees by which the new tariff bill is being shaped up, and to each member now representing Illinois in the Senate and House of Representatives.

Another resolution was adopted urging the academy members to cooperate with other scientific organizations whose purpose it is to promote the use of the metric system of weights and measures, so that the public in general may become familiar with the advantages of this system, and so that proper legislation may be enacted. A committee on metric system was appointed to act on the above resolution.

The academy members were guests of the Rockford University Club at dinner April 27, and the Rockford Chamber of Commerce acted as hosts on one of the field trips April 29 down the beautiful Rock River Valley. A second field trip, taking two days, was conducted by H. S. Pepoon to Apple River Canyon. These geological and biological trips were much enjoyed.

The following officers were elected for 1922-1923:

President: W. S. Bayley, University of Illinois.

Vice-president: W. G. Waterman, Northwestern University.

Secretary: C. Frank Phipps, State Teachers College, DeKalb.

Treasurer: W. F. Schulz, University of Illinois.

Librarian: A. R. Crook, State Museum, Springfield.

C. Frank Phipps,
Secretary

THE THIRD INTERNATIONAL CONGRESS OF THE HISTORY OF MEDICINE

The International Society of the History of Medicine was founded in Paris on October 8, 1921. It has for its object the study of the history of medicine in all its branches and the coordination of research work in these subjects. A permanent committee has been established in Paris consisting of delegates appointed by sections of the society in various countries.

The society meets in congress every three years, and it has been decided to hold the next meeting in London from July 17 to 22, 1922. Meetings will be held at the Royal Society of Medicine, the Royal College of Physicians, the Royal College of Surgeons, the Wellcome Historical Medical Museum and elsewhere. There will be special exhibitions of objects connected with the history of medicine, surgery and the allied sciences. The loan of any objects of special interest from members will be greatly appreciated by the executive committee.

Communications are invited from members on subjects connected with the history of medicine in all its branches. The following subjects have been suggested for communication and discussion, but are by no means intended to exclude papers on any subject of general interest in connection with the history of medicine:

1. The principal seats of epidemic and endemic diseases in the Occident and Orient in the Middle Ages, including plague, gangrenous ergotism, leprosy and malaria.
2. The history of anatomy.
3. The revival of medical knowledge during the sixteenth century.

Communications should be addressed to: The General Secretary, Dr. J. D. Rolleston, 21, Alexandra Mansions, King's Road, London, S. W. 3.

The other officers are: President of honor, Sir Norman Moore, Bart., M.D.; vice-presidents of honor, Sir D'Arcy Power, K.B.E., F.R.C.S., Professor Ménétrier, Professor Jeanselme, Dr. Tricot-Royer; president of congress, Charles Singer, M.D.; treasurer, W. G. Spencer, O.B.E., M.S.

SCIENTIFIC NOTES AND NEWS

The Croonian lecture was delivered before the Royal Society on June 1, by Dr. T. H. Morgan, professor of experimental zoology in Columbia University. His subject was "The mechanism of heredity."

Dr. Ross G. Harrison, of Yale University, has been elected an honorary member of the Royal Academy of Medicine of Turin.

Dr. William Bateson, F.R.S., director of the John Innes Horticultural Institution at Merton, Surrey, has been elected a trustee of the British Museum, to fill the vacancy caused by the death of Lord Harcourt.

At the quarterly meeting of the Royal College of Physicians at Edinburgh it was resolved to offer its honorary fellowship to Professor Albert Calmette, of the Pasteur Institute, Paris, on account of his distinguished services to medical science.

The University of St. Andrews will confer the degree of LL.D. on July 7 on Sir P. R. Scott Lang, emeritus professor of mathematics in the university; on Dr. G. R. Marshall, professor of materia medica, University of Aberdeen; and on Sir Harold J. Stiles, regius professor of clinical surgery, University of Edinburgh.

John K. Haywood, chairman of the Insecticide and Fungicide Board of the U. S. Bureau of Chemistry, recently completed a quarter of a century of service at the bureau, and was the recipient of a gold watch from his present and former colleagues.

T. M. Bains, assistant professor of metallurgy at the Missouri School of Mines and Metallurgy at Rolla, Mo., has accepted the position of geologist with the Moctezuma Copper Company, Pilares de Macodari, Sonora, Mexico.

DR. EDWIN C. ERNST, St. Louis, was elected president of the American Roentgen Ray Society, central section, at the meeting held recently in Chicago.

G. R. MANSFIELD has been placed in charge of the section of the U. S. Geological Survey devoted to non-metalliferous deposits.

LEON F. CURTISS, instructor in the department of physics in Cornell University, has received an appointment from the National Research Council as national research fellow in physics. He expects to pursue special investigations at the Cavendish Laboratory, Cambridge.

THE Franklin Institute has awarded to Professor Eugene C. Bingham, of Lafayette College, its certificate of merit for his improved variable pressure viscometer.

THE Committee on Scientific Research of the American Medical Association has awarded to Dr. F. W. Mulsow, a grant of $225 for work on a selective medium for gonococcus.

THE new buildings of the Astrophysical Observatory at Potsdam are to be controlled for the next ten years by a committee consisting of the director of the observatory, Professor Einstein, Dr. Freundlich, Professor Bosch, and Dr. R. Schneider.

A TESTIMONIAL fund is being raised for Mr. E. Grey, field superintendent of the Rothamsted Experiment Station, who has completed fifty years' work at the station.

THE retirement of Professor Ambronn, of the Observatory at Göttingen, has been announced. Dr. Meyermann, formerly director of the Observatory of Tsingtau, and subsequently a prisoner of war in the hands of the Japanese, has been appointed to succeed him.

PROFESSOR P. P. VON WEIMARN has been appointed research associate of the Imperial Research Institute of Osaka, Japan, charged with the creation of a laboratory for research in colloids.

MEMBERS of the American Chemical Society resident in Morgantown, West Virginia, met at the university on May 12 to elect permanent officers for the North Western Virginia Section of the society, the charter, for which section was just recently granted. The following officers were elected: *President,* Dr. F. E. Clarke; *secretary-treasurer,* Dr. E. P. Deatrick; *vice-president,* Professor W. W. Hodge; *counselor,* Dr. H. G. Knight. The section consists of thirty-four members.

ON May 9, ex-Provost Edgar F. Smith, of the University of Pennsylvania, closed a series of public lectures given at Connecticut College by professors from Harvard, Yale, Columbia, the University of Minnesota, and the University of Chicago. Dr. Smith's subject was "Chemistry and civilization."

DR. JOHN A. DETLEFSEN, of the University of Illinois, delivered Sigma Xi lectures at Purdue University on April 21 and at Northwestern University on May 19, on the subject of "Recent experiments and observations bearing on the inheritance of acquired bodily modifications."

DR. RICHARD C. TOLMAN, director of the Fixed Nitrogen Research Laboratory, Washington, delivered a lecture on the "Quantum Theory," May 16, before the Scientific Society at Swarthmore College.

H. C. PARMELEE, editor of *Chemical and Metallurgical Engineering,* addressed on May 10 the Chemical Society of the Massachusetts Institute of Technology on "The chemist in public life."

AT a joint meeting of the Washington Academy of Sciences with the local section of the American Institute of Electrical Engineers, on May 18, Dr. A. Van Dyck, of the General Electric Company, delivered an address on "The vacuum tube in present day radio."

THE Miami Aquarium and Biological Laboratory, Miami Beach, Florida, on the grounds, building and equipment of which nearly $400,000 has been expended from private sources, has had a successful winter season of collecting and classifying, adding many new specimens to the exhibit in its fifty tanks. After careful deliberation the officers of the Miami Aquarium Association decided to close the station for the summer, in order that necessary changes in tank arrangement and water supply might be made and at the same time to save the heavy overhead operating expenses at a period of the year when daily attendance of visitors is very small. The station will open again next December. Seventy thousand persons visited the Aquarium during the recent winter and spring months—January to April, 1922. If the investigators specializing in ichthyology decide to take advantage of the unusual opportunity offered by the Biological Laboratory, it will hereafter be kept in operation continuously throughout the year; otherwise, the very heavy overhead expense makes its twelve-month-a-year availability prohibitive, and, as the station is supported by private contribution, its laboratory will not be kept open throughout the year unless a number of investigators decide to apply for tables.

The laying of the cornerstone of the building to be erected in Panama by the Gorgas Memorial has been postponed until February 7, 1923. It was intended to lay the stone during the visit to the isthmus of Dr. Richard Strong, of the School of Tropical Medicine of Harvard University and member of the governing board of the Gorgas Memorial, but on the suggestion of Admiral Braisted and others the ceremony was deferred until next year, on the occasion of a visit of a group from the American College of Surgeons. This group from the College of Surgeons, numbering several hundred, are planning a trip through South America to hold clinics in the principal cities. It is expected that they will hold a clinic in Panama. In any event the party will cross the Isthmus. That time is to be taken for the laying of the cornerstone of the Gorgas Memorial Building to be erected here. The building in Panama for the Gorgas Memorial is to be devoted to research in tropical medicine and sanitation, and will house laboratories as well as executive and record offices, etc. It will be built on the seafront, close by the new Santo Tomas Hospital, overlooking the Pacific. Its cost is estimated at about $500,000.

The Association to Aid Scientific Research by Women reports that at the recent annual meeting thirteen theses were submitted in competition for the Ellen Richards Research Prize of $1,000. Of these essays six were from Great Britain, five from the United States, one from Australia and one from a Russian woman doing research work in New York. Since its establishment the prize has been awarded five times, three times to American competitors and twice to English competitors. While the prize for 1922 was not awarded, as in the opinion of the judges none of the essays were of the same grade as those to which the prize has been awarded previously, the judges gave such high credit to one of the papers submitted that the association voted honorable mention with a grant of $1,000 to the author. This is the first time the grant has been made, and it carries with it the stipulation that "the grant shall be made only on the basis of submitted work and shall be used for the immediate continuation or completion of a definite piece of research." To these conditions the writer of the paper entitled "An investigation of the critical electron energies associated with the excitation of the spectra of helium and their significance in relation to certain modern views of the stationary states of the helium atom" has agreed and therefore the grant has been awarded to Miss Ann Catherine Davies, Royal Holloway College, Englefield Green, Surrey, England. Miss Davies holds the B.Sc. degree from the University of London, 1915, and the M.Sc. degree from the same university, 1917.

We learn from the *British Medical Journal* that the officers of the Section of Anesthetics at the forthcoming annual meeting of the British Medical Association in Glasgow have arranged the following program: (1) A discussion on the broncho-pulmonary complications following operation under anesthesia; (2) a paper and demonstration by Dr. A. L. Flemming on effects produced by exposing tissues to various concentrations of anesthetic vapor; (3) demonstration of anesthetic apparatus. The officers of the Section of Microbiology (including Bacteriology) have arranged the following provisional program: (1) "The bacteriophage," by Dr. F. D'Herelle (Pasteur Institute, Paris) and Dr. F. W. Twort; (2) "The bacteriology of influenza," by Dr. Mervyn H. Gordon; (3) "Some similarities and dissimilarities in the microbiology of plant and animal diseases," by Professor V. H. Blackman; (4) "Mutation of species," by Dr. W. B. Brierley. Demonstrations will be arranged by Sir William Leishman, Professor Graham Kerr, and others. The officers of the Section of Anatomy have chosen the following preliminary list of subjects for discussion: (1) "The relation of the urethra to the vagina," by Professor J. C. Brash (Birmingham); (2) "The naked-eye anatomy of the bone marrow, with age changes," by Mr. Piney (Birmingham); (3) "The teaching of anatomy by radiology in the anatomy department," by Dr. J. M. Woodburn Morison (Manchester); (4) "The problem of the structure of the vertebrate head," by Dr. W. B. Primrose (Glasgow); (5) A discussion on the administration of the Anatomy Act will be opened by Dr. Alexander Macphail. Dr. Adam Patrick (16, Buckingham Terrace, Glasgow, W.), one of the honorary secretaries of the Section of Medicine, writes to say that he or his co-secretaries will be glad to hear of any members who might wish to submit short papers in the section, in addition to having the names of any who desire to take part in discussions. The meetings of the sections will be held on Wednesday, Thursday and Friday, July 26, 27 and 28.

UNIVERSITY AND EDUCATIONAL NOTES

IT is announced that the contest of the will of Amos F. Eno will be settled out of court by the payment of about four million dollars to Columbia University. The 1915 will, which has been twice broken by juries but both times upheld by courts on appeal, gave the residuary estate to Columbia University. The will made bequests of $250,000 each to the Metropolitan Museum of Art, the American Museum of Natural History, the New York Association for Improving the Condition of the Poor, and the New York University. Had the will been broken finally, these institutions would have received nothing. Whether they receive the full $250,000 each under the settlement, or what proportion of the total they receive, is not disclosed. The Society of Mechanics and Tradesmen received $1,800,000 under the 1915 will, and had that will been broken would have received $2,000,000 under an earlier will. This institution could not therefore be called upon to sacrifice anything in order to satisfy the heirs, and will receive the full $1,800,000.

DR. SYDNEY WALKER, JR. has provided $200 per annum for a scholarship for the furtherance of research in physiology at the University of Chicago in memory of his son.

DR. HERBERT W. MUMFORD, who has been away for a year on leave of absence from the University of Illinois as director of live stock marketing for the Illinois Agricultural Association, has been appointed dean of the College of Agriculture as successor of Dr. Eugene Davenport, who retires after twenty-seven years service at the end of the present year.

DR. WALTER R. MILES, research psychologist at the nutrition laboratory of the Carnegie Institution of Washington, Boston, has been appointed professor of experimental psychology at Stanford University, to fill the vacancy created by the retirement of Professor Frank Angell at the close of the present academic year. Dr. Angell has been professor of psychology at Stanford almost from the time of the opening of the university, having joined the faculty in 1892.

DR. HARRY D. KITSON, professor of psychology at Indiana University, will lecture at the summer session of New York University School of Commerce and Finance, giving courses on employment psychology and the psychology of advertising and selling.

DISCUSSION AND CORRESPONDENCE

THE WRITING OF POPULAR SCIENCE

TO THE EDITOR OF SCIENCE: I have read with much interest Dr. Slosson's letter[1] referring to my recent remarks[2] regarding the writing of popular science. I fear that Dr. Slosson has missed the main object of those remarks. They were not primarily intended to discourage the presentation of "mere information," though they did aim to discourage the practice of calling such matter "science," and of describing it as "scientific," but they were especially intended to point out the need of driving home to the layman the fact that science does not consist in the accumulation and cataloguing of such information, but in the establishing of relations between observed facts.

[1] SCIENCE, 55: 480, 1922.

[2] SCIENCE, 55: 374, 1922.

The layman has for so long been fed, under the guise of science, upon mere information that has, so far as he can see, no significant use or relation to anything with which he or his neighbors are in any way concerned, that he has acquired a false idea of what science really is. He is prone to regard scientists as visionary, unpractical freaks who spend their time in hunting up queer facts and in dreaming fantastic dreams, as harmless imbeciles who putter around at things that are of no interest to any one else, who from a depraved taste talk a jargon that others can not understand, and who once in a while by pure chance stumble upon something that some more sensible individual is able to put to some real use. This false conception should be rectified. In my opinion this can not be done by the simple process of offering the layman a larger or a more varied diet of mere information, even though this diet is guaranteed to conform to all the pure food laws. It must be done by driving home the fact that the prime object of science is the establishing of relations between facts, the facts themselves being merely incidental to that, and in many cases of no other interest whatever; and by showing him that the facts that are presented for his consideration have significant relations to those he already knows and of which he appreciates the importance.

I realize that the preparation of articles suited to these purposes is difficult, and I sympathize with Dr. Slosson in the difficulty he is experiencing in getting them; but the presence of difficulties should not deter us from facing the issue squarely and trying to meet it. Articles setting forth relations between facts can not be reeled off by the yard, their preparation is slow and laborious; also it is a work purely of love, other recompense than the joy of the work being insignificant. Consequently, such articles can be expected only from those scientists whose daily work of getting a living is such that they have considerable leisure. Does this not in part explain why Dr. Slosson finds more writers of good popular science in England than in this country?

Be this as it may, I am convinced that the layman's keen interest in science will awake when, and only when, he has been brought to recognize that science is concerned primarily in the establishing of relations, and that thereby he will be enabled to forecast and to control future events with ever greater and greater certainty.

N. Ernest Dorsey
404 Maryland Building,
Washington, D. C.

To the Editor of Science: Certain scientific men are attacking us editors of daily and Sunday newspapers and charging us with fabrication and exaggeration in our presentation of scientific matter for popular reading. As the editor of the Sunday magazine section of a metropolitan newspaper which has for many years been doing its best to keep the general public informed of the latest developments in science, permit me to present the other side of the case.

In my earnest efforts to publish the truth, the whole truth and nothing but the truth about such matters, I have over and over again asked men who are eminent in their specialties to write articles for me. But, with a few rare exceptions, the articles they have furnished me have been failures, because written in a style that, however appropriate for a purely scientific magazine, was utterly unsuitable for the average reader, because filled with technicalities which only the highly educated could be expected to understand. The fault I have to find with our American men of science when writing of their specialties is that they fail to present their ideas in the simple language and with the clarity of expression which are so necessary if one is going to awaken the interest of the "man in the street." In this respect, they are far behind their British, French and Italian fellows.

So far as the New York Sunday *World Magazine*, over which I have authority, is concerned, it has been our persistent policy for the last ten years to print nothing except that for which we have the very best authority obtainable. We devote two pages every Sunday to scientific matter, the greater part of which is quoted literally from the scientific and medical magazines. Besides this, when any highly important scientific discovery is made, we devote a special article to it, generally in the form of an interview with either the discoverer himself or the greatest available authority on the subject, and all such interviews are revised by the man interviewed and not printed until he has given them his O. K. In other cases, the facts are taken from a book or article written by the discoverer and are presented as his say-so and not as ours.

Quite recently we have received from some of the most eminent scientists in the world letters heartily congratulating us on the way in which we have presented articles that had specially interested them. I recall one from the late Professor Baskerville, another from Professor Milllikan, and the most recent of all are from Dr. L. O. Howard of the U. S. Bureau of Agriculture and Professor E. L. Bouvier of Paris on a page review of the latter's book on the "Psychic Life of Insects," translated by the former, both of whom are enthusiastic in their congratulations.

I venture to ask if you can find fault with Mr. Arthur Benington's article "The Chemists' Battle with Death" on page 2 of our magazine section of Sunday, April 9? Is there anything in that which is lax, inaccurate or "falsified"? Is this a "hoax"? If so, the hoax is not ours, but that of the leading chemists of the United States. I might ask the same question about dozens of articles we have published within the last few years.

That there are newspapers which publish fake science, I know as well as you, and that there are scientists who lend their names to such fakes—at a price—you ought to know as well as I. But, in condemning the few fakers, it is unfair and unjust to condemn also those which are honestly striving to interest and inform the general public on scientific affairs.

I sympathize with Mr. Slosson in his difficulty of finding men with the ability to write on scientific matters for the general reader. I have had the same difficulty, but I flatter myself that I have a few men on the staff of the Sunday *World* whose knowledge of science may not be that of specialists, but is, what is far more valuable, broad, thorough and comprehensive, and to this knowledge they unite an ability to convey to the man in the street a good idea of even the most abstruse subjects—witness, for example, our exposition of the Einstein theory, which was the best really popular article on the subject that it has been my good fortune to read. My long experience proves to me that the worst writers on scientific subjects are scientific men, for the reason that they do not know how to make their writings interesting and it is manifestly futile to publish uninteresting articles, for no one will read them.

J. O'H. Cosgrave,
Sunday Editor

The World,
New York City

THE UNIVERSITY OF GRAZ

To the Editor of Science: A letter was received by me some time ago, the English translation of which runs as follows:

University of Graz, Austria.
Institute for Plant Physiology.

Graz, January 22-22.

Dear Colleague:

Due to the collapse of our exchange, the condition of science in this country is getting worse every day. This fact brings back to me the promise you gave me last fall, at the laboratory of Dr. Went (Utrecht, Holland). You promised me to send, after your return to the United States, the *Botanical Abstracts*, possibly also reprints of anatomical and physiological work.

I am forced to bring this conversation to your remembrance because I am unable to see any other way to obtain American literature. The value of the Austrian crown is so deeply depressed that the rate of exchange, even with Germany, is 60-70 crowns pro mark. To buy foreign literature is of course out of the question. The University of Vienna enjoys the support of many financially influential persons. Our small university in Graz, however, lacks any such support. It is even difficult to produce enough energy required for scientific endeavor.

My short stay with Dr. Went has shown to me clearly the hopeless position of our Austrian institutes.

Nothing will describe the situation better than the following statement: my (recently increased) annual income is about twelve thousand crowns (about $1.40). I hope you will not feel offended when, under such circumstances, I bring back to your remembrance the help you promised me last year.

Sincerely yours,

(Signed) K. LINSBAUER.

L. B. BECKING

DEPARTMENT OF BOTANY,
STANFORD UNIVERSITY, CALIFORNIA

REQUEST FOR PAPERS ON GEOLOGIC DIFFUSION

I HAVE received from Professor Raphael Ed. Liesegang, of the Institut für physikalische Grundlagen der Medizin, Schloss Str. 21, Frankfurt am Main, who is well known for his studies of diffusion and of the phenomena generally referred to as "Liesegang rings," a letter in which he requests that geologists who may publish, or who have recently published, papers dealing with the relation of ore deposition to colloid chemistry or diffusion will forward to him copies of their works. He explains that he desires these for abstracting for the "Kolloid Zeitschrift" and for use in the preparation of new editions of his books on *Geologic Diffusion* and on *Agates*. Hitherto he has obtained such papers by personal letters to their authors, but the present postage rate from Germany is so high as to make a continuance of this practice a heavy burden on his resources.

GEO. OTIS SMITH,
Director

UNITED STATES
GEOLOGICAL SURVEY

ATMOSPHERIC POLLUTION

READERS of SCIENCE have been in touch with the work of the Committee for the Investigation of Atmospheric Pollution. In the issue for April 22, 1921, a review of the Sixth Report is given, and in the issue for November 28, 1919, a summary of the Fourth Report.

The Seventh Report has now appeared[1] giving results of measurements of the deposits from 31 stations. During the year, automatic apparatus for measuring suspended impurity was set up at six stations.

The tables are similar to those in previous reports, and cover:

1. Monthly deposit for two selected stations, representative of high and low deposits such as central Birmingham and Rothamsted.

2. Total solids deposited monthly at all stations.

3. Mean monthly deposits at all stations for the summer half years, *i. e.*, April to September, 1919 and 1920.

4. Mean monthly deposits at all stations for the winter half years, *i. e.*, October to March, 1919-1920 and 1920-1921.

5 and 6. Classification of the stations according to amounts of various elements of pollution.

7 to 10. Totals of stations as classified for each element of pollution.

There is also a discussion of the type of deposit gage. The metallic gage, even when varnished, gave traces of metallic salts; and the glass gage proved too fragile; and finally enameled stoneware was adopted. One set of gages has been provided with Nipher shields to improve the catch; and it would seem as if the amount so caught now agreed closely with the catch of the rain gage, which was not the case previously.

A twin atmospheric pollution gage has been devised and put in operation at Rochdale by Dr. Ashworth and an attempt made to measure the quantity of impurities brought into the town and the amount carried out.

The west wind brought 14.8 tons per square kilometer; and 11.84 tons were carried out by the east wind. The data covered a period of five months. The amount brought in by the west wind, however, is not sufficient to account for Rochdale's high atmospheric pollution.

From the records of the instruments at the Meteorological Office it would appear that in London domestic fires are responsible for nearly two thirds of the total smoke.

The relation between health and impurity is discussed by Dr. J. S. Owens.

Curves were prepared in which the daily deaths of London were plotted with the data for maximum suspended impurity in the air. Temperatures were also considered.

There is a tendency for the death rate to reach a maximum when the impurity is highest or rather a little later.

On the whole there is no obvious relationship between the quantity of impurity and the number of deaths in London.

Dr. Owens also contributes an article on "London Fog in November," describing measurements made of the black particles. These

[1] M. O. 249. Meteorological Office, Air Ministry, London, 1922. Price 2s.

varied from .00013 mm to .00026 mm in diameter. The thickness of the water film was probably .0014 mm. He compares these with the diameters of fog particles measured by Barus in his experiments on atmospheric nucleation. He also treats of the sources of solid particles in London fogs. These come quickly, the air being relatively clean at 6 a.m.; and heavily laden with smoke fog by 9 a.m. When the air in London is fairly clear in winter, the amount of suspended matter is approximately 1 milligram per cubic meter; during a dense fog it rises to 5 mgs/m^3. A rough estimate of the weight of the impurity in a fog for an area of 310 square kilometers (120 square miles) and a height of 122 meters gives 193 tons. According to Dr. Owens the amount of smoke produced between 6 a.m. and 10 a.m. from domestic fires and factories is sufficient to account for this load of suspended matter over London on a foggy day at 10 a.m.

Dr. Owens touches on the amount of dust in expired air. It has been assumed by medical men that the air passage through nose and throat practically trapped all the solid impurities. He doubts this and some experiments which he made seem to prove that in ordinary breathing the expired air contained about 70 per cent. of the suspended impurity which entered during inspiration. It seems certain that suspended matter is not entirely removed by action of the respiratory passages. In fact, only about 30 per cent. is removed.

Quite a good deal of space is given to a discussion of the relation of visibility to suspended impurity. The discussion is technical and no definite conclusions are reached.

Research work on measurements of acidity in the suspended matter of air is in progress.

ALEXANDER MCADIE

SPECIAL ARTICLES

STUDIES OF THE POLLEN TUBES AND ABORTIVE OVULES OF THE GLOBE MUTANT OF DATURA

THE Globe mutant, like the twelve or more other $(2n+1)$ mutants already described (1 and 3), owes its mutant character to the presence of a single extra chromosome, the somatic number being 25 instead of 24. One of us (2) has shown by means of breeding tests that the inheritance of Globes is almost exclusively through the ovules, by which it is transmitted to only one quarter of the offspring whether the parent Globe is selfed or is pollinated by a normal diploid. Pollen from a Globe when applied to stigmas of a normal parent transmits the Globe complex to considerably less than 3 per cent. of the offspring.

Our colleague, Mr. Belling, finds that half of the pollen grains of Globe plants receive the extra chromosome. The fact that some of the ovules transmit the character, while some give rise to normal plants, indicates that a similar segregation takes place in the formation of the ovules. While the back-cross of Globes x normal pollen does not produce more than about one quarter Globes in the offspring, there are more than enough small aborted ovules in the seed pod to account for the missing Globes necessary to satisfy the expected 1:1 ratio of Globes to normals. We may safely infer, therefore, that half of the mature megaspores within the ovules receive the extra chromosome.

If there were no losses through bad pollen or abortion of ovules, the expected result of selfing $(2n+1)$ Globes would be 25 per cent. normal diploid plants with the formula $2n$, 50 per cent. $(2n+1)$ Globes, and 25 per cent. $(2n+2)$ Globes with two extra chromosomes in the Globe set. Instead, we get mostly normals, with only about 25 per cent $(2n+1)$ Globes and but rarely a $(2n+2)$ Globe.

The problem here is to find if possible exactly where the losses are incurred, whether in pollen grains which fail to germinate, in pollen tubes which fail to grow fast enough to reach the ovary, or which fail to fertilize the ovules, or entirely in zygotes which are lost in the aborted ovules.

Aborted ovules were counted in seed pods that were nearly ripe. These can be seen with a hand lens or binocular dissecting microscope on the enlarged fleshy portion of the placentæ among the seeds.

Two classes of aborted ovules were recognized, the tiny apparently unenlarged ovules and those that were distinctly enlarged. The enlarged ovules were doubtless fertilized while the tiny ovules which were probably but not certainly fertilized were counted as fertilized when they were located among the enlarged ovules and seeds.

Counts of the aborted ovules in well filled seed capsules resulting from abundant hand pollinations were as follows:

A. Normal x Normal, 6-9 per cent. (exact average for 5 capsules was 7.6).

B. Normal x Globe, 10-15 per cent. (exact average for 5 capsules was 12.8).

C. Globe x Normal, 22-34 per cent. (exact average for 5 capsules was 29.5).

D. Globe x Globe, 35-50 per cent. (exact average for 4 capsules was 39.4).

Since the Globe character is transmitted through the pollen parent in less than 3 per cent of the seeds, the discrepancy in the number of abortive ovules between A and B as well as between C and D suggests that 4-10 per cent. of the $(n+1)$ pollen tubes enter the ovary. More extensive studies will be needed to justify this tentative conclusion but the data at hand seems to indicate this and that there is a much greater mortality of Globe zygotes than of normals in embryonic development.

The style of Datura, as in many angiosperms, contains a central core of conducting tissue which is soft and fibrous, made up of narrow linear shaped cells, extending lengthwise of the style and terminating in the stigma where these cells become papillate. The pollen tubes, aided by a process of digestion grow down to the ovary through this tissue.

For a study of the pollen tubes, receptive stigmas were pollinated with a single layer of pollen in order to insure opportunity for uniform germination. This was done by applying the pollen in moderate quantities and blowing off the excess which was not immediately held by the stigmatic fluid. The styles were removed after a given period of time, scalded in hot but not boiling water (about two minutes) their cortex slit lengthwise by passing them through a groove in which the sharp corner of a fragment of a razor blade protruded slightly. This treatment facilitated the removal of the cortical tissue by dissection, leaving only the central strand of conducting tissue with which the stigma is continuous at the end. These central cores were stained in magenta (acid red), washed a little in water and mounted whole on a slide using concentrated lactic acid as a mounting medium and clearing agent. Balsam mounts were not found satisfactory but these lactic acid preparations have kept for more than six months.

Pressure applied to the cover glass will spread this tissue out in a thin layer, and the pollen tubes may be seen even under low power (better after 12-24 hours) as dark red streaks imbedded among the elongated pink-stained cells of the conducting tissue. Germinated pollen grains are transparent and may be recognized only by their empty shells (the exine walls) while the ungerminated pollen grains will stain a deep red. This method makes possible reliable counts of the number of ungerminated pollen grains and the num-

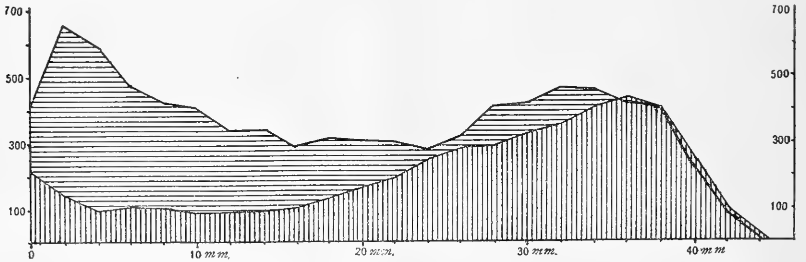

FIG. 1. Distribution of the pollen tubes in the styles of 18 Globes combined, and compared with 11 normals. Stigma is at left and the pollen tubes were growing to the right. Values plotted at O distance represent the ungerminated pollen grains.

ber of pollen tubes in various portions of the style at any given time after pollination.

Though a lateral displacement of the pollen tubes results from the flattening of these strands of conducting tissue, every pollen tube is practically in place with reference to its distance from the stigma or ovary. By means of a microscope equipped with a mechanical stage it was found possible to count their number and measure their distance from the end of the stigma, down as far as they had penetrated, from which their curves of distribution could be plotted and studied.

In the adjoining diagram the pollen tube distribution curves were made by superposing the pollen tube counts of a dozen or more styles whose foremost pollen tubes had penetrated to about 42 mm. The counts were made for 2mm. intervals and this represents their distribution about fourteen hours after pollination under fairly uniform temperature conditions—approximately 20°C. The bi-modal curve is for Globes selfed and represents a total of 8,365 pollen grains applied to 18 stigmas under similar conditions, while the curve of distribution for selfed normal plants is shown superposed on this and represents 4,691 pollen grains applied to 11 different stigmas. In the normals the germination was 95.6 per cent. while the Globe pollen selfed gave a germination of 94.9 per cent. The curves are much more jagged when the pollen tube populations from individual styles are plotted but those from Globes are quite as characteristically bi-modal.

The explanation offered is that though the Globe pollen selfed germinates about as well as the normal pollen selfed, there are slower growing pollen tubes among the rapidly growing ones and soon this population of gametophytes becomes resolved into two groups which grow at slightly different rates. This bi-modal character increases with time, and the slowest pollen tubes may fail to fertilize because they fail to enter the ovary before abscission of the style, or they may fail only because the ovules were already fertilized by the more rapid pollen tubes. Since the Globe character is only slightly transmitted through the pollen, we infer that the pollen tubes with $(n+1)$ chromosomes are the slow ones, while the tubes with n chromosomes are those in the lead.

While this study is very largely still in its preliminary stages, it seems to show that we have in Datura a selection between gametophytes, one of the special forms of Developmental Selection described by one of us (4), thus proving that this form of selection is subject to experimental study. The result of our preliminary study also shows that the Globe, as well as the other $(2n+1)$ mutants of Datura, illustrates a condition in which the mutations tend to disappear because they are not favored by the processes of Developmental Selection.

Literature Cited

1. Blakeslee, A. F., 1922; Variations in Datura due to changes in chromosome number. *American Naturalist*, 56: 16-31, Jan.-Feb.

2. ———, 1921; The Globe Mutant in the Jimson weed (Datura Stramonium). *Genetics*, 6: 241-264, May.

3. Blakeslee, A. F., John Belling and M. E. Farnham, 1920; Chromosomal duplication and Mendelian phenomena in Datura mutants. Science, N. S., 52: 388-390, Oct. 22.

4. Buchholz, J. T., 1922; Developmental Selection in vascular plants. *Bot. Gaz.*, 73: 249-286, Apr.

John T. Buchholz,
Albert F. Blakeslee
Station for Experimental Evolution,
Cold Spring Harbor, L. I.

THE MATHEMATICAL ASSOCIATION OF AMERICA

The sixth annual meeting of the Mathematical Association of America was held at the University of Toronto on Thursday and Friday, December 29 and 30, 1921. One hundred and ten were in attendance at the sessions of the association, 88 of these being members of the association. The following papers were read at the meeting aside from the papers by Professors Carmichael, Curtiss and Slaught on the program of the joint sessions with the American Mathematical Society, and Section A of the American Association:

Outlines of Certain Fields of Research:

(*a*) "Foundations of geometry," by Professor Oswald Veblen, Princeton University.

(*b*) "Calculus of variations," by Professor G. A. Bliss, University of Chicago.

(It is frequently urged that college and university teachers should be engaged in some form of productive work, but many college instructors do not know promising lines of investigation and do not know how and where to find the literature which will inform them what has already been done in various lines. A suggestion has been made that the Association can do a valuable service if on its programs and through the *American Mathematical Monthly* university teachers map out for college teachers possible lines of research growing readily out of college courses. These papers afford a beginning of such suggestions.)

"Courses in mechanics for students majoring in mathematics," by Professor E. V. Huntington, Harvard University.

"Topology of three-dimensional manifolds in three dimensions," by Professor Norman Miller, Queen's University.

"Functionality in mathematical instruction in schools and colleges," by Professor E. R. Hedrick, University of Missouri.

"An example in the inversion of upper limits and bounds," by Professor Samuel Beatty, University of Toronto.

"New mathematical periodicals," by Professor G. A. Miller, University of Illinois.

"Proof of the fundamental theorem regarding the length of a curve," Professor J. L. Synge, University of Toronto, by invitation.

At the business meeting the following officers for 1922 were elected:

President: R. C. Archibald, Brown University.

Vice-presidents: R. D. Carmichael, University of Illinois, and B. F. Finkel, Drury College.

Trustees: L. P. Eisenhart, Princeton University; E. V. Huntington, Harvard University; D. N. Lehmer, University of California; G. A. Miller, University of Illinois; E. J. Wilczynski, University of Chicago.

The trustees elected to membership 58 individual members and 4 institutional members.

The financial report indicated an estimated surplus of $240 on the year's business.

The full proceedings of the meeting were published in the *Monthly* for March, 1922.

W. D. Cairns,
Secretary-Treasurer

THE AMERICAN MATHEMATICAL SOCIETY

The twenty-eighth annual meeting of the society and the forty-eighth regular meeting of the Chicago section were held at the University of Toronto on Wednesday and Thursday, December 28-29, in affiliation with the meetings of the American Association for the Advancement of Science. The regular sessions of the society were held on Wednesday, President Bliss occupying the chair, relieved by Professors P. F. Smith and C. N. Haskins. On Thursday morning there was held a joint session with Sections B and C of the American Association and the American Physical Society, and on Thursday afternoon a joint session with Section A and the Mathematical Association of America. The attendance included 84 members. At the meeting of the council on Wednesday, 61 persons were elected to membership in the society.

At the annual election the following officers and other members of the Council were chosen: *Vice-presidents,* R. D. Carmichael and D. E. Smith; *secretary,* R. G. D. Richardson; *treasurer,* W. B. Fite; *librarian,* R. C. Archibald; *committee of publication,* E. R. Hedrick, W. A. Hurwitz, J. W. Young; *members of the Council,* to serve until December, 1924, J. W. Alexander, Henry Blumberg, L. L. Dines, F. R. Sharpe.

The total membership of the society is now 1,005, including 85 life members. The total attendance of members at all meetings, including sectional meetings, during the past year was 420; the number of papers read was 175. At the annual election 169 votes were cast. The treasurer's report shows a balance of $10,604.22, including the life membership fund of $7,528.87. Sales of the society's publications during the year amounted to $3,222.16. The library now contains 6,014 volumes, excluding 500 unbound dissertations.

The program of the joint session of Thursday morning was as follows:

I. Atomic nuclei and extra-nuclear electronic configuration, by Professor J. C. McLennan, retiring vice-president of Section B.

II. Symposium on quantum theory: for Section C, Dr. R. C. Tolman; for the American Mathematical Society, Professor H. B. Phillips; for the American Physical Society, Dr. Saul Dushman.

The joint session on Thursday afternoon has already been reported under Section A.

The following papers were read at the regular sessions of the society:

Differential geometry of an m-dimensional manifold in a euclidean space of n dimensions: C. E. Wilder.

Differential geometry of an m-dimensional manifold in a euclidean space of n dimensions. Second paper: C. E. Wilder.

A modification of Peano's postulates for positive integers: M. H. Ingraham.

Riemann geometry and its generalizations: L. P. Eisenhart and Oswald Veblen.

The problem of apportionment. The method of the weighted geometric mean: R. W. Burgess.

Necessary and sufficient conditions in the problem of apportionment: E. V. Huntington.

Commutativity of contact transformations of mechanics: S. D. Zeldin.

Substitutions which are commutative with every substitution of an intransitive group: G. A. Miller.

Seeming contradictions in the theory of groups: G. A. Miller.

Convergence-factors in Cesàro-summable series: W. A. Hurwitz.

Note on the determination of the rectilinear secular trend of an ordered series of statistical relatives: W. L. Crum.

Provisions for depreciation based directly upon appraisal: C. H. Forsyth.

Plane algebraic curves invariant under a given quadratic Cremona transformation: Arnold Emch.

Canonical systems and the general problem of dynamics: Joseph Lipka.

Euler squares: H. F. MacNeish.

The expression of general forms as determinants whose elements are forms. Preliminary report: H. S. Everett.

The arithmetic mean of the least and greatest of n measurements: E. L. Dodd.

Convex distribution of the zeros of Sturm-Liouville functions: Einar Hille.

On Kellogg's diophantine problem: D. R. Curtiss.

The isodyadic quintic equation: J. S. C. Glashan.

On the isodyadic septimic equation: J. S. C. Glashan.

Criteria for relative root distributions: C. F. Gummer.

The algebraic theory of algebraic functions: Samuel Beatty.

An algebraic proof of the existence of the branches of an algebraic function: I. R. Pounder.

On the determinant of an hermitian matrix of quaternionic elements: E. H. Moore.

Some properties of the surfaces which represent the real and imaginary components of a function of a complex variable: E. J. Wilczynski.

Note on differential invariants: O. E. Glenn.

Hesse's associated points and the Weddle surface: Louise D. Cummings.

Some of the principles of the operation with series applied to a partial fraction problem: I. J. Schwatt.

Expansion of powers of infinite series: I. J. Schwatt.

A symbolic theory of formal modular invariants: Olive C. Hazlett.

The equivalence of expansions in orthogonal functions: Norbert Wiener and J. L. Walsh.

The next meeting of the society was held in New York City on February 25, this being the only meeting held in New York during the spring.

R. G. D. RICHARDSON,
Secretary

THE two hundred and twenty-second regular meeting of the American Mathematical Society, being the seventeenth regular Western meeting, and the forty-ninth regular meeting of the Chicago Section, was held at the University of Chicago on Friday and Saturday, April 14 and 15, 1922, in honor of the twenty-fifth anniversary of the Chicago Section. The attendance at these meetings was approximately one hundred and fifty, and included one hundred and four members of the society.

At the meeting of the council, ten persons were elected to membership in the society. Professor A. B. Coble was reelected a member of the editorial committee of the *Transactions* for a term of three years, beginning October 1, 1922.

The council accepted for the society the trust of the Eliakim Hastings Moore Fund, tendered through Professor Arnold Dresden, chairman of the committee that had collected the fund; this fund is to be used for the publication of mathematical books and memoirs, and the award of prizes. In this connection a pleasant feature was the presentation at the dinner on Friday evening of a testimonial to Professor Moore from his former students and fellow-members of the Chicago Section. A more detailed account of this testimonial and of the establishment and purposes of this fund has appeared in SCIENCE.

The session on Friday afternoon was devoted to a symposium lecture by Professor A. B. Coble, on "Cremona transformations and applications to algebra, geometry and modular functions," followed by questions and discussion. The following papers were read at the other sessions of the society, those of Professors Dresden, Shaw and E. H. Moore being by request:

Abstract definitions of the symmetric and alternating groups and certain other permutation groups: R. D. CARMICHAEL.

On the zeros of successive polars of a binary form: D. R. CURTISS.

Relations between kindred P and Q functions: D. R. CURTISS.

On the equivalence of the Cesàro and Hölder means for multiple limits: C. N. MOORE.

On convergence factors in triple series and the triple Fourier series: BESS M. EVERSULL.

Independent sets of coaxial minors of determinants: E. B. STOUFFER.

On the minimizing of a class of definite integrals: P. R. RIDER.

On the approximate representation of periodic functions of two variables: ELIZABETH CARLSON.

Substitution groups whose cycles of the same order contain a given number of letters: G. A. MILLER.

Conformal transformations of linear homogeneous difference equations and their invariants: S. D. ZELDIN.

A new form of integral expansion: NORBERT WIENER.

Note on certain semi-invariants of n-lines: LENNIE P. COPELAND.

Residues of figurate numbers: O. E. GLENN.

Inter-variate correlation and the successive measures of dispersion in an ordered statistical series: W. L. CRUM.

Inter-variate partial regression equations in an ordered statistical series: W. L. CRUM.

Concerning relatively uniform convergence: R. L. MOORE.

On the cut-points of continuous curves and of other connected point sets in space of two dimensions: R. L. MOORE.

A solution of a spinning oblate spheroid two-body problem: F. E. CARR.

The elliptic modular functions associated with the elliptic norm curve E^7: ROSCOE WOODS.

Die Zerlegung von Primzahlen in algebraischen Zahlkörpern: ANDREAS SPEISER.

A boundary value problem in the calculus of variations: G. A. BLISS.

Certain generalizations of osculatory interpolation: J. F. REILLY.

A survey of the scientific work of the Chicago Section, 1899-1922: ARNOLD DRESDEN.

On functional transformations: J. B. SHAW.

On the determinant of a hermitian matrix of quaternionic elements. Definition and elementary properties with applications: E. H. MOORE.

Trigonometric expansion of aperiodic functions: T. C. FRY.

Mathematical paradoxes involved in the new Bucyrus gasoline shovel: R. S. HOAR.

On permutable quadratic forms in infinitely many variables: E. W. CHITTENDEN.

A fundamental system of invariants of a modular group of transformations: J. S. TURNER.

Note on a generalization of the strophoid: F. H. HODGE.

Ruled surfaces of Green-reciprocal correspondences: E. P. LANE.

The Laplace-Poisson mixed equation: K. P. WILLIAMS.

A criterion from integral equations relating to the existence of solutions for the one-dimensional boundary value problem: H. T. DAVIS.

A general criterion relating to the existence of solutions for the one-dimensional boundary value problem: H. T. DAVIS.

A continuous curve in the rôle of a space: R. L. WILDER.

Continuous transformations in analysis situs: N. J. LENNES.

On the foundation of the theory of sets: N. J. LENNES.

An error in the theory of differential equations by Lie's method: L. E. DICKSON.

Present status of the history of the theory of numbers: L. E. DICKSON.

The determination of a seasonal variation: W. L. HART.

Concerning compact Kürschák fields: V. D. GOKHALE.

A second mechanism for illustrating lines of force: W. H. ROEVER.

R. G. D. RICHARDSON,
Secretary

SCIENCE

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SURGICAL AND ANATOMIC EVIDENCE OF EVOLUTION[1]

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I PROPOSE in this address to approach evolution, not from the controversial side or from general arguments, but from a plain statement of a series of *facts,* many of them drawn from my personal experience as a surgeon and anatomist—facts which, to my mind, absolutely demonstrate the solidarity of animal life, more especially in the case of the vertebrates, such as fish, birds, other mammals and man, the highest mammal.

Many opponents of evolution admit the gradual development of animal life from its lowest form up to and including the anthropoid apes, but they draw the line there, basing this belief on the account in Genesis. Man, they insist, stands as a separate direct creation by the Almighty, "out of the dust of the ground." Such an argument is like declaring that the laws of mathematics reign in numbers up to, say, 100,000 or 1,000,000, but beyond that limit are no longer valid.

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Let me now point to facts—not theories but facts—which demonstrate this unity of the animal kingdom, including man.

1. Let me relate some operations I have done on the human brain. The brain in animals, including man, consists in a general way of (*a*) the cerebrum; (*b*) the cerebellum; (*c*) the spinal cord; and (*d*) certain structures which bind these three together. Extend the fingers straight forward. The fingers then resemble the "convolutions" on the surface of the brain; the furrows between them resemble the "fissures" between the convolutions of the brain. The principal fissures between the convolutions are similar in man and animals.

[1] Part of the Commencement Address at Crozer Theological Seminary, Chester, Pennsylvania, on June 6, 1922.

In the convolutions on the surface of the brain are certain small aggregations of motor nerve cells in the gray matter called "motor centers." On being stimulated by an electric current, these cells produce motion, each center in one definite portion of the body, and never in any other part. These motor centers are all grouped around the fissure of Rolando, which runs obliquely downward and forward above the ear. This, and another deep furrow called the fissure of Sylvius, are always readily identified in the lower animals. The motor centers for movements of the leg, arm, face, fingers, etc., in the brains of the lower animals, up to the anthropoid ape, have been exactly mapped out by experiments on animals. In the human brain the location of the corresponding motor centers is a duplicate of those in the brains of animals. Let me relate some striking cases to confirm this statement.

A young woman with epilepsy, in whom the attacks were constantly increasing in frequency and violence, insisted that her attacks always began in her left thumb, then spread to the hand, then to the arm, followed by unconsciousness and violent convulsions all over the body. Careful observation for two weeks in hospital confirmed her statements that the fits always did begin in this left thumb. If, then, I could prevent the fit from beginning in this thumb, so I reasoned, it might be that I could prevent the entire attack. Just as, in a row of bricks standing on end, if I can prevent the first one from falling, none of the others will fall.

The possibility of the exact localization of the little cube of gray matter on the surface of the brain, dominating all the muscles of the thumb, was the key to the whole operation. This localization of the thumb center had been made absolutely by experiments on the brains of animals. Accordingly, I opened her skull, identified the spot corresponding to the thumb center (*i. e.*, the great toe of the fore foot) in animals, and cut out a small cube less than an inch on each side.

Next, note the fact that there are nine muscles moving the thumb, some in the ball of the thumb, some between the thumb and the forefinger, some extending up the front of the forearm, and some up the back of the forearm, both of the latter reaching nearly to the elbow. Some flex and some extend the thumb, some separate it from the other fingers, and by one we can make the thumb touch each of the other four fingers. This is the motion which differentiates the human "hand" from the animal fore foot.

When this patient awoke from the ether, *every one* of these nine muscles was paralyzed and in *not a single additional muscle* was motion affected. The human brain center and the animal brain center for the thumb were proved to be *precisely identical.* My hopes were justified. Her epileptic attacks, which had occurred almost daily, recurred only about once in a year. In a few months she even regained full control over this thumb.

Two other later similar cases still further confirmed this wonderfully exact localization.

A fourth brain case: In 1888, I reported my first three cases of modern surgery of the brain. Attending the meeting of the American Surgical Association in Washington, when I read this paper, was Sir David Ferrier of London. He had contributed very largely to this then wholly new mapping of the brain centers which control motion. In one case, I described how I had stimulated a certain small, definite motor area in the brain of my patient by the battery,[2] and described the resulting movements of the arm at the shoulder. Ferrier afterwards said to me, "I could hardly restrain myself from leaping to my feet, for this was the very first demonstration on the human brain of the exact identity of my own localization of this very center in animals."

A fifth brain case: A midshipman in the United States Naval Academy at Annapolis, in 1902. I saw him three days after his accident. All the history I obtained was that he had been injured in a foot-ball game, had been unconscious for half an hour, and since then had complained bitterly of headache, which he located in his forehead. He was almost comatose, his pulse was only 52. There was no fracture of the skull. Soon after the accident, he developed local convulsions—note this care-

[2] The brain tissue itself is wholly devoid of sensation and can feel no pain.

fully—first in the right leg and later and chiefly in the right arm, but never involving the face. In six and a half hours he had had twenty-four of these convulsions, all in the right arm. The only evidence of a local injury was a slight bruise at the outer end of the left eyebrow. Had I seen this case prior to 1885—when I first made a careful study of the motor centers in the brain—I should have followed, of course, the only visible indication of the location of the injury to the brain, namely, the bruise. Had I opened his skull near the bruise, I should have been confronted with a perfectly normal brain. I should then have been compelled to close the wound and have perforce done nothing more. He would have died within two or three days.

But experiments on animals, after 1885, had shown that above the ear and a little in front of it lay the centers controlling the muscles of the face, the arm, and the leg, from below upwards, the leg center being near the top of the head.

As there was no fracture of the skull, and as the convulsions began first in the leg and then concentrated chiefly in the arm, but never extended to the face, my diagnosis was a rupture of the large artery on the surface of the brain over these motor centers; that the escaping blood had formed a clot, the edge of which first overlapped the leg center, but that the chief mass of the clot lay over the arm center. Moreover, I felt sure that it had not yet reached downwards over the motor center controlling the muscles of the face. Evidently, this clot must be immediately removed or he would quickly die. I opened his skull directly over the center for the arm muscles, and *far away from the bruise.* The opening in the skull at once disclosed the clot, the thickest part of which did lie exactly over the arm center, as I had foretold. I removed nine tablespoons (three-quarters of a tumblerful) of blood, which had caused the headache, the somnolence, the slow pulse and the convulsions; then tied the artery and closed the wound. He made an uninterrupted recovery. He entered the navy but some years later lost his noble life in saving his ship and the crew from destruction by a fire near the powder magazine.

Do not such exact localizations of the brain centers in animals, as directly applied to man, in hundreds, if not thousands of operations by now, most closely ally man to animals?

II. Go with me next into the Museum of the Academy of Natural Sciences in Philadelphia, and compare the skeleton of man with those of the lower animals. Practically, these animal skeletons all closely resemble the human skeleton, though when clothed with flesh and skin they look very unlike.

All of the ape and monkey skeletons are practically replicas of the human skeleton.

Look at the many skeletons with five toes—the prevalent or typical number—such as those of the cat, tiger, bear, elephant, etc.[3] Take, for instance, the front and hind legs that correspond to the arm and leg in man. Bone for bone, they are counterparts of the human skeleton—shoulderblade, humerus, radius and ulna (the two bones of the forearm), and those of the hand; with a similar correspondence in the bones of the hind leg and foot.

Nothing could be more unlike externally than the flipper of a whale and the arm and hand of a man. Yet you find in the flipper the shoulderblade, humerus, radius, ulna, and a hand with the bones of four fingers masked in a mitten of skin.

Observe the bones of the next chicken you eat. The breast bone of all birds has a great ridge developed to give a large surface for attachment of the large and powerful breast muscles for flight. You will find in the wing the counterpart of the shoulderblade, the humerus and the radius and ulna. The bones of the bird's wing, *i. e.,* the hand, are three in number, the bones corresponding to the little finger and the ring finger being absent. They are thus modified to support the feathers. It is a hand altered to suit the medium in which birds move so gracefully.

While undoubted evidence shows that man has existed for only about 500,000 years, the horse has a consecutive geological history of over 3,000,000 years. The skeleton of the earliest horse, which was scarcely larger than a cat, had four toes in front and three behind.

[3] Sometimes there are only four toes in the hind leg, or the fifth, if it exists, is rudimentary.

Gradually, all the toe bones except one—the middle toe—have been lost. But the second and fourth digits, though they do not show externally, are represented by two rudimentary bones, the two "splint bones." The horse of to-day walks literally on tip toe, for the hoof is the toe- or finger-nail.

III. The internal organs of the body have the same story to tell of likeness or identity. Let us first look at the *heart*. You all know there is a right side of the heart which sends the blood through the lungs to be oxygenated, and a left side, which sends the blood to all the rest of the body. Each of these sides has two cavities—the auricle to collect the blood, the other, the ventricle, with strong, muscular walls, to drive the blood on its long journey. These four cavities are all united into one heart, with an important *groove* on the surface, marking a partition between the two auricles above and the two centricles below.

A steady, rhythmical action of the four cavities is essential for the proper propulsion of the blood, and, therefore, for health and life. The four cavities act, not all at once, but in succession, like the feet of a walking horse—1, 2, 3, 4; 1, 2, 3, 4, each foot having its own number. Until 1892 we did not know exactly what regulated this orderly sequence. In that year, the younger Professor His discovered that in the groove between the auricles and the ventricles there was a small bundle of muscular fibers which existed as one bundle until it reached a certain point. There it divided into two smaller bundles, one going to the muscles of the right side of the heart, and the other to those of the left side.

But the great importance of this "bundle of His" was not fully appreciated until twelve years later (1904). If, under an anesthetic, an animal's chest is opened, the heart laid bare, and this "bundle of His" is injured, the rhythm of the heart is at once disturbed. Instead of 1, 2, 3, 4, the order in which the hoofs struck the ground might be 1, 4, 2, 3, or 1, 3, 2, 4, etc. This fluttering of the heart threatens life. If the bundle is destroyed, death quickly follows.

In man, such physiological experiments, of course, are forbidden, but occasionally disease maims or destroys this bundle of His in the human heart itself. A small tumor named a gumma, in a few cases, has formed directly in or near the bundle of His, and in some cases has destroyed it. This has deranged the action of the heart of the human patient, just as the physiologist did in the experimental animal. Severe flutterings of the human heart, with difficulty of breathing, a pulse slowed down from 72 to 20, 10 or even 5 in the minute were observed. Not seldom sudden death occurred. The post-mortem in these cases disclosed the tumor, or other cause, which had injured or destroyed this bundle of His, and was the immediate cause of death.

Now, this bundle of His is found in all vertebrates, in man and other mammals, in birds, and even in frogs and fishes. Does not this show a solidarity of the entire animal kingdom? Do not so many such exact parallels between the human and the animal body strongly suggest a close inter-relation of the two?

Even plants convey the same message. I have seen Professor Bose, of Calcutta, put plants to sleep with ether and chloroform. If enough is given, they are killed just as a man is killed. If only a moderate dose is given, the plant passes into a state of greatly lessened activity, which may be well called sleep. When the anesthetic is withdrawn, it gradually wakens and returns to its normal activity, just as a man does.

One can even descend still further down in the scale to the bacteria, that is, germs visible only by the microscope. As Welch, of the Johns Hopkins, points out, "The gentle killing of certain bacteria by chloroform enables us to detect in their bodies toxic [poisonous] substances which are destroyed by more violent modes of death."

IV. The Liver and the Ductless Glands. Everybody knows that the liver secretes bile, or gall. The bile, which is necessary for proper digestion, is discharged into the intestine through a tube called the bile duct. The gall bladder is simply a reservoir for extra bile, and a sturdy means of support for us surgeons, especially in the late hard times—by reason of the dangerous gall stones which form in it and require removal by a surgical operation.

Now, in 1848, Claude Bernard, of Paris, one of my own teachers in the middle sixties, discovered that the liver had a second function totally unsuspected until then. Practically all the blood from the intestines goes through the liver on its way back to the heart. Bernard opened the abdomen of a fasting animal, drew some of the blood *before* it entered the liver, and also some of the blood *after* it had gone through the liver. He found that the blood, before it entered the liver, was sugar free, but after it emerged from the liver, it always contained *sugar*. This was the first step in the scientific study of diabetes, in which there is an excess of sugar which is excreted through the kidneys.

But the liver has no second duct or tube for the discharge of this sugar into the blood current. Being in solution, it soaks through the thin walls of the blood vessels into the blood current as it passes through the liver.

Following this, came later the discovery of the now numerous "ductless glands" of which we have learned so much chiefly by animal experimentation in the last few years. Some of them, though only as large as a pea, are essential to life itself.

V. Let me now say a few words about one of the most important of these ductless glands—the thyroid gland in the neck. When it becomes enlarged it is familiar to us as a "goiter."

From this gland, as in the case of the liver, there soaks into the blood stream a secretion of great importance to life. If the gland is rudimentary, either in substance or in function, it results in that form of idiocy known as cretinism. As a remedy we have learned to administer an extract from the thyroid glands of animals. The remedy is usually remarkably successful.

In certain conditions, goiter is very prevalent in the thyroid gland of brook trout. It has even threatened to destroy the culture of these food fishes.[4] By the administration of iodin, this disease has been prevented in the trout. As a result of this success, the same method has been found efficient in preventing goiter in human beings.

Here, again, you perceive the solidarity of the animal kingdom in such identity of function that the thyroid gland of animals, when given as a remedy to man, performs precisely the same function as the human thyroid. Moreover, it is not the thyroid gland from the anthropoid apes that is used as a remedy, but that from the more lowly sheep.

VI. The Sympathetic Nerve and its wonderful phenomena. When I was a student of medicine, one of our text books was Dalton's Physiology. In connection with the sympathetic nerve, there was a picture of a cat, of which the Chessy cat of *Alice in Wonderland* reminded me, for in both only the face was pictured.

The sympathetic nerve is a slender cord about as thick as a fairly stout needle. It runs vertically in the neck, alongside of the carotid artery and the jugular vein, and so close to them that a dagger, a knife or a bayonet thrust, or a bullet which would cut the nerve, would almost surely cut the great artery and the vein. The patient then would bleed to death in a few minutes and never reach a hospital. Hence, no one had ever had a chance to observe the effects following division of this nerve in man. Before Brown-Séquard's experiment in animals, in 1852, its function, therefore, was entirely unknown. By a small incision he exposed the nerve in the neck of a cat, rabbit and other animals, divided the nerve, and observed what happened. The small wound healed quickly.

These results were as follows: 1. The pupil of the eye on the same side as the cut nerve diminished from the normal large sized pupil in the cat to almost the size of a pin hole. 2. The corresponding ear became very red from a greatly increased flow of blood, *i. e.*, the blood vessels were greatly dilated. 3. On that side there was increased sweating, that is, the sweat glands became very active as a result of the increase in the blood supply. 4. The temperature increased to a marked degree; in rabbits, by seven to over eleven degrees Fahrenheit.

Dalton's picture of the cat could not be forgotten because the two pupils differed so greatly in size.

In 1863, during the Civil War, when I was assistant executive officer of a military hospi-

[4] Kimball: *American Journal of the Medical Sciences*, May, 1922, p. 634.

tal, one day a new patient approached my desk just as I was about to sign a letter. The moment I looked up at him I was struck with his appearance and instantly said to myself, "Surely you are Dalton's cat." "Where were you wounded?" I quickly asked. He pointed to his neck and I said to myself, "His sympathetic nerve must have been cut." Further careful observation showed the reddened ear, the increased temperature, the sweating and the greater flow of saliva, thus confirming in every particular the results of Brown-Séquard's experiments on animals. It is interesting to know that this was the very first case in surgical history in which division of the sympathetic nerve had ever been observed in man.

Further experiments on this little nerve in animals revealed a wholly new world of most important phenomena. It was discovered that the sympathetic nerve sent branches to every artery in the body, from head to foot. Now the arteries are tubes, like the water pipes in a house, not, however, of rigid metal but soft and flexible, for they consist largely of muscular fibers which contract or relax automatically, making the arterial tubes of a larger or a smaller diameter according to the need for more or less blood.

For instance, just before a meal, the stomach is of a yellowish color. Not a single blood vessel is to be seen. An hour later the stomach has become so red that it seems almost as if the wall of the stomach is made up of nothing but blood vessels. This greatly increased supply of blood is needed to secrete gastric juice for the digestion of our food. As the food is digested, less and less blood is needed, the caliber of the arteries is gradually diminished by the contraction of the muscular wall of the arteries until the stomach looks as bloodless as before breakfast.

How fortunate that all this is automatic! Were it not, and after breakfast you forgot to order an increasing supply of blood for digestion, or if after digestion was accomplished, you forgot to shut off the blood, what would become of you?

The iris, the colored circular curtain inside the eye, with a round, black hole in the center called the pupil, is under similar automatic control of this sympathetic nerve. The iris is like a wheel. Around the pupil there are circular fibers which one may call the hub, while the rest of the iris consists of radiating fibers corresponding to the spokes. When you go out of doors, the bright light at first almost blinds you, but very quickly the circular fibers around the pupil contract so that the pupil becomes as small as a pin hole and protects the retina. On going into a dark room, at first you stumble over the furniture, but in a few moments the radiating fibers pull the pupil wide open and you see clearly everything in the room.

When you blush from emotion, the arteries of your skin have dilated. When you turn pale with fright, the caliber of your arteries is lessened, and if the arteries going to your brain supply too little blood, you fall in a faint. When you cut your hand, you know how all around the cut the redness shows that the arteries have dilated to furnish extra blood for the repair of the injury, and when the wound is healed, your blood vessels again contract and the redness at last disappears.

All these processes also are automatic. You do not have to remember to order blood to or from a cut hand, or to contract or widen the pupil, etc. It is all done for you; in fact, it is done in spite of you, for you have not the least control over these varying conditions. The automatic action of this nerve is of the utmost importance for many functions involving life itself.

I could go on almost indefinitely with a multitude of similar illustrations. All of our knowledge of these facts started from Brown-Séquard's little experiment of cutting the slender sympathetic nerve in the neck of an animal.

VII. Another evidence of our animal origin is found in organs which are well developed and actively functioning in some of the lower animals, but which in man are only rudimentary. The best known example of this is the appendix, which, in some of the lower animals, is well developed and functions actively. Its frequent inflammation is also a good example of the fact that such imperfect vestigial organs are very prone to disease and often require the surgeon's skill to avert disaster. The only really safe place for the appendix is in the surgeon's collection of trophies.

VIII. Let us now turn to the very significant evidence of our animal origin in the embryonic development of man. I have time to note but a single, though very enlightening instance.

During pre-natal development in man, between the two upper jaw bones is a triangular bone which carries the four upper incisor or "front teeth." At birth, and afterwards, there is normally no such bone because it has become fused on each side with the upper jaw bone. In sheep and some other animals, this always persists as a separate bone called the pre-maxillary bone. Now note a curious defective development in human fetal life. Sometimes this pre-maxillary bone, in the human embryo, fails to unite with the upper jaw bone on the right or the left side, and then we have what you all know as "cleft palate." If not only the bones fail to fuse together, but this failure extends also to the lips, we have a "hare lip." We see in some cases only a cleft palate, in others only a hare lip, in still others, both hare lip and cleft palate.

When there is such a deformity, it *never* occurs in the middle line, or any indifferent place, here or there, but invariably to the right or the left side and corresponding exactly to the site of the failure of this pre-maxillary bone to unite with the upper jaw.

Is not such an exact correspondence between the anatomy and development of the sheep and of the child most significant of the ancestry of the human body?

IX. Lastly, there have been discovered several grades of actual prehistoric men. Their skeletons or skulls, their flint instruments, and the remains of their fires are evidences of the grade of their several civilizations. This chain of human ancestors was unknown to Darwin, for they have been discovered since his death.

I have myself seen in the caverns of southern France the extraordinary and convincing evidences of the assured existence of our immediate ancestor, the Cro-Magnan man, who lived about 25,000 years ago. There are to be seen the work of the first painter and the earliest sculptor, prehistoric Sargents and Rodins of remarkable skill.

Before the Cro-Magnan man was the Neanderthal man, "whom we know all about, his frame, his head-form, his industries, his ceremonial burial of the dead," as Dr. Henry Fairfield Osborn has pointed out. Before him was the Piltdown man; before him the Heidelberg man; still earlier, in Java, the Trinil man; and still further back in geologic time was the Foxhall man—all named for the localities in which their remains were found. This earliest Foxhall man lived in England before the Great Ice Age, about 500,000 years ago.

The differences between the highest anthropoid apes and the lowest man gradually grow less and less the further we trace them backwards. We must clearly understand that no existing species of anthropoid apes could have been our ancestors. They and we are collateral descendants from ape-like species living far, far back in geologic time; before, and probably long before the Great Ice Age. The earth is very big, the various excavations have covered only a very minute part of its surface during only half a century. Every discovery has but confirmed the wonderful story of the ascent of man. Bateson, himself, who has been misquoted as an opponent of evolution, says: "Let us proclaim in precise and unmistakable language that our faith in evolution is unshaken. Every available line of argument converges on this inevitable conclusion."

Man's ascent from an animal of low intelligence seems to me to be absolutely proved by the many phenomena which reveal identical organs and physiological processes in the animal and the human body, a few of which, chosen out of a very great number, I have described. It is confirmed by the discovery of the remains of a number of prehistoric men, as is now definitely proved. This ascent of man, in perfectly orderly sequence, is far more probable than that evolution progressed up to the anthropoid apes and stopped there, and that God then made man by a separate, special, creative act, yet—*mirabile dictu*—with all these minute and exact correspondences of similar structures and functions in animals. Microscopically, the various structures in man and animals are practically identical. Even the tiny muscles moving the wings of insects, such as the fly and the mosquito, resemble microscopically the muscles of man.

If man was a special creation, the Almighty was not limited to the lowliest form of matter—the "dust of the ground"—as material for the human body. He could have created a nobler, a more subtle, a more puissant and exalted stuff out of which to fashion man. The plan and structure and function of man's body would then supposedly have differed *toto coelo* from man's present body. Probably it would have been free from the defects and deformities inherent to the animal body, and free from the diseases which it shares with animals.

But, no! God deliberately made man out of the same stuff as the animals, and, as I have shown, on the same plan as animals. Bodywise, man *is* an animal, but, thanks be to God, his *destiny* is *not* the same as that of the beasts that perish. To develop great men, such as Shakespeare, Milton, Washington and Lincoln, and then by death to quench them in utter oblivion, would be unworthy of Omnipotence. To my mind, it is simply an impossible conclusion. Man's soul *must* be immortal.[5]

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W. W. Keen

CULTIVATION AND SOIL MOISTURE

The question of cultivation in relation to soil moisture is one on which there has been difference of opinion among agricultural workers. The work of Professor Call of Kansas has tended to show that (under his conditions) cultivation, as cultivation, does not conserve soil moisture.

Since 1913 the writer has been engaged in agricultural work where the question of cultivation in relation to the conservation of soil moisture has been important. In the early years of this work the surface mulch idea, which is quite generally accepted by agriculturalists, was believed and used to explain the presence of ample moisture under cultivation when there was a deficiency without cultivation. When other features of plant growth were investigated some effects of cultivation, other than moisture, were brought out.

The recent controversy between Dr. Jerome Alexander and Mr. L. S. Frierson in the September 2, 1921, the February 10 and March 24, 1922, issues of Science has been interesting. One of these writers accepts the general view that cultivation of the surface of the soil conserves soil moisture by preventing surface evaporation, while the other does not believe that this is in accord with engineering experience. If our work had shown that, in cultivation, we were dealing with a moisture factor alone, the writer might agree with one of these two men without going into the specific conditions under which the data were obtained. Our work has shown that cultivation changes the composition of the soil solution and has an effect on the water requirements of the plants grown.

The Journal of Industrial and Engineering Chemistry for March, 1922, Vol. 14, No. 3, has the following in an article by the writer in discussing a composition basis for the water requirements of plants: "There is a common saying, cultivate to conserve soil moisture and you will have larger crops. The author believes that cultivation lets air down into the soil, thereby increasing bacterial activities which in turn cause the plants to get more food and grow larger on less moisture, would be nearer the truth. Experiments are reported 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.

In the field experiments we had plants growing well, *with* cultivation, when on the same soil *without cultivation,* lack of water in the soil was hindering plant growth. It was easy to say that these were the results of cultivation in conserving soil moisture but to find out how the mulch conserved the soil moisture was a problem for intensive study. The evident facts were that the well cultivated crops were not suffering from lack of water in the period of dry weather.

It was found that the soil having the water reserve had a higher concentration of plant food and the plants growing in this soil con-

[5] The full address will appear in the *Philadelphia Public Ledger* for Sunday, June 11.

tained larger quantities of the plant food elements. Plants of the same species are known to vary in analysis and plants of different analyses in our experiments were found to have different water requirements. It appears that if the soil solution is weak the plant transpires more water in its attempt to make a normal growth. The larger number of stomata on the leaves of plants with high water requirements substantiate this.

The results of cultivation are a different plant growing in a different soil and requiring less water per unit of weight.

In the spring the soils of the humid regions of the United States contain plenty of water and it is general observation that the results of cultivation (higher moisture in the soil) do not show up until periods of dry weather come. In the fall there is again plenty of water, under all systems of soil management. It is the author's belief, based on experimental results, that proper cultivation throughout the season will allow the plants growing on good soils to make their growth on enough less moisture (early in the season) so that they can keep on growing during periods of dry weather on what may be called an accumulative moisture reserve.

The summary of the water requirement paper in the *Industrial Journal* follows:

The results of field and greenhouse experiments recorded in the following paper indicate that fertilization of a soil which responds to direct or indirect fertilizer treatment allows the plants to make their growth on a smaller amount of water and to have a different composition from what they otherwise would.

The same effect is produced by cultivation, which by opening up the soil increases bacterial activity, which in turn gives increased concentration of the soil solution.

Proper fertilization and cultivation minimize dangers to crops from drought injury in humid regions of the United States by having the plant go into the drought period with an accumulative reserve of soil moisture.

This work opens up the study of fertilization from the basis of water requirement.

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THE COPPER ESKIMOS

I RETURNED in the autumn of 1921 from six consecutive years in the arctic regions. Three of these were spent for purposes of geographic and ethnographic study among the Copper Eskimos. I am now engaged upon writing up the results of that investigation, but, as there is no prospect of getting this printed before at least one year, I want to make a preliminary announcement about certain results of my archeological and ethnological work.

Previous to 1912, the eastern known limit of pottery among the Eskimos was Point Barrow (cf. Murdock on the Point Barrow Eskimos). Stefansson's work of the years 1908-12 extended the known pottery area eastward some six or seven hundred miles to Cape Parry, and he found it there in the most ancient ruins, indicating that pottery has been used by the Eskimos for centuries and perhaps by the earliest Eskimos who occupied that country.

Jenness has published the results of his two years spent among the Copper Eskimos (*Report of the Canadian Arctic Expedition,* 1913-1918, Vol. XII, published by the Department of the Naval Service, Ottawa). In this he does not mention pottery, which would indicate that he found none to the east of Cape Parry. In excavating various sites I have found pottery fragments as far east as Point Agiak, just west of Gray's Bay, or about 80 miles east of the Coppermine. This extends the known pottery territory some 400 miles east beyond Stefansson's results. Like Stefansson, I found the pottery deep down, indicating that it had been in use probably several centuries ago and perhaps by the earliest Eskimos. The implements associated with the pottery were of undoubted Eskimo type.

Previous to 1910 houses of earth and wood had not been reported from the western arctic coast of Canada further east than Pierce Point. Stefansson in his journeys along the coast the spring of 1910 and again the summer of 1911 found the ruins of earth and wood houses as far east as one mile east of Crocker River. In an appendix to Jenness' report (cited above) we learn that since his return in 1916 Captain Joseph Bernard, who entered the Copper Eskimo country only a few months after Stefansson in 1910 (see *My Life with the Eskimo,* by V. Stefansson, p. 258) has reported finding the ruins of houses made of earth and wood on southwestern Victoria Island. Jenness concludes that this is a sporadic occurrence and attributes it to a visit from the western Eskimos. Thus Jenness evidently assumes that the people from whom the present Copper Eskimos are descended never had wooden houses.

In 1919 A. H. Anderson found earth and wood houses on Cape Krusenstern and at various places in Coronation Gulf. Lastly, I have (during the years of 1917-1921) found ruins of the type of earth and wood houses used in Alaska and the Mackenzie River at intervals along the shores of Coronation Gulf to the above-mentioned Point Agiak. I also have accurate Eskimo information about the location of a village of the same type on the coast of Melville Sound due south of Kent Peninsula. Thus we find houses of wood and earth as far east as West Longitude 107°. For reasons which I cannot go into here, I consider it likely that future investigations will show a continuation of this chain of ancient earth and wood dwellings most if not all the way to Atlantic and Hudson Bay waters.

As it seems to differ from that of some other investigators, I want to record here the opinion (based on my studies in Coronation Gulf) that the present Copper Eskimos, who have no pottery and use no wooden houses, are in the main at least descendants of the earlier inhabitants who used pottery and wooden houses. My view is that the present culture (characterized in part by stone pots instead of pottery, and snowhouses instead of wooden houses) has been gradually evolved partly because the previous culture was never as well suited to the local conditions as the present, and partly because the local conditions have changed somewhat. One important feature of the change has been the lessening importance and eventual abandonment of whaling. My work shows that whaling was formerly practiced in certain parts at least of the Copper Eskimo country.

Harold Noice

The Explorers Club,
New York City

SCIENTIFIC EVENTS

THE BRITISH INSTITUTE OF PHYSICS

At the annual general meeting of the British Institute of Physics, held on May 23 in the rooms of The Royal Society, the following officers and board were elected to serve for the year beginning October 1, 1922: *President,* Sir J. J. Thomson; *past president,* Sir R. T. Glazebrook; *vice-presidents,* Sir Charles Parsons, Professor W. Eccles, Professor C. H. Lees, Mr. C. C. Paterson; *non-official members of the board,* Dr. R. S. Clay, Professor C. L. Fortescue, Professor A. Gray, Major E. O. Henrici, Sir J. E. Petavel, Dr. E. H. Rayner, Sir Napier Shaw, Mr. R. S. Whipple; *representatives of participating societies*—Physical Society, Mr. C. E. Phillips, Mr. F. E. Smith; Faraday Society, Mr. W. R. Cooper; Optical Society, Mr. John Guild; Röntgen Society, Dr. G. W. C. Kaye; Royal Microscopical Society, Mr. J. E. Barnard.

The annual report stated that there were 408 members of the institute at the end of the year, of whom 258 were fellows.

The institute is watching the possibility of establishing a central library for physics, although the financial difficulties in the way of its realization are stated to be considerable.

In the course of his presidential address Sir J. J. Thomson, after dealing with the project to establish a *Journal of Scientific Instruments,* spoke of the present depression in industry, but he made the reassuring statement that out of 67 students who graduated with distinction in physics and chemistry in 1921, 46 had obtained suitable positions, while 14 were doing research work. He hoped that the series of lectures on physics in industry which had been established would act to some extent as "refresher courses."

Speaking of the difficulties which the safeguarding of industries act had, in many instances, placed in the way of research, he characterized research itself as a "key industry" and he hoped that the government would put every facility in the way of research workers being able to obtain without delay the apparatus they required.

THE RADIO SERVICE OF THE UNIVERSITY OF WISCONSIN

EXTENSIVE new radiophone broadcasting services were started by Station WHA, University of Wisconsin, on Monday, May 29, to be continued throughout the summer and until further notice.

Noonday radio broadcasts, consisting of five- or ten-minute talks, will be sent at 1:05 p.m. five days each week. These talks will be by members of the university faculty and in many cases will be delivered in person. They will be on subjects of general interest and will enable the public to hear university men talking on subjects on which they are authorities.

A Tuesday night university radiophone lecture course was started on May 30. At 8 o'clock every Tuesday night a university professor will broadcast a twenty-minute lecture on a subject of general interest. The first lecture was a Memorial Day address delivered by Professor W. F. Lorenz, major in the Thirty-second Division, now actively associated with the rehabilitation of disabled soldiers.

These new broadcasting services will not affect the present services of University Station WHA. It will continue the Friday night musical appreciation course and radiophone news service of the University Press Bureau, as well as the daily market and weather reports and services for amateurs.

The schedules of each week in the new lecture courses will be sent to the newspapers in advance. The program of the first week was as follows:

1:05 Monday, May 29—"The Wisconsin Spirit," by Professor E. H. Gardner.

1:05 Tuesday, May 30—An address by President E. A. Birge.

8:00 Tuesday, May 30—Memorial Day address by Major Lorenz.

1:05 Wednesday, May 31—"The Medical Clinic," by Dr. J. S. Evans, director.

1:05 Thursday, June 1—"Spring Sports" by a member of university athletic department.

1:05 Friday, June 2—Readings by Dean F. W. Roe, of the English department.

SCIENTIFIC EXHIBIT AT THE MEETING OF THE AMERICAN MEDICAL ASSOCIATION

THE *Journal* of the American Medical Association states that this year the exhibit exceeded expectations in the number of exhibitors, while the quality of the work shown was of a high order. The setting for the exhibit was much better than usual; the booths were of pleasing appearance, painted green with white trimmings, and with overhanging plants. As has been customary, the exhibit was classified. The educational section included a number of exhibits of charitable or semi-public organizations. Probably the pathologic section was the most interesting. Here one found such exhibits as that on pelykography (Dr. Reuben Peterson, University of Michigan); studies on ringworm fungi (Mr. Robert Hodges, University of Alabama); specimens of flagellate protozoa under well illuminated microscopes (Dr. Kenneth Lynch, Dallas, Texas); work on the bile factor in pancreatitis (Drs. F. C. Mann and A. S. Giordano, Mayo Clinic); gross pathologic specimens and comparative Roentgen ray records (Dr. Eugene Opie, St. Louis), and the excellent work on renal circulation (Department of Urology, University of California). The most striking exhibit in the surgical section was the display of plaster casts and comparative photographs dealing with facial surgery; one half of the exhibit was devoted to civilian work, the other half to war reconstruction (Dr. Vilray P. Blair, St. Louis). In the medical section the diagnosis of syphilis from the laboratory point of view was well presented (Dr. Loyd Thompson, Hot Springs, Ark.); in another booth was an interesting exhibit of pigeons illustrating vestibular tremors (Dr. C. L. Woolsey, Boston). In addition to the foregoing were a large number of electrocardiographic exhibits. The total number of exhibitions was 48, thus divided: educational, 12; pathologic, 10; surgical, 6; medical, 6; electrocardiographic, 14. On the stage of the auditorium the work of the various councils and the chemical laboratory of the American Medical Association was shown.

The committee on awards, consisting of Drs. W. B. Cannon, George Dock and Louis B. Wilson, made the following recommendations:

The Gold Medal to Drs. Frank Hinman, D. M. Morison, A. E. Belt and R. K. Lee-Brown, of the University of California Medical School, for a study of renal circulation.

The Silver Medal to Mr. Robert A. Hodges, University of Alabama, for a study of certain culture-medium characteristics of ringworm fungi.

The Certificate of Merit to Dr. Vilray Papin Blair, St. Louis, for an exhibit of photographs and plaster casts showing various types of face restoration.

The committee also desires to give honorable mention to the following exhibitors:

Dr. K. M. Lynch, Dallas, Texas, for a study of the cultivation and differentiation of flagellate protozoa.

Drs. F. C. Mann and Alfred S. Giordano, Mayo Foundation, Rochester, Minn., for studies on the bile factor in pancreatitis.

Dr. Eugene Opie, Washington University, St. Louis, for a comparison of Roentgen ray records and gross pathologic specimens.

Miss Elizabeth Green, Barnes Hospital, St. Louis, for a demonstration of methods used in distributing books in hospitals.

THE ROME MEETING OF THE INTERNATIONAL GEODETIC AND GEOPHYSICAL UNION

Some 300 delegates and guests attended the meetings at Rome, May 2 to 10, of the Geophysical Union and of the Astronomical Union. Every country belonging to the unions had sent one or more representatives. There were besides present representatives from other countries (the neutrals during the late war), which have already joined the International Research Council and are making preparations to join one or more of the unions. The delegates from the United States for geodesy and geophysics were: Bowie, Bauer, Kimball, Littlehales Reid and Washington. All of the sections reported well-attended, successful and stimulating meetings.

Among the special social features, abundantly provided for by the Italian National Committee, were the following:

May 2, 3 p.m.—Inaugural ceremony at the Campidoglio, at which H.M. the King of Italy was present.

May 4, 9 p.m.—Reception of the delegates at the Campidoglio by the municipality of Rome.

May 8, 3 p.m.—Visit to the Palatino at the invitation of the under-secretary of antiquities and fine arts.

May 10, 1 p.m.—Visit to the Vatican and audience with the Pope.

After the meetings, various special trips were arranged for. Thus on May 12 visiting delegates were entertained by the municipality of Florence.

The Sections of Seismology and Volcanology were definitely organized, as well as a new section of Scientific Hydrology.

Professor C. Lallemand was reelected president of the union for two terms. The next meeting of the union will be at Madrid in 1924.

Louis A. Bauer

SCIENTIFIC NOTES AND NEWS

Dr. W. W. Campbell, director of the Lick Observatory, has been elected president of the International Astronomical Union in succession to M. Baillaud, director of the Paris Observatory. The Astronomical Union held its triennial meeting in Rome in May and will hold its next meeting in Cambridge, England.

Dr. Ray Lyman Wilbur, president of Stanford University, has been elected president of the American Medical Association for the meeting to be held next year at San Francisco.

Dr. Louise Pearce, of the Rockefeller Institute for Medical Research, has been elected a corresponding member of the Société belge de Médécine tropicale of Brussels, Belgium.

The John Scott Medal of the Worcester Polytechnic Institute was awarded at the commencement exercises to Elwood Haynes, head of the Haynes Automobile Company, in recognition of his discoveries in certain forms of high speed steels.

Mr. Gano Dunn, president of the J. G. White Engineering Corporation of New York, has been elected a member of the board of trustees of Barnard College, Columbia University.

Dr. F. Rossi, of the University of Bologna, has been awarded the Garibaldi Franco-Italian prize offered by the French Surgical Society for his work on "War Wounds of the Thorax."

Dr. E. Perroncito has reached the age limit and will retire from the chair of parasitology in the University of Turin. A celebration in his honor has been planned and subscriptions will be received by the Perroncito Committee, via Nizza 52, Turin, Italy.

DR. NORMAN MACLEOD HARRIS, of Dalhousie University, has been appointed chief of the division of medical research of the Canadian Dominion Department of Health.

SIR THOMAS HENRY HOLLAND, F.R.S., formerly director of the Geological Survey of India and later professor of geology in Manchester University, has accepted the invitation of the governing body of the Imperial College of Science and Technology, London, to be rector from September 1 next, in succession to Sir Alfred Keogh, who is rêtiring under the age limit.

MR. D. D. BEROLZHEIMER, assistant technical editor of the *Chemical Engineering Catalog* and co-author of the *Condensed Chemical Dictionary,* has been appointed manager of the Information Bureau of The Chemical Catalog Co., Inc., and of that of the service department of *The Journal of Industrial and Engineering Chemistry.*

ELBERT A. WILSON has resigned as director of the Pyralin Research Laboratory of the E. I. DuPont de Nemours and Company to enter private practice as a consulting chemical engineer.

MR. HARRY E. RICE has severed his connection with the R. R. Donnelley and Sons Co., printers, of Chicago, where he has been employed for several years in the capacity of chemist. He is now in charge of research and development work for the American Printing Company, also of Chicago.

THE following have been appointed as the official delegates of the United States to the International Chemical Conference at Lyons: C. L. Parsons, *chairman;* E. W. Washburn, *vice-chairman and secretary;* R. B. Moore, H. S. Washington, Edward S. Chapin and Edward Bartow.

DR. LOUIS A. BAUER, after attending the meetings of the International Geodetic and Geophysical Union, sailed from Marseilles on May 19 for Australia, where he will inspect the Watheroo Magnetic Observatory of the Department of Terrestrial Magnetism. He expects to visit the magnetic observatories in New Zealand and Samoa, returning to Washington early in September.

DR. AUGUST KROGH, professor of comparative physiology at the University of Copenhagen, who received the Nobel prize for medicine in 1920, will visit the United States in the autumn.

DR. LEONHARD STEJNEGER, of the U. S. National Museum, will spend the summer in the Commander Islands and other points of interest in and around Bering Sea. He expects to return in October.

DR. R. D. RANDS, for the past three years engaged in rubber disease research for the Dutch government at Buitenzorg, Java, has recently returned to this country and accepted an appointment as pathologist in the Office of Cotton, Truck and Forage Crop Disease Investigations, Bureau of Plant Industry. Dr. Rands will take charge of the department's work on diseases of beans, with headquarters in Washington.

THE *Journal of Industrial Chemistry and Engineering* reports that on May 10, the Society of Industrial and Micrographic Photography was organized at the Chemists' Club in New York. A further meeting to discuss and ratify the constitution and by-laws will be held on June 14. In the interim the following serve as an executive committee charged with preparing the constitution: *President,* James McDowell, Sharp and Hamilton Manufacturing Company, Boston; *secretary and treasurer,* Thomas J. Keenan, editor of *Paper,* New York; *vice-presidents,* J. H. Graff, Brown Company, Berlin, N. H., Bennett Grotta, Atlas Powder Company.

AT the annual meeting of the Congress of Physicians and Surgeons of North America, Dr. Frank Billings, Chicago, was elected president. Presidents of societies meeting with the congress were elected as follows: American Association of Pathologists and Bacteriologists, Dr. Paul A. Lewis, Philadelphia; American Climatological and Clinical Association, Dr. Charles W. Richardson, Washington; American Laryngological, Rhinological and Otological Society, Dr. Dunbar Roy, Atlanta, Ga.; American Ophthalmological Society, Dr. William H. Wilmer, Washington, D. C.; American Bronchoscopic Society, Dr. Samuel Iglauer, Cincinnati.

Professor Lewellys F. Barker, of the Johns Hopkins University, will give the annual address at the tenth annual meeting of the Eugenics Research Association to be held at Cold Spring Harbor on June 10. His subject is "Heredity and the endocrine glands."

Dr. William H. Welch, director of the School of Hygiene and Public Health, Johns Hopkins University, gave the commencement address at Bryn Mawr College on June 8.

Dr. Frederick V. Coville lectured before the Gamma Sigma Delta of Kansas State Agricultural College on April 26 on "The influence of cold in stimulating the growth of plants." At Manhattan Dr. Coville spoke before the staff of the experiment station on "Acid tolerant plants" and related topics.

Professor R. B. Moore, of the Bureau of Mines, delivered a public lecture on "The manufacture of helium by the government of the United States of America" at University College, London, on May 24. The chair was taken by Professor J. Norman Collie.

Dr. Jacob G. Lipman, of the New Jersey Agricultural Experiment Station, who is now traveling in Europe, delivered two lectures in Paris recently, the first before the Académie d'Agriculture on the condition of agriculture in the United States, the other before the Société de Chimie Industrielle on the fertilizer industry in the United States.

Dr. George E. de Schweinitz, retiring president of the American Medical Association, has accepted the invitation to deliver the Bowman Lecture in London, in 1923.

The medical profession and allied scientific bodies of Philadelphia are arranging for a celebration of he centenary of Pasteur's birth on December 27.

Emerson McMillin, a New York banker, who took an active interest in scientific work, died on May 31, at the age of seventy-six years.

John Allen Wyeth, founder and for forty years professor of surgery in the New York Polyclinic, died of heart disease, on May 28, at the age of seventy-seven years.

Ernest Solvay, distinguished for his process for the manufacture of soda, died in Brussels on May 26, at the age of eighty-five years. M. Solvay made large gifts for scientific and educational purposes.

Dr. René Benoit, former director of the International Bureau of Weights and Measures, corresponding member of the Academy of Science and of the Bureau of Longitudes, has died in Dijon at the age of 78.

A meeting was held in Toronto on April 28, of which the result was a resolution to form a Canadian Metric Association. A temporary committee was formed to draft a constitution and inaugurate action toward more definite efforts to popularize the system for the benefit of science and industry.

The Western Psychological Association announces the postponement of its annual meeting, originally announced to be held at Salt Lake City on June 22 and 23. A meeting will probably be arranged at Stanford University later in the summer.

The New England Intercollegiate Geological Excursion will have as its leader for the coming fall Dr. Ernst Antevs, who has been carrying on the work of Baron de Geer since the return of the latter to Sweden. Dr. Antevs will demonstrate the field methods used by him to obtain a record of the retreat of the ice since the glacial epoch. The excursions will be held on October 6 and 7, and the geologists will begin their investigations at Springfield, Massachusetts, following the Connecticut River northward.

The twelfth season of the Laguna Marine Laboratory of Pomona College will begin on June 21 and will last six weeks. Besides general classes in general biology and marine zoology, there will be opportuniy for special investigators. Eight private laboratories are provided for individual work. Dr. W. A. Hilton will be in charge.

The Division of Geology and Geography of the National Research Council has been informed by Professor Émile de Martonne, of the Sorbonne, Paris, that he has undertaken to direct the publication of a collection of photographic albums of the French regions. About sixty albums of fifteen plates each are projected, each picture to be chosen by Professor de Martonne, and to have about four lines of descriptive text. A high-grade mechanical reproduction is contemplated. Each picture will be reproduced in the form of a lantern slide. The publisher is Baudinière, 23 rue du Caire, Paris.

UNIVERSITY AND EDUCATIONAL NOTES

DR. HOWARD M. RAYMOND has been appointed president of the Armour Institute of Technology, filling the office that was made vacant by the death of Dr. Frank W. Gunsaulus last year. Since the death of Dr. Gunsaulus, Dr. Raymond had been serving as acting president. He has been with the institute for twenty-seven years, and since 1903 he has been dean of engineering.

ARTHUR J. WOOD, professor of railway mechanical engineering, has been appointed to succeed Professor E. A. Fessenden as head of the department of mechanical engineering at the Pennsylvania State College. Professor Fessenden goes to the Rensselaer Polytechnic Institute.

DR. WALLACE CRAIG, professor of philosophy and psychology in the University of Maine, has resigned. He will spend a half year in Great Britain and Germany. Dr. H. M. Halverson, of Clark University, has been appointed professor of psychology in the University of Maine.

DR. CARROLL C. PRATT, instructor in experimental psychology at Clark University, has been appointed instructor in psychology at Harvard University, where he will be associated in the laboratory with Dr. Langfeld and Dr. Boring. Dr. Floyd H. Allport, instructor in psychology at Harvard has been called to an associate professorship at the University of North Carolina.

ASSOCIATE PROFESSOR JACOB O. JONES, of the department of mechanics at the University of Kansas, has been appointed associate professor of hydraulics in the College of Engineering and Architecture at the University of Minnesota.

DR. E. P. CHURCHILL has been promoted from the position of assistant professor of zoology in the University of South Dakota to the professorship of zoology.

DISCUSSION AND CORRESPONDENCE

THE THERMEL

IN the early literature thermoelectric generators were classified, regardless of use or character, according to the number of their parts, into thermocouples and thermopiles. Some years ago, when it became clear that thermoelectric thermometers of widely differing complexity were going to be frequently used interchangeably or in combination, it seemed desirable to have a single not too lengthy name for them. The word "thermoelement," though not fully satisfactory, seemed to be the only word in use which would answer, and was accordingly proposed, in a paper from this laboratory, as a shorter synonym for thermoelectric thermometer. Its rather wide adoption indicates that the idea of a single short name for all thermoelectric thermometers is generally welcome, but the somewhat equivocal term, thermoelement, has been the means of some confusion. Leading writers, even, have spoken of such things as "multiple *thermo-couples,*" "thermocouple elements," "a multiple thermo-*couple* of four elements."

It therefore has seemed better to use the modified form "thermel." Logically, this may be taken as an abbreviation either of "thermoelement," or of "thermoelectric thermometer," both now in use. It is a handier word, even, than "thermometer" itself, and has received considerable approval. Since there appears to be, unfortunately, no authoritative body to which new terms can be referred for acceptance or rejection, we in this laboratory are taking the responsibility of using thermel in our publications, and recommend its general use. A thermel, then, may be a single thermocouple, or a *multiple thermel* or *thermopile,* containing more than one couple. Its distinguishing characteristic lies in being used for temperature measurement. The term "thermocouple" may, unmolested, preserve its original application to a single couple only. The term "multiple thermel" seems rather better than "thermopile" since it classes its object with other thermels or thermoelectric thermometers, whereas "thermopile" is more commonly associated with current generators, or with the special thermometry of radiation measurement.

Walter P. White
Geophysical Laboratory,
Carnegie Institution of Washington,

SOLAR ENERGY

"Creative Chemistry," by Edwin E. Slosson, M.S., Ph.D. (The Century Company), is a most interesting account of the astonishing number of important practical uses, in industry and war, of applied chemical science. For the benefit, apparently, of readers who are not educated chemists, or physicists, it makes occasional statements of pure science. One of these has the effect to revive the inquiry whether such statements ought not to refer to the observations or experiments on which they are based, unless readily available elsewhere. It reads: *"Solidified Sunshine.* All life and all that life accomplishes depend upon the supply of solar energy stored in the food." This is, in substance, but a repetition from prior publicists, many of them distinguished.

For example, Dr. Schuchert says: "Plants convert the kinetic energy of sunlight into the potential chemical energy of foodstuffs. Animals convert the potential chemical energy of foodstuffs into the kinetic energy of locomotion." And Dr. Soddy says: "Energy may sleep indefinitely . . . . In the potential form in coal, it has persisted for untold ages. Once released, heat is the sole ultimate product."

A quite extensive search has failed to find, in any literature, the account of an observation or experiment as leading to such conclusion. An elementary item of chemical teaching is that the sun's rays convert (approximately) 44 weight units of the comparatively inactive gas, carbon dioxide, into 32 like units of the universally active gas, oxygen, and 12 like units of carbon, ultimately a solid possessing no readily perceptible activity and incapable even of combination without the application of external heat. It is not easy for a non-specialist to believe, without evidence, that the energy of the sun's rays which decomposed the 44 units of the dioxide, adhered to the 12 units of carbon, and perhaps fell asleep there, while no noticeable amount went into the activity of the 32 units of oxygen.

Francis B. Daniels

SCIENTIFIC WORK IN RUSSIA

Scientific men may be interested in the following letter that I have received from Dr. Th. Fjeldstrup, of the Russian Museum at Petrograd:

The effect the arrival of this letter will have produced on you is probably that of something dropping into your hands out of space.

It is of no use speculating on the possible ideas you had as regards my fate, no more than on the picture you Americans have imagined to yourselves of the state of Russia's home life to-day, since they are based on scraps of news, often defective, given in papers or obtained otherwise—our two worlds have been separated too long and too completely in their intellectual life to know much of each other.

Often and often did I feel tempted to recommence correspondence with you, but the prospect of being read a year or so after having written, if at all, cut short all attempts of the kind. I have better hopes now and therefore I permit myself to remind you of my existence and send you my best greetings.

After an absence of almost full four years (since end of February, 1918) I returned to Petrograd two months ago. Throughout this long period I have had various occupations, not always agreeable to my inclinations, but this was unavoidable, nor could one expect to be allowed to choose. The scene lies beyond the Ural Mts.

I do not intend to waste your time by giving a detailed description of my doings in the run of these years. I shall only dwell for a moment on some facts that might interest you.

The summer of 1920 I spent as a member of a scientific research party sent out by the University of Tomsk in the region that you paid a short visit to before joining me in Verchni-Udinsk, viz., the Minusinsk region. The city of Minusinsk and its museum I visited twice. The curator of the museum is a new man since you saw it, but the state in which the archeologic collections are is exactly the same, I suppose—no worse. Mr. Kozevnikoff (the curator) is a zoologist.

Part of my time was dedicated to work among the natives (folklore and collections) and part to excavation of the Bronze age mounds (kurgans) under the directions of Professor S. Rudenko—Professor Volkov's pupil and his successor at the University of Petrograd now. (By the way, I suppose you have heard that Volkov, Radloff, Princes Oukhtomsky—son and his father quite recently—are no more).

Last summer we spent a couple of months with the Kirghiz of the Turgai region, "taking stock," so to say, of possibilities for work on a larger scale, if circumstances permit. Anthropometric measurements (800 individuals) and 2-3 Neolithic stations were among the results.

Next spring and summer I may return to the Kirghiz—they are in my department at the Russian Museum with which I am now scientifically connected.

In spite of unfavorable conditions and difficulties scientific work in Russia has not ceased to progress, and scientists of all classes continue their field and home studies with all the energy they are capable of. There is one great privation of which we are acutely sensible, and that is—book famine. We are so thoroughly isolated that scarcely any literary news comes filtering through the frontier. The appearance of a copy of some comparatively fresh publication from the outside world becomes known immediately to the circles interested in its subject, is welcomed with joy and every one tries to get at the book and have it lent to him for a time; individual book, periodicals, pamphlets, all one.

Without knowing what goes on elsewhere in science one feels like going about with plugs of cotton wool in one's ears.

Now, Professor Rudenko, with whom I am on very friendly terms, begs me to put a businesslike question to you in a quite unofficial way.

During your stay in Petrograd in 1912, you spoke to Professor Volkov and Pr. Oukhtomsky of the desirability of establishing here a bureau for the exploration of the northeastern portions of Siberia by Russians with American cooperation. Having this idea of yours in mind, Rudenko, who is now the curator of the Siberian Department and is proposed to the post of director of the Russ Museum,[1] would like to know whether you still think this project practicable, and if so would your or any other institution wish to participate in the realization of a series of expeditions to the Far East (Mongolia, the Amur region, Central Siberia) which would make it possessor of scientific results and collections. The Russ Museum has a sufficient number of well qualified explorers. The question of fitting them out for the field may prove difficult in some respects; but such difficulties would be easily allayed if the work were planned on the principles of cooperation.

[1] Formerly the Museum of Alexander III.

ALEŠ HRDLIČKA

U. S. NATIONAL MUSEUM

DOCTORATES IN AGRICULTURE

IN SCIENCE, Vol. LV, page 271, appears an article by Callie Hull and Clarence J. West on "Doctorates conferred in the sciences by American universities in 1921." Three theses are listed for the subject of agriculture. There are in universities, generally, no departments of agriculture, but colleges of agriculture consisting of departments using methods of their own development and methods of the different sciences in studying agricultural problems.

Students being trained for work in such departments are listed in the article mentioned as having done their work primarily in bacteriology, botany, chemistry and zoology, perhaps because the titles indicate that the methods of these sciences were used. The fact remains, however, that they were preparing to study agricultural problems. Thus, at Cornell University alone, at least fifteen of the persons named under these four sciences were working in the College of Agriculture, preparing to study agricultural problems. And from the titles, I can be certain of at least four such men for other universities.

If no names had been listed under the subject of agriculture, no harm could have been done, but to list a subject of agriculture with only three names, it seems to me, might leave the impression that, with the great development of the agricultural colleges, there is very little tendency for workers to secure the training necessary to attack problems in an effective way. I believe that every one acquainted with the conditions in the colleges is convinced that there is a very hopeful development of graduate work and that the number of young men who are securing sound training for effective work in agricultural subjects gives promise of very sound and rapid growth in agricultural research.

W. H. Chandler

New York State
College of Agriculture

THE WRITING OF POPULAR SCIENCE

To the Editor of Science: The letters of Dr. Dorsey and Dr. Slosson, which have appeared in Science, raise questions that have perplexed both scientists and editors of popular scientific magazines. Neither Dr. Dorsey nor Dr. Slosson, in my opinion, has struck at the root of the matter.

So long as the standards of American journalism are what they are, it will be difficult to enlist the whole-hearted cooperation of scientific men in popularizing the results of their researches. A distinguished biologist put the matter thus to me a few years ago: "We do not mind being popularized, but *we do mind being made ridiculous!*"

And there we have the whole truth in a nut-shell. Consider these facts which have come under my notice:

In the basement of the Bureau of Standards is an electric furnace used for conducting experiments at high temperatures. A Washington reporter, in quest of good red journalistic meat, was permitted to see that furnace in operation. On the following day there appeared an article from his pen in a Washington newspaper under the title, "Bureau of Standards Has Little Hell in Basement." Is it any wonder that the men in the Bureau of Standards look at him askance now?

During the days when Halley's comet was the subject of almost daily newspaper articles, about twenty Chicago reporters camped on the grounds of the Yerkes Observatory. Fearing complete misrepresentation of the work that they were doing, the members of the observatory staff granted no interviews. Finally, one ingenious reporter suggested that he be permitted to photograph the entire staff on the steps of the observatory. Inasmuch as all the reporters had been treated rather haughtily, it seemed as if this harmless request might be granted. Accordingly, the staff posed. Two days later, there appeared in a Chicago newspaper a photograph of one of the astronomers—a distinguished telescopic observer—seated at the eye piece of the huge Yerkes refractor, but in a position outrageously absurd. His photograph had been cut out of that made on the observatory steps, pasted upon a lifeless picture of the refractor, and the whole reproduced, with results that astonished every astronomical observer who saw the newspaper. The observatory staff was kept busy explaining to its colleagues all over the country how this absurdity was perpetrated.

Washington scientists surely have not forgotten the great injustice done to Samuel P. Langley at the time when his historically important experiments with his man-carrying airplane were conducted. If ever a scientist's life was embittered and shortened by gross newspaper misrepresentation, it was Langley's.

Our newspapers and magazines are right in demanding what they call "human interest." It is what science does for mankind that is interesting. The best popularizers of science have always been humanly interesting—particularly the men who have had theories to propound which were not readily accepted by their colleagues.

The campaign waged by Darwin and his colleagues was a conspicuous example of sound popularization. But our newspapers and magazines ride human interest too hard. The one thing that seemed to strike our reporters about Einstein was the fact that he smoked a pipe and that his hair was disheveled. At the moment, I do not recall more than two articles on Einstein in the newspapers that pointed out the tremendous practical significance of his theory of relativity—the fact that chemists, physicists, engineers and astronomers must henceforth reckon with time, space and motion in a new way. What Edison eats for breakfast seems to be of more importance than what Edison has actually achieved. So long as our newspapers publish simply gossip and the news of death and destruction, we have little to hope from them. If anyone were to write a history of the United States one hundred years hence, with no other information before him than that contained in current newspapers, he would inevitably draw the conclusion that Americans of our day led scandalous private lives and were savagely addicted to killing one another. Curiously enough, only the advertisements would save him from presenting an utterly distorted picture of present day life and manners.

Since these are the editorial standards of the day, is it any wonder that scientists hold aloof from the reporter? Is it any wonder that they *do not wish to be made ridiculous?*

In Europe it is otherwise. I have never had any difficulty in securing whole-hearted co-operation from English, French and German scientists. They send their portraits on request—something that American scientists hesitate to do. They write delightful scientific *feuilletons,* many of them models of simplicity and clarity. They recognize their journalistic obligation to the public at large. But when they come to this country, they soon learn the wisdom of withdrawing into their shells.

The newspaper and magazine editor constantly uses the stock argument that he "gives the public what it wants." But does he really know what the public wants? Would any magazine or newspaper editor have predicted that Wells' *Outlines of History* or Van Loon's *Story of Mankind* would have sold in editions of one hundred thousand and more?

The *Saturday Evening Post,* with a circulation of over two million, publishes articles on economics and industry which are, in the main, excellent examples of what the popularization of technical subjects should be. It has its standards of human interest, but it does not forget that the *facts,* simply, humanly, and interestingly presented are "what the public wants."

It is possible that the schools of journalism which have been established in various parts of the country may bring about a reformation of editorial standards through their graduates. Not much is hoped for from the publishers themselves.

WALDEMAR KAEMPFFERT

MR. SLOSSON's indictment of American scientists, in your issue of May 5, for their failure to write interestingly and attractively about their work is all too true. As a teacher of English, I have observed the same failure throughout our universities. Among both faculty and students an opinion prevails that there are but two general ways of writing: a so-called literary and polished style fit only for esthetes and poets; and a crude, inchoate style that marks the profound researcher and busy technician. The scientific man generally thinks that he hasn't time to "polish" and "adorn" his sentences; therefore he slips into the slovenly jargon that he sees is customary among his colleagues. He fails to notice that there is a middle ground of simple, clear English that can be made interesting and attractive without his becoming a poet or an esthete. Mr. Slosson's English is an example. Another example of a scientific man who taught himself to write excellent English was Professor John W. Draper, of New York University. His volume of "Scientific Memoirs" is a model of clear, incisive prose.

Professor Draper won the Rumford medals and was the first president of the American Chemical Society. But look at the accounts of chemical research as published to-day, and see what they have become from the point of view of English or readableness. Look at the tiresome, too-modest statements, phrased in passives and circumlocutions to avoid saying "I" or "me." Pick a sentence at random and try to tell what it means without reading it several times. Such a style is supposed to indicate the scientific, objective researcher. The awkward sentences and confused transitions are supposed to connote the profound scholar intent on his specialty. The curious thing is that many chemists can write well if they choose. But when they begin to explain their work, they drop into professional jargon, which disguises their real ability. Such jargon is the custom. It makes all the articles alike, looks technical, dulls the interest, eliminates the personal element, and discourages discussion.

Mr. Slosson hints that he would like to see the great events in the history of science described in their proper dramatic significance. So should I, and if such descriptions could be included in a text-book on the history of science for use in colleges, it would be a great benefit to teachers.

PHILIP B. McDONALD

COLLEGE OF ENGINEERING,
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To the Editor of Science: There is one point in Dr. Allen's letter of April 28 that I think will bear further emphasis. As he points out, most editors will print sound scientific "stuff" which they can get for nothing. But they won't pay a living wage to the man who writes it.

I have been doing this sort of work, off and on, for a quarter century. In fact, for some years I actually supported myself—at about the clerical level. Those were the days when "the Old Man" edited McClure's and cared more for the permanent repute of his magazine than for selling out any single issue. Newspaper work paid decently. One could occasionally make a short story of a scientific item. Even the women's publications used to buy semi-scientific articles on diet and child training.

Now all this is past; I haven't tried to sell anything since the war. It takes about as long to verify all the statements in one article as it does to write another. The verification is a labor of love, for which no editor will pay. The writer with an unhampered imagination can turn out stuff that the public prefers; and he can do twice as much of it in a day. My old market is absolutely dead. In the present day market, I can compete neither with the men who are selling their product, nor with those who are giving it away.

Dr. Allen's solution, I heartily agree, is for the moment the only practical one—though I doubt whether, in the long run, the public will get much good out of anything that it isn't willing to pay for. Nevertheless, I cannot help thinking that the condition which Drs. Allen and Slosson are trying to cure is only a symptom, not the real disease. For the fact is that the world just now is being simply drowned in a vast wave of superstition, that is bringing in every sort of pre-scientific opinion that the nineteenth century thought disposed of for good and all. My own town, for example, makes education its leading industry. But our public library has to buy books, just off the press, on palmistry, handwriting, character reading and fifty-seven other varieties of nonsense; while, significantly, it owns no old volumes on any such topics. The current number of the *Atlantic Monthly* carries the advertisement of a professional astrologer!

Here then lies the real trouble: The reading public does not know good science from bad; but if it did, it would certainly choose the bad.

E. T. Brewster

Andover, Mass.

NOTES ON METEOROLOGY AND CLIMATOLOGY

THE STREAMFLOW EXPERIMENT AT WAGON WHEEL GAP, COLORADO

Students of hydrology have always had a keen interest in the relation of run-off to the forestation of watersheds, and there has been much theorizing as to the probable relation. But there are so many factors involved—evaporation, transpiration, interception, etc., these, in turn, being influenced by the geological, phenological, and meteorological character of the watershed,—that it is difficult, if not impossible, to estimate correctly the degree of influence of each. It has been the purpose of the Forest Service and the Weather Bureau to conduct an actual experiment in order to obtain quantitative measures of these influences and, in general, the response of streamflow to a forested and denuded watershed. The site selected for this large-scale experiment is near the railroad station of Wagon Wheel Gap, Colorado, the station having an elevation of 8,437 feet above sea-level. The plan was to select two contiguous watersheds of similar character, make extensive meteorological and hydrological observations on each, and, after the lapse of a certain number of years, denude one watershed of its trees and continue observations for a sufficient number of years to determine in what manner the streamflow is influenced.

On June 30, 1919, an eight-year continuous series of stream-flow observations and a nine-year meteorological record had been obtained, and, after a general survey of the results, it was decided that the trees could properly be removed from one watershed. The denudation was completed in the autumn of 1920. This, therefore, marked the completion of the first stage of the experiment. Observations are being continued, and will continue for several years, but the report on the first stage has just been published.[1] The Forest Service is represented by Carlos G. Bates, silviculturist, and the Weather Bureau by Professor A. J. Henry, meteorologist, the reports representing joint authorship.

While an effort was made to select watersheds of similar character, it is obvious that, no matter how good the general agreement of the main features, exact duplication was impossible. Watersheds *A* and *B* at Wagon Wheel Gap, therefore, have certain characteristics in which they are quite different. Through these two small valleys flow tiny streams which descend toward the Rio Grande. The streams are approximately parallel in their lower portions and flow, in a general direction, from west to east. The area of the south watershed, *A*, is 222.5 acres and that of the north watershed, *B*, is 200.4 acres. The lower point of *A* is 9,373 feet and the upper point 11,355 feet above sea-level. Corresponding elevations for *B* are 9,245 feet and 10,952 feet above sea-level. These facts are not as significant, so far as this study is concerned, as the fact that watershed *A* is relatively long and narrow, while *B* is short and fan-shaped. These characteristics exert considerable influence upon the rate of runoff, for, owing to the short, steep, slopes of *A*, the flood crest arrives more quickly than in *B*, but falls sooner, then comes to a secondary maximum of longer duration, because of the greater length of the watershed. The flood at *B* exhibits no secondary maximum because the water reaches the dam from all parts of the watershed at approximately the same time. Moreover, *A* and *B* lying in different directions, as explained above, involves a difference in the rate of snow melting owing to the different exposure of the slopes to the sun; this has an effect upon the streamflow. The geological character of the two watersheds has been found to be the same. The trees consist largely of Douglass fir, although there is a considerable sprinkling of bristle-cone pine and Englemann spruce, the distribution depending upon the altitude, the exposure of the slope, and the amount of rock in the soil.

The observing equipment is of two kinds, meteorological and hydrological. Six primary meteorological stations were established at the beginning of the experiment, one at the base and one in the upper reaches of the streams, and two in each of the valleys. The equipment of these stations varies according to the topographic features in the vicinity; but, among them are to be found maximum and minimum thermometers, psychrometers, thermographs, soil thermoscopes, hygrographs, anemometers, raingages, and snow bins. The headquarters station is the most completely equipped, having two standard barometers, and a triple register for recording automatically wind direction and speed, precipitation and sunshine. On *A* there are 18 snowscales—graduated stakes 12 feet high—and on *B*, 14 scales, the location of each having been carefully selected so as to be representative of the snowfall on a given acreage.

The hydrological equipment consists of a dam in each stream so constructed as to make the surface and subflow of the streams available for measurement. Back of the dams are concrete basins in which continuous automatic record of the waterstages is kept by a Friez recorder. The instrumental record is checked daily by a reading with the hook gage, the latter being so accurate that several observers do not differ more than 0.001 foot on a given reading. The dams at first had rectangular weirs, but for these triangular weirs were later substituted.

The following facts are shown by the nine years of meteorological observations: (1) The mean minima for identical periods and times are slightly higher for slopes facing south than for those facing north, but the greatest differ-

[1] Bates, Carlos G., and Henry, Alfred J.: "Streamflow Experiment at Wagon Wheel Gap, Colo." *Mo. Weather Rev. Supplement No. 17*, pp. 55, figs. 41. A very complete paper representing a summary and extracts from the *Supplement* was published in the *Mo. Weather Rev.* for December, 1921, under the same title, pp. 637-650. Believing that separates of this shorter paper will satisfy those who have an academic, rather than a professional, interest in the subject, a limited number of reprints are now available. Application should be made to the Chief of the Weather Bureau, Washington, D. C. Copies of the complete report, *Supplement 17*, may be obtained at 50 cents each from the Superintendent of Documents, Government Printing Office, Washington, D. C.

ence for any month does not exceed 1° F. Comparing corresponding slopes of the two watersheds, the mean temperature is substantially the same. (2) Precipitation occurring as rain is practically equal on both watersheds. If the soil is saturated, as small a rain as 0.01 inch may cause the streamflow to respond; but ordinarily rains of 0.10 inch or less in summer merely replenish losses due to evaporation or transpiration, and do not affect streamflow appreciably. Most of the summer rains are not in excess of 0.25 inch, hence it is seen that summer rains are not, in general, of great importance. (3) A little less than 50 per cent. of the precipitation is snow, but it yields more than half the runoff. The average depth of snow per season is 113.3 inches. The maximum observed was 149.7 inches and the minimum 80.7 inches.

Interesting features of the streamflow records are: (1) Stream *A* rises more rapidly than *B* and reaches a maximum sooner than *B*, but before the flood has subsided a secondary maximum with a steadier flow may occur at *A*. This feature, as mentioned above, is easily explained by topography. (2) Winter and autumn show very little diurnal variation of streamflow; summer is more marked, with a maximum in the early morning hours and a minimum between 1 and 2 o'clock in the afternoon; spring, however, with the great amount of melting snow, has a pronounced diurnal period owing to alternate freezing and thawing. The amplitude of variation is greater at *A* than at *B*, and the *A* maximum and minimum are more pronounced. (3) An estimated disposition of 21.00 inches of precipitation, the average annual amount for eight years observations, is shown for *A* as follows:

Evaporation	7.39 inches
Transpiration	3.91 inches
Interception	3.62 inches
Runoff	6.08 inches
Total	21.00 inches

It is clear that the objective of all these studies is an accurate estimate of the relations between the various factors on *A* and *B* in order that, in the years following denudation, the conditions on *A* can be used as an index to what would have occurred on *B* had denudation not been effected. It is only in this way that the effect of the presence or absence of trees can be ascertained. Much of the paper, therefore, is devoted to these relations in too great detail for abstracting. Thirteen "rules" are developed as statements of these relations to be used in the later discussions. These concern ratios of discharges in different periods and at different times, time intervals between crests, probable height of crests, and the deposition of silt.

This experiment is of great practical importance with respect to hydrological problems—floods, irrigation, etc., and its outcome will doubtless be watched with the greatest interest by those who are concerned with these problems.

C. LeRoy Meisinger

Washington, D. C.

SPECIAL ARTICLES

AN EARLY STAGE OF THE FREE-MARTIN AND THE PARALLEL HISTORY OF THE INTERSTITIAL CELLS

The theory that the intersexual condition of the free-martin depends upon hormones secreted by interstitial cells of the testis of the male twin and distributed by its blood to the female depends primarily upon the demonstrated connection between fœtal vascular anastomosis and the intersexual condition of the female twinned with a male calf, and secondarily on comparative data. The time of effective action of the male hormone has been presumed to be very shortly after the beginning of sex-differentiation in the embryo (Lillie, '17) owing to the known normal condition of the embryonic membranes in such stages, which renders vascular connection possible, and the very profound nature of the effect. The earliest stage of the free-martin hitherto described is 7.5 cm greatest length (Lillie, '17; Chapin, '17). Sex-differentiation begins at approximately 2.5 cm. The gap thus indicated in our knowledge of this phenomenon is now largely filled up by study of a free-martin of 3.75 cm greatest length, and of the complete history of the interstitial cells of the testis and ovary from 2.5 cm throughout life.

In the 3.75 cm free-martin the gonad is much less than half the bulk of those of normal males and females of corresponding age. The germinal epithelium (cortex of ovary) is only about one fifth the thickness of that of the normal female of corresponding age and less developed than a female of 3 cm greatest length. The blood of the male has already operated to inhibit growth of the entire gonad and to stop the differentiation of the cortex. The specific male sex-hormone is thus demonstrably present in the blood at this stage.

Interstitial cells appear in the testis of the normal calf embryo between the stages of 2.7 and 3 cm greatest length. At the latter stage they are identical in size and histological structure with those of later stages and the adult; they have a continuous history up to adult age. In the female, on the other hand, comparable cells do not appear in the ovary until about the time of birth.

The following conclusions may be drawn:

1. The appearance of interstitial cells in the testis at the very time that a male hormone may be demonstrated by its physiological effects (free-martin) is strong evidence that these cells secrete the sex-hormone.

2. The absence of such cells in the female and the corresponding lack of effect of the female blood on the male twin argue in the same sense.

3. In the female of cattle sex-differentiation before birth is apparently due to genetic factors exclusively; in the male the genetic factors are intensified by the production of a hormone.

The detailed data will be published shortly by the authors separately, Mr. Bascom dealing with the interstitial cells.

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MAY 18, 1922

THE EFFECT OF ACID ON CILIARY ACTION AS A CLASS EXERCISE IN pH

THE effects of changes in hydrogen-ion concentration have received so much attention in the recent literature that it has become desirable to incorporate some exercise into laboratory courses in physiology which will illustrate the principles by which the p_H of a solution is determined. For the majority of college laboratories "gas chain" apparatus, potentiometers, etc., are out of the question for student work. The colorimetric method, however, which is very simple and sufficiently accurate for general laboratory problems, can be used to good effect at very little expense.

For our class in general physiology consisting of some twenty students in their second and third college years, we have outlined an experiment on the stopping of ciliary movement in the epithelium of the frog's esophagus by acid which has proved most successful. The experiment is in the form of a problem, and is stated thus: "Find the concentration of acid which will stop ciliary action within approximately three minutes." The students work in pairs. A small bit of ciliated epithelium is placed on a slide, and while one student observes this under the low power of the microscope, the other places upon the tissue a few drops of acid, and records the time. When the concentration has been found which stops the movement of cilia in three minutes, an indicator is added in the correct proportion (Clark, '20, p. 40) and the p_H determined by matching the resulting color with the appropriate color in the color chart.

When acetic acid diluted with distilled water was used with brom phenol blue as indicator, the following answers were handed in by the class:

Motion stopped in less than 2 min., $p_H = 3.4$, 2 groups of students.

Motion stopped in 3 min., $p_H = 3.5$, 6 groups of students.

Motion stopped in 3½ min., $p_H = 3.6$, 1 group of students.

Motion stopped in 9 min., $p_H = 3.8$, 1 group of students.

The agreement between these results is, we think, very good for an ordinary class exercise.

It should be noted that ordinary distilled water is decidedly acid, $p_H = \pm 6.3$, and that cilia cease to beat in it within approximately half an hour. In 0.7% NaCl, the beating continues for a day, and in Ringer's solution for three or four days at room temperature. For purposes of strict accuracy, therefore, the acid should be added to normal saline or Ringer's solution, but for class purposes the distilled water will serve.

The experiment has been designed not only to show the stopping of ciliary action at a definite hydrogen-ion concentration, but also to bring out the difference in effect between an organic acid, such as acetic, and a mineral acid, such as hydrochloric. In the latter case even a concentration, $p_H = 2$, thymol blue as indicator, will not stop the beating of the cilia in less than 15 minutes. The greater concentration of hydrogen-ion required for the mineral acid than for the organic acid is of course correlated with the difference in rate of penetration of these acids into tissues.

Furthermore, in order to obtain comparable results the pieces of epithelium must be from corresponding regions of the frog. If the tissue is taken from the more posterior levels, *i. e.*, from within the esophagus itself, where the cilia are very long, it is found that the beating continues for a longer time in a given concentration of acid than in the pieces from more anterior levels, *i. e.*, the back of the mouth, where the cilia are very short. The experiment therefore brings out the fact that susceptibility to acid decreases in passing from anterior to posterior levels of the alimentary tract.

J. M. D. Olmsted
J. W. MacArthur
University of Toronto

Reference: W. M. Clark, 1920, *The Determination of Hydrogen-Ions.*

THE SOCIETY OF MAMMALOGISTS

The fourth annual meeting of the Society of Mammalogists was held in New York City on May 16 to 18, 1922, where the society was invited to hold its meetings at the American Museum of Natural History. Besides the regular business sessions and the election of new officers, papers were presented, and the program is given as follows:

Tuesday, May 16
Afternoon Session, 2:00 P.M.

The present status of the elk: E. A. Goldman.

Mammals of the mountain tops: William L. Finley. (Presented by John Treadwell Nichols).

The water supply of desert mammals: Vernon Bailey.

A quantitative determination of damage to forage by the prairie-dog, cynomys gunnisoni zuniensis Hollister: Walter P. Taylor.

Studies of the Yellowstone wild life by the Roosevelt Station: Charles C. Adams.

The part played by mammals in the World War: Ernest Harold Baynes.

Evening Session, 8:00 P.M.

The members of the society were invited to the new home of the Explorers' Club, 47 West 76th Street. The board of directors of the club extended the courtesy of the club to the members of the society during their session.

Wednesday, May 17
Morning Session, 10:00 A.M.

The frequency and significance of bregmatic fontanelle bones in mammals: Adolph H. Schultz.

A fossil dugong from Florida: Glover M. Allen.

Certain glands in the dog tribe: Ernest Thompson Seton.

The elephant in captivity: W. H. Sheak.

The burrowing rodents of California as agents in soil formation: J. Grinnell.

Afternoon Session, 2:00 P.M.

Symposium on the Anatomy and Relationships of the Gorilla:

How near is the relationship of the gorilla-chimpanzee stock to man? W. K. Gregory.

Notes on the comparative anatomy of the gorilla: G. S. Huntington.

Was the human foot derived from a gorilloid type? D. J. Morton.

Reichenow's observations on gorilla behavior: J. H. McGregor.

On the sequence of eruption of permanent teeth in gorilla and man: Milo Hellman.

Phylogenetic relations of the gorilla: evidence from brain structure: Frederick Tilney.

Evening Session, 8:00 P.M.

The motion picture as a medium for intimate animal studies: Arthur H. Fisher.

Motion pictures, some showing slow motion, of anthropoidea, sea lion, Barbary sheep, kangaroo and yak, and the habits of the beaver: Raymond L. Ditmars.

Motion pictures of sea-elephants: Charles H. Townsend.

THURSDAY, MAY 18

Morning Session, 10:00 A.M.

Close of the age of mammals: HENRY FAIRFIELD OSBORN and H. E. ANTHONY.

Food-storing by the meadow-mouse: GLOVER M. ALLEN.

An evolutionary force of a wide range: ERNEST THOMPSON SETON.

The meetings were well attended, and among the members present were mammalogists who represented the leading institutions of the country, such as the United States National Museum, the Bureau of the Biological Survey, the Field Museum of Natural History, the Museum of Comparative Zoology, the Academy of Natural Sciences of Philadelphia, the American Museum of Natural History and the New York Zoological Society.

Among the many interesting papers that were given before the mammalogists was the "Symposium on the Anatomy and Relationships of the Gorilla." At this session the attendance was probably greater than at any of the others, and representatives of the press were present to make the most of a subject in which the public is at present so keenly interested. The consensus of opinion as expressed by the speakers in this symposium was that the gorilla stands very high among the anthropoids in its relationship to man, and the evidence presented, together with the detailed descriptions of the man-like characters of the anthropoids, set forth data for an argument which the anti-evolutionists would have great difficulty to refute.

At the last of the meetings for the presentation of papers, the "Close of the Age of Mammals" was given by Professor Henry Fairfield Osborn and Mr. H. E. Anthony. Professor Osborn took as his thesis the very rapid disappearance of our mammalia, which leads to the conclusion that the age of mammals will come to a close at no very distant date. After outlining the inception and the development of the age of mammals, illustrating his points by distributional maps, Professor Osborn stated that this age had reached its greatest development in the late Pliocene and early Pleistocene, at which time the glacial periods began the destruction which is receiving its final acceleration to-day at the hands of man. Having brought this outline of the history of the age of mammals down to the present day, Professor Osborn was followed by Mr. Anthony, who showed a chart of statistics and gave figures on the great destruction of mammal life which may be laid at the door of the fur trade. A discussion of the papers followed, during which Dr. W. T. Hornaday, the noted advocate of wild life conservation, spoke at some length upon the disappearance of present day mammals and urged the great necessity of untiring efforts to stave off complete extermination.

Further discussion was given by Dr. W. D. Matthew, Dr. Wilfred H. Osgood, Dr. Charles C. Adams and Dr. E. W. Nelson, all of whom were inclined to believe that it was no exaggeration to consider that the "Age of Mammals" was rapidly coming to a close, and that stringent measures are necessary to protect the surviving members. Dr. Adams, who is director of the Roosevelt Wild Life Forestry Extermination Station at Syracuse, N. Y., maintained that the only hope lies in education, not so much of the adult, as of the younger generation, and pointed out the advisability of establishing numbers of wild life preserves, so that people might come to know the wild life of their own region by visiting the local preserves.

The mammalogists were the guests of the American Museum at a luncheon on Tuesday, May 16, and were guests of the New York Zoological Society at luncheon on Thursday, May 18.

The annual dinner was held the evening of Wednesday, May 17, at the Hotel San Remo.

At the annual election of officers, all of those holding office were re-elected.

At the close of the morning session of Thursday, the members adjourned to the North American Hall of the American Museum where, by short exercises, the museum dedicated this hall to the memory of the late Dr. J. A. Allen, who was the society's only honorary member. The hall hereafter will be known as the J. A. Allen Hall of North American Mammals.

President Henry Fairfield Osborn presided and, on behalf of the trustees, made the dedication of the hall, which was accepted on behalf of the Division of Zoology and Zoogeography of the museum by Dr. F. M. Chapman. An appreciation of Dr. Allen's services to natural history was given by Dr. E. W. Nelson, president of the Society of Mammalogists.

At the close of the luncheon given by the New York Zoological Society, the mammalogists were taken for a private view of the new halls of the National Collection of Heads and Horns and a tour through the park under the guidance of the officers of the Zoological Society.

PROGRESS IN ANIMAL PHOTOGRAPHY

The American Museum had planned for a prize exhibition of photographs of mammals to be held at the time of the meeting of the American Society of Mammalogists. This exhibition was opened to the public on May 15, and judges for the exhibition were appointed by President Nelson of the American Society of Mammalogists at the first business meeting of the society. The board of judges appointed by Dr. Nelson was as follows: Dr. Wilfred H. Osgood, chairman, Dr. Witmer Stone, Mr. Charles R. Knight, Mr. James L. Clark and Mr. H. E. Anthony.

The photographs were exhibited in the Hall of Forestry on the first floor of the museum, where they will remain on exhibition for a month. Some 1,654 photographs were received for this exhibition and there were 139 contributors. Requests for photographs and conditions of the contest had been drawn up and submitted by an American Museum Committee as follows: Mr. H. E. Anthony, chairman, Mr. Herbert Lang, Dr. Robert Cushman Murphy and Dr. G. Clyde Fischer, but the credit for the very unusual and splendid display of photographs which was brought together must be given to Mr. Herbert Lang, who worked day and night to make the exhibition a success. The unanimous opinion of the many who have seen this exhibition has been that it is easily the finest exhibition of mammal photographs ever displayed in this country. So many unusual photographs were submitted that the judges found it a difficult task to award the prizes, but finally made the following selection:

1. Photographs of Mammals in the Wild State

First prize: John M. Phillips, Mountain Goat.

Second prize: Norman McClintock, White-tailed Deer.

Third prize: Edmund Heller, Mountain Sheep.

First honorable mention: Carl E. Akeley, Hartebeest.

Second honorable mention: Donald R. Dickey, Deer.

Third honorable mention: Kermit Roosevelt, African Elephant.

Fourth honorable mention: Edward Mallinckrodt, Brown Bear.

Fifth honorable mention: Donald B. MacMillan, Polar Bear.

II. Photographs of Mammals in Captivity

First prize: Elwin R. Sanborn, New York Zoological Park, Chimpanzee.

Second prize: J. E. Haynes, Bison Stampede.

Third prize: W. Lyman Underwood, Bay Lynx.

First honorable mention: Mr. and Mrs. Ernest Harold Baynes, Wolf.

Second honorable mention: J. B. Pardoe, Flying Squirrel.

Third honorable mention: Joseph Dixon, Cougar Kittens.

Fourth honorable mention: Leland Griggs, Fox Head.

Fifth honorable mention: Arthur H. Fisher, Lioness.

JOEL A. ALLEN MEMORIAL

One of the most important measures taken up by this meeting of the American Society of Mammalogists was the formulation of plans and the appointment of a committee for establishing a publication fund to be known as the J. A. Allen Memorial Fund. This fund has been set at $10,000, and the interest from this sum, when it has been properly invested, will be used by the American Society of Mammalogists for the publication of papers to constitute a series of continually appearing memorials to the late Dr. J. A. Allen. The committee appointed to raise this fund, and given full powers for this purpose by the society is as follows: Mr. Madison Grant, chairman, President Henry Fairfield Osborn, Mr. Childs Frick, Dr. George Bird Grinnell and Mr. H. E. Anthony.

It is expected that friends of Dr. J. A. Allen, mammalogists and students of wild life throughout the country will give their support toward the raising of this fund, since natural science has never had a more devoted student than Dr. J. A. Allen, and the purposes for which the fund will be devoted are outlined to give the greatest possible encouragement to research in mammalogy.

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CONTENTS

THE MAINTENANCE OF SCIENTIFIC RESEARCH[1]

BROADLY taken, the apparatus of prosecution of research in this country is made up as follows: (1) Scientific and professional societies and some institutions entirely privately supported; (2) universities and colleges, with their scientific departments; (3) institutions, using that term in the widest sense, directly subventioned by the state, such for instance as the Medical Research Council, the Development Commission, and the Department of Scientific and Industrial Research. Of these three categories, the first named, the scientific societies group, works without financial aid from the state, apart from the small though extremely useful two government grants distributed, mainly to individual workers, through the Royal Society. At the present time many of the societies sorely need financial help to carry on their labors, and some are absolutely at a loss to know how to publish the scientific results that are brought to them. The second category, the universities and colleges, depends in part upon government aid. In the aggregate of twenty-one institutions of university rank, following Vice-Chancellor Adami's figures, students' fees and endowment provide about 63.5 per cent. of the total income; for the rest they are dependent on government grant. The third category, as said, draws state-support direct.

This triple system may seem a somewhat haphazard and incoordinate assembly. Yet in reality it is an organization with much solidarity, and its coordination is becoming more assumed. Its parts dovetail together. The first group, the scientific and professional societies, is provided with a medium of intercommunica-

[1] From the presidential address delivered at the anniversary meeting of the Royal Society and printed in *Nature.*

tion and co-action, the Conjoint Board of Scientific Societies. As to the separate categories composing the triple system itself, they also are in wide touch one with another. Between the scientific and professional societies on one hand and the universities on the other, contact and inter-relation are secured by some degree of free and rightful overlap, both as regards general subject-matter of research and of their *personnel*. Finally, there is excellent contact between both these categories and the third, the state subventioned institutions. A special feature of the policy and administration of these state organizations secures this, a feature which makes the whole of this subject the more cognate to the purview of our own society. To exemplify I may turn, for instance, to the Development Commission. Its program of fishery research, avoiding the terms "pure" research and "applied" research in view of the possible implication that pure research does not lead to practical result, directs research not alone to the solving of particular economic problems. It supports more especially what it terms "free" research, investigation in this case of the fundamental science of the sea and of marine life.

Again, with the Advisory Council of Scientific and Industrial Research, its program, gradually defined during the past six years, is laid down as having four main points: (1) the encouragement of the individual research worker, particularly in pure science; (2) the organization of national industries into cooperative research associations; (3) the direction and coordination of research for national purposes; and (4) the aiding of suitable researches undertaken by scientific and professional societies and organizations. It recruits researchers by giving financial opportunity to promising students to be trained in research, attaching them to experienced researchers. In short, it apprentices to research a number of selected younger workers in universities, colleges and other institutions scattered throughout the country.

So, similarly, the Medical Research Council. Its secretary, Sir Walter Fletcher, in an illuminating presidential address to Section I of the British Association meeting this summer, said, speaking of the nexus between scientific research and the progress of medicine, "It is the accumulating knowledge of the basal laws of life and of the living organism to which alone we can look for the sure establishment either of the study of disease or of the applied sciences of medicine."

It is evident, therefore, that, with a policy based on such principles as these, the third category in the triple system constituting the organization for scientific research in this country is one which has common aim and solid touch with both the others, the universities and the scientific and professional societies. One sees in short that the organization which has come into existence and is maintaining scientific research in this country is a real organization. It did not spring fully equipped from the head of Zeus. It has grown up rather than been planned. In that respect it is an organization essentially British, and it seems qualified to do its work for the country well. We hear of adventures, political and other, the offspring of the day. But these were no adventures, these, to my mind, welcome, long-overdue steps forward by the state toward the succor of science and its welfare, steps that help to strengthen and consolidate the organization for research by such adjuncts as the Medical Research Council and the Department of Scientific and Industrial Research. One of the strengths of this organization that has arisen is, in my view, that it interlocks with the educational system of the country. It is an organization which proceeds on the wise premise that, in the case of science, the best way to get the fruit is to cultivate the tree. It is an organization which is proving successful and economical. Its output has proved a more than liberal return on the funds at its disposal.

But essential to its continuance is continuance of adequate financial support from the government. A tripod can not stand upon two legs. The state-contribution in this country is relatively not large, but it is most important. Important as it has been in the past, it has now an importance most especially great. The cost of investigation is now higher, much higher than it has been. Endowment funds carry less far than they did carry. Private benefactions and voluntary generosity, although willing, are less able to be found and less capable at this time; already gauged as inadequate of themselves alone before the war, they obviously can not alone cope with the necessary undertakings now. The present is a time when a large-scale withdrawal of the government's financial support must prove most formidably crippling. Such crippling will be greater than the actual measure of the sum withdrawn would entail in ordinary times.

To pull down under emergency what has been built up through years of careful experience and is proving efficient can scarcely be ultimate economy. It is to unlearn a useful lesson learnt. Curtailment of the state aid—relatively small in this country—given to scientific research must harm the scientific production of the country. Some curtailment, however, at this time seems unavoidable. Though extension of buildings and equipment and *personnel* is wanted, it may be necessary to withhold that extension at this time, maintaining broadly the *status quo* ready for expansion when that is once more feasible. But if research be an indispensable factor in the rebuilding of the national life, sacrifices should not be required from it disproportionately greater than from other services of a similarly essential kind. Reduction of the state's support on a scale to entail ruin to the existent organization would be a wastage rather than an economy. Calmly viewed, what more reminiscent of the wastage of the war itself than for machinery actually constructed, assembled, and producing what is needful for a nation's strength as a pillar in the industrial and intellectual temple of the world, to be now under temporary change abandoned or broken up; and at a time when industry as a whole stands convinced of scientific research as a necessity for its recovery and well-being.

My hope would be that scientific research on its present maintenance will be considered part of the intellectual bread of the community, part of the bed-rock on which rests the efficiency, not to speak of the industrial equipment, of the nation; that it will be treated as such in the measure of state-support continued to it; that the state will remember that that support has to embrace at least both the universities on one hand, and, on the other, the research institutions administered by the state, for this reason, namely, that the country's organization for research, complex in origin, yet economical and effective, stands as an integral system to the entire existence of which is essential an adequate state provision for both these constituent elements, indispensable, since they are, to the whole structure of the system.

C. S. SHERRINGTON

HENRY MARION HOWE

IN the death of Professor Howe the world lost both a great scientist and a great teacher. There has been recorded in various places the account of his life and life work, of his honors and of his publications. When in 1917 he was presented with the John Fritz medal of the United Engineering Societies a complete record of his work as a metallurgist, as a teacher and as a writer was given, together with a list of his professional papers, of which there are over 300 titles (*Monthly Bulletin A. I. M. E.*, July, 1917, p. 30).

Henry Marion Howe died on May 14, 1922, at his residence in Bedford Hills, N. Y., after an illness of over a year. He was born at Boston, Mass., in March, 1848, the son of Dr. Samuel G. and Julia Ward Howe. His father was noted for his philanthropy and distinguished services in the Greek war for independence, while his mother, the author of the "Battle Hymn of the Republic," was a leader of many reforms, from the abolition of slavery to woman's suffrage. As Dr. Raymond at the presentation of the John Fritz medal said, "It was a good stock on both sides, making him heir to intellectual keenness and refinement, the capacity for both enthusiasm and perseverance, a passion for the pursuit of knowledge and a gift of clear and felicitous statement." For he was imbued with the spirit of scientific research, the love of investigation, a striking power of observation and of interpretation, to which was added his wonderful clearness in expressing his thoughts not alone in his writings but more especially in his lectures and in the presentation of his papers at scientific meetings.

Graduating from the Boston Latin School in

1865, he received the degree of A.B. from Harvard in 1869 and the B.S. in mining and metallurgy from the Massachusetts Institute of Technology in 1871. The following year he received the degree of A.M. from Harvard, followed by the LL.D. in 1905.

The practical side of his life began in iron and steel. He was superintendent of the Bessemer Steel Works, Joliet, in 1872, and of the Blair Iron and Steel Company, 1873-74. For some five years he devoted himself to the metallurgy of copper and improved copper smelting in Chile for the heirs of Augustus Hemenway, and then designed and built the works of the Orford Copper Company at Capelton and Eustis in the Province of Quebec and at Bergen Point, N. J., 1879-1882. This latter year he was manager of the Pima Copper-mining and Smelting Company of Arizona.

From 1883-97 he was a consulting metallurgist in Boston and at the same time lectured in metallurgy at the Institute of Technology. In 1897 he was called to the chair of metallurgy at Columbia University and became professor emeritus in 1913.

His notable books were "The Metallurgy of Steel," 1888 (translated into French) and "The Metallography of Steel and Cast Iron," 1916. They were both epoch making. In the first he accumulated all the notable interestworthy material in the metallurgy of steel and with amazing insight arranged it so logically and so clearly as to bring out the significant similarities rather than the striking differences. In his last book we have a record of his own creative work and his interpretations of the newer results in metallography, striking out into a path far remote from the ordinary textbook and leading to a new country of thought and investigation.

His honors were many and varied and showed that his work and life were appreciated not only at home but abroad. He was Knight of the Order of St. Stanislas of Russia and Chevalier of the Legion of Honor, France. He had honorary membership in many of the societies, from the Royal Swedish Academy of Scientists to the Société d'Encouragement pour L'Industrie Nationale of France. He held fellowships in many of the academies and was president of the American Society Testing Materials, the American Institute Mining Engineers, the International Association for Testing Materials and honorary vice-president of the Iron and Steel Institute of Great Britain.

He received the Bessemer medal of the Iron and Steel Institute of Great Britain, Eliot Cresson medal, Franklin Institute of Philadelphia, gold medal of the Verein zur Befoerderung des Gewerbfleisses, Berlin, gold medal of Société d'Encouragement pour l'Industrie Nationale of France, 1916, and John Fritz medal, United Engineering Societies, 1917. He received honorary doctor's degrees from Harvard, Lafayette and the University of Pittsburgh.

But it is as a teacher and as one who has followed the paths of research that Professor Howe should be honored above all. As a lecturer his diction was most simple and his ideas and logical development of thought so clear that the dullest could not help but understand it. In fact, his courses seemed very easy compared with collateral reading from text-books and the like, and to those of us who had the privilege of working with him in the laboratory his inspiration was immeasurable. Possessed of a kindly personality, he took a fatherly interest in us all and spared no pains in our training. His methods were new, too new for many of his associates to understand or appreciate, for he believed that science must be followed in an orderly and well-thought-out manner, that the problem should first of all be stated, our knowledge of the subject be reviewed and then a complete plan of campaign laid out before any experimental work was started, for he had no use and less respect for the old cook book methods of metallurgy, which unfortunately are not yet quite a thing of the past. Another marked characteristic was his tolerance and patience. While the systematic planning of work came naturally to him, yet he realized the difficulties in the paths of others and was never intolerant or unkindly critical when things went wrong, even when his advice had been neglected. Each of us was made to feel that he was a co-worker and not merely an assistant, and in that way the best of each of us was brought out and developed.

His thoughtfulness of others was always uppermost in his mind, and many a man had cause to thank him for pecuniary help, which was always made available in such a way that the most sensitive could not feel any hurt to his pride. "Outside jobs" were frequent; very often they were doubtless thought up by Professor Howe himself, and they were always paid for most generously.

In 1874 he married Fannie Gay, of Troy, who survives him. She was deeply interested in his work and always accompanied him on his travels and in his attendance at all scientific conventions. She so looked after him that she helped him to conserve his energy for the main purpose; in fact, without her aid he could never have accomplished all that he did. She was as much interested in his students as he was himself, and the little luncheons and dinners at their home were affairs to be sought after and remembered, for she knew us all by name and also knew all our old instructors—often from an angle new to us.

An enthusiastic advocate of the cause of the Allies, he served during the war and later as chairman of the engineering division of the National Research Council. He worked incessantly, and with his wonderful and extraordinary energy and activity he accomplished a great deal in the study of improved methods of the open hearth process and the methods of production of new alloy steels and their physical properties.

In short, we can say of him that he was a kindly gentleman, thoughtful of others; a great scientist, greatly honored and yet most modest; a remarkably clear writer with a gift of simplicity of thought and diction; and, lastly, he was undoubtedly the greatest of all the steel metallurgists.

Wm. Campbell
Columbia University

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE SALT LAKE CITY MEETING

The summer meeting of the American Association for the Advancement of Science, to be held at Salt Lake City, June 22 to 24, will be a joint meeting of the American Association with the Pacific Division of the association. This will be the seventy-fifth meeting of the association and the sixth annual meeting of the Pacific Division and its affiliated societies. The illustrated preliminary announcement of the meeting has recently been published and mailed to all members of the association.

The meeting will be held under the auspices of the Pacific Division. Dr. Barton Warren Evermann, president of the division, will preside at the general sessions and will deliver the presidential address at the opening session on Thursday evening, June 22. The general secretary of the association, Dr. D. T. MacDougal, will represent the larger organization. The hosts for this meeting are the University of Utah, the Utah Academy of Sciences, the Utah Agricultural College and the Brigham Young University. Much valuable help is being rendered by the City of Salt Lake, the Union Pacific System, the Hotel Utah and the Commercial Club of Salt Lake City.

A glance at the preliminary announcement shows that the Salt Lake City meeting will be successful in every way, an interesting and valuable meeting for all who attend. The city itself is unusually interesting from many view-points—scientific, educational, religious, commercial, social and artistic. The vicinity is famous for its agriculture and for its mining activities. The summer climate is very enjoyable, with sunny days and cool nights. Opportunities for the pleasures of outdoor life are furnished by the broad streets with their stately shade-trees, the beautiful parks and boulevards, the many canyons in the vicinity, and the famous bathing beach on Great Salt Lake.

The Hotel Utah is to be the official headquarters. No special railway rates will be available for those who attend this summer meeting, but advantage may be taken of the extraordinarily reduced summer excursion tariffs. The following examples give round-trip rates to Salt Lake City from the places named: From San Francisco, Sacramento, Oakland, Berkeley, Fresno, San Jose and Los Angeles, \$48.82; from Denver, \$36.10; from Omaha, \$50.25; from Kansas City, \$50.25; from St. Paul, \$62.30; from Chicago, \$60.00; from St. Louis, \$56.00; from Memphis, \$73.60; from New Orleans, \$85.15; from Fort Worth, \$64.15.

Liberal round-trip summer rates will be available for those wishing to proceed beyond Salt Lake City, with stop-over privileges at that point and elsewhere. Local railway agents should be consulted for exact information.

Some of the features of the varied program of the meeting are the following: A conference on "Research Problems of the Great Basin" will be held at noon on Thursday, June 22. Dr. John A. Widtsoe, past president of the University of Utah, will lead the discussion, and delegates from Pacific Coast institutions will take part. President Evermann's address Thursday evening will be on "The Conservation and Proper Utilization of our Natural Resources." Following this address there will be a general reception.

The afternoon of Friday will be devoted to a symposium on "The Problems of the Colorado River," with the following titles, several of which represent changes made in the program since the publication of the preliminary announcement: (1) "Description and physiography of the Colorado River Basin," Dr. Frederick J. Pack, Deseret professor, department of geology, University of Utah; (2) "Geology of the Colorado River Basin with reference to the engineering problem," Professor Bailey Willis, professor of geology, Leland Stanford, Jr., University; (3) "The vegetation of the Colorado River Drainage Basin," Dr. Frederic E. Clements, Carnegie Institution of Washington; (4) "The Algerian Sahara," Professor E. V. Gautier, Faculty of Letters, University of Algiers, and exchange professor, Harvard University; (5) "The conservation of the waters of the Colorado River from the standpoint of the reclamation service," Mr. Frank E. Weymouth, chief engineer, United States Reclamation Service; (6) "The interstate and international aspects of the Colorado River problem," Dr. C. E. Grunsky, vice-president of the Pacific Division, American Association for the Advancement of Science, San Francisco, California.

All members of the association and of the affiliated societies should attend the banquet Friday evening, at which an address will be given by the distinguished writer and student of human evolution, Professor James Harvey Robinson, of the New School of Social Science, New York City.

Saturday will be devoted to excursions and entertainment. A free organ recital will be given in the Tabernacle, and there will be a trip to the famous Saltair bathing beach. In the evening Dr. J. E. Broaddus will give an illustrated lecture entitled "From the Grand Canyon to the Yellowstone."

The distinguished Dutch evolutionist, Dr. J. P. Lotsy, of the Holland Society of Science in Haarlem, is expected to give a talk on evolution, probably on Thursday.

The regular section organizations of the association will not hold sessions at the Salt Lake City meeting, but many scientific societies and groups of workers will present programs. Among these are the American Physical Society, the American Meteorological Society, the Pacific Division of the American Phytopathological Society, the Cooper Ornithological Club, the Ecological Society of America, the Pacific Coast Entomological Society, the Pacific Slope Branch of the American Association of Economic Entomologists, the Plant Physiologists, the Society of American Foresters, the Western Psychological Association, the Western Society of Naturalists, the Agronomists and Soil Experts.

Correspondence regarding the preparations for the summer meeting should be addressed to Mr. W. W. Sargeant, secretary of the Pacific Division, A. A. A. S., Golden Gate Park, San Francisco.

BURTON E. LIVINGSTON,
Permanent Secretary

SCIENTIFIC EVENTS

THE SPENCER FULLERTON BAIRD MEMORIAL

A NATIONAL movement has been inaugurated in Washington to commemorate on February 3, 1923, the one hundredth anniversary of the birth of Spencer Fullerton Baird. Through a local organizing committee of twenty-six members, of which Dr. Hugh M. Smith is chairman and Dr. Paul Bartsch is secretary, a permanent national organization has been effected with the following officers: *Honorary president,* Dr. William H. Dall, Washington, D. C.; *presi-*

dent, Dr. Charles D. Walcott, Washington, D. C.; *vice-presidents,* Mr. G. R. Agassiz, Boston, Mass., Dr. Alexander Graham Bell, Washington, D. C., Professor F. W. Clarke, Washington, D. C., Professor Stephen A. Forbes, Urbana, Ill., Dr. David Starr Jordan, Stanford University, Cal., Professor Edwin Linton, Columbia, Mo., Professor Edward S. Morse, Salem, Mass., Professor Henry Fairfield Osborn, New York, N. Y., Professor Addison E. Verrill, New Haven, Conn., and Professor Robert S. Woodward, Washington, D. C.

Steps are now in progress for the formation of a national committee, and Dr. Walcott has addressed letters to various persons inviting them to become members of the committee, and to scientific bodies inviting them to name representatives to serve on the committee, and individuals and organizations have been asked to submit suggestions in regard to the general subject of the memorial.

While Spencer Fullerton Baird's scientific attainments and public services are well and widely known, the letter which Dr. Walcott has sent out recalls that Baird was the secretary of the Smithsonian Institution, the virtual founder of the United States National Museum, the creator and head of the United States Fish Commission, and a prime mover in the establishment of the United States Geological Survey and the Bureau of American Ethnology.

His personal contributions to knowledge in the domain of biology were numerous and profound. His ability and achievements, his fidelity to the public weal, his unselfish devotion to duty, the encouragement and aid he extended to other workers, and the beauty and simplicity of his character combined to produce one of the most noteworthy figures in our national history and one whom America will undoubtedly delight to honor on this appropriate occasion.

Up to the present time the matters that have been decided upon are a public meeting in Washington on February 3, 1923, at which addresses will be delivered and announcements made of the memorial or memorials that have been determined on, and the placing of wreaths on the grave of Baird in Oak Hill Cemetery, the bust of Baird in the American Museum of Natural History, the Baird memorial boulder at Woods Hole, and the Baird memorial tablet at the Bureau of Fisheries building in Washington.

Among the suggestions that have been made for a permanent national memorial are (1) a bust, statue, mural or open-air fountain, or bronze mural tablet to be provided by voluntary subscriptions and erected in the grounds of the Smithsonian Institution or the National Zoological Park, and (2) a fishery museum or exhibit, with public aquarium, embracing both the scientific and applied features of fishery problems, to be established by Congress under the auspices of the Smithsonian Institution.

It has been suggested also that there be established a Baird memorial medal to be awarded periodically to persons performing noteworthy original or meritorious work in science, and that there be published during 1923, preferably under the auspices of the National Museum or the Smithsonian Institution, a memorial volume to be made up of original papers on scientific subjects contributed by Baird's associates, colleagues and immediate followers.

HUGH M. SMITH

COSMOS CLUB,
WASHINGTON, D. C.

INTERNATIONAL CONGRESS OF THE HISTORY OF MEDICINE

ACCORDING to the program as abstracted in the *British Medical Journal,* as already announced, the Third International Congress of the History of Medicine will be held in London this summer from July 17 to 22. The congress will be opened by the minister of health at the house of the Royal Society of Medicine, on Monday, July 17, at 10:30 a.m., after which the delegates from foreign countries will be received, and the president, Dr. Singer, will give his address. In the afternoon the president of honor, Sir Norman Moore, will give a reception and address at the Royal College of Physicians; in the evening there will be a reception and conversazione by Dr. and Mrs. Singer at the Royal Society of Medicine, and an address by Professor Elliot Smith. Morning sessions for papers and discussions will be held on Tuesday, Wednesday, Thursday and Friday, and afternoon sessions on Tuesday, Thursday and Friday. Receptions will be given on Tuesday afternoon by the Lord Mayor and Lady Mayoress, at the Mansion House; on Tuesday evening by Sir James Purves Stewart and Lady Stewart; on Wednesday afternoon by the president of the Royal College of Surgeons of England, at the college; and on Thursday evening by Mr. and Mrs. H. J. Waring. On Wednesday afternoon visits to Barbers' Hall and Apothecaries' Hall have been arranged, and in the evening there will be a conversazione at the Wellcome Historical Medical Museum, where a special loan exhibition will be on view. On Friday afternoon Sir D'Arcy Power will give a historical address at St. Bartholomew's Hospital, and in the evening a banquet will be held at the Hotel Cecil. On Saturday Hampton Court Palace will be visited. Those wishing to become members of the congress are asked to communicate as early as possible with the general secretary, Dr. J. D. Rolleston, 21, Alexandra Mansions, King's Road, S.W.3, London.

RESEARCH FELLOWSHIPS ADMINISTERED THROUGH THE DIVISION OF BIOLOGY AND AGRICULTURE OF THE NATIONAL RESEARCH COUNCIL

INASMUCH as the announcement of medical fellowships to be administered by the National Research Council has called forth many inquiries regarding fellowships in biology and agriculture, it seems desirable to set forth briefly the situation in this division. Notwithstanding the many worthy applications which have reached it, the Division of Biology and Agriculture has not yet been successful in securing a series of general fellowships comparable to those provided by the Rockefeller Foundation through the Divisions of Physics and Chemistry, or those financed by the Rockefeller Foundation and the General Education Board for the Division of Medicine. The Division of Biology and Agriculture does have administered through it directly or indirectly, however, a series of special fellowships, as follows:

The Rosenwald fellowship with a stipend of $2,000 a year for three years, donated through the General Education Board to Dr. E. E. Just for his studies on the physiology of development.

Two Sigma Xi fellowships at $1,600 each, supported by the membership of the Sigma Xi Society. The present policy is to award these in subjects other than physics and chemistry and the medical sciences. The chairman of this division acts *ex officio* with the fellowship committee of Sigma Xi in their administration.

Two Crop Protection Institute Sulphur fellowships (beginning in 1922) at not to exceed $2,500 each, donated by three sulphur companies; an additional $2,500 is to be used in organization work. One of these fellowships is to be assigned to a phytopathologist, the other to an entomologist.

Eight sulphur fellowships (beginning in 1922) at approximately $1,000 each for one year, with assurance of further support, donated by the Texas Gulf Sulphur Company (see SCIENCE, May 26). Two thousand dollars additional is provided for the traveling expenses of those concerned with the research.

M. F. GUYER, *Chairman*
COMMITTEE ON FELLOWSHIPS,
DIVISION OF BIOLOGY AND AGRICULTURE

AMERICAN METEOROLOGICAL SOCIETY

THE American Meteorological Society will hold its first western meeting at Salt Lake City on June 22. Western members have arranged a program of varied interest, which will probably occupy all of June 22 and the morning of the 23d. Of particular interest will be the several papers on climatology in relation to agriculture and forestry to be presented on the morning of the 22d, and the symposium on "Forecasting Irrigation and Flood Waters," led by Dr. J. E. Church, Jr., director, Nevada Cooperative Snow Surveys, on the afternoon of the 22d. It seems probable that at this meeting a Pacific division of the society will be organized in affiliation with the Pacific Division of the American Association for the Advancement of Science.

The society held a highly successful meeting in Washington on April 26, the proceedings of which are being published in the *Bulletin of the American Meteorological Society.*

CHARLES F. BROOKS, *Secretary*
CLARK UNIVERSITY,
WORCESTER, MASS.

CHAIRMEN OF THE DIVISIONS OF THE NATIONAL RESEARCH COUNCIL

The National Research Council has elected the following chairmen of its divisions for the year 1922-23:

Division of Foreign Relations: Robert A. Millikan, foreign secretary of the National Academy of Sciences, and director of the Norman Bridge Laboratory of Physics, California Institute of Technology, Pasadena, California.

Division of States Relations: H. S. Graves, dean-elect, School of Forestry, Yale University.

Division of Educational Relations: Vernon Kellogg, permanent secretary, National Research Council.

Division of Research Extension: W. M. Corse, formerly general manager of the Monel Metal Products Corporation, Bayonne, New Jersey.

Research Information Service: Robert M. Yerkes, National Research Council, Washington, D. C.

Division of Physical Sciences: William Duane, professor of bio-physics, Harvard University Medical School.

Division of Engineering: Alfred D. Flinn, secretary, Engineering Foundation, 29 West Thirty-ninth Street, New York, N. Y.

Division of Chemistry and Chemical Technology: Edward W. Washburn, professor of ceramic chemistry and head of the department of ceramic engineering, University of Illinois.

Division of Geology and Geography: Nevin M. Fenneman, professor of geology and geography, University of Cincinnati.

Division of Medical Sciences: Frederick P. Gay, professor of pathology, University of California.

Division of Biology and Agriculture: F. R. Lillie, professor of embryology, University of Chicago.

Division of Anthropology and Psychology: Raymond Dodge, professor of psychology, Wesleyan University.

THE U. S. COMMISSIONER OF FISHERIES

The president, acting upon the recommendation of Herbert Hoover, secretary of commerce, has nominated Henry O'Malley to be commissioner of fisheries, effective on May 13, 1922, and this nomination has been confirmed by the Senate. Mr. O'Malley, like his predecessor, Dr. Hugh M. Smith, has had long experience in the bureau's service, having entered in December, 1897, as an apprentice fish-culturist at St. Johnsbury, Vermont, in which place he was born in 1876. From St. Johnsbury he was transferred to the bureau's station at Leadville, Colorado, thence to Baker Lake, Washington. In July, 1903, he was appointed superintendent of the Washington stations; in 1907, of the bureau's work in the Columbia River watershed; in 1913, he was placed in charge of all fish-cultural work on the Pacific coast, with headquarters at Seattle; in 1916, he was made chief of the Division of Fish Culture in Washington and in 1918 placed in charge of all the bureau's activities on the Pacific coast.

The commissioner is responsible for a number of innovations in fish-cultural practices, such as the discovery of the salt-solution process for separating dead fish eggs from the live ones, eliminating the necessity of removing dead eggs by hand, and the practice of holding young salmon beyond the period when the yolk-sac is absorbed, the wisdom of which has been indicated by the improved run of salmon in such streams.

For the past three years he has spent the entire fishing season in Alaska engaged in comprehensive investigations of the fisheries of this region in conjunction with Dr. Charles H. Gilbert, of Stanford University, the results of which have been published in bureau reports for 1919 and 1920.

In 1916 he was elected president of the Pacific Coast Fisheries Society and in 1918 president of the American Fisheries Society. Mr. O'Malley enters the commissionership with a full acquaintance of the needs of the service and its possibilities for rendering fruitful service in its various phases.

SCIENTIFIC NOTES AND NEWS

The degree of doctor of science was conferred at the one hundred and sixty-eighth commencement of Columbia University on Dr. Stephen Smith, the university's oldest living graduate, and on Frank Julian Sprague, the electrical engineer.

Dr. John J. Carty, president of the American Telegraph and Telephone Company, received the degree of doctor of laws at the commencement exercises of New York University.

The State University of Iowa conferred at the recent commencement exercises the doctorate of laws on Mr. Vilhjalmur Stefansson and on Dr. Franklin H. Giddings, professor of sociology in Columbia University, who delivered the commencement address.

The degree of doctor of science was conferred by the Kansas State Agricultural College on C. V. Piper, in charge of forage crop investigation, United States Department of Agriculture, and on Walter T. Swingle, in charge of the office of crops physiology, United States Department of Agriculture.

At the commencement exercises of the University of Maine the doctorate of science was conferred on Leon S. Merrill, dean of the College of Agriculture; Professor Jeremiah S. Ferguson, of Cornell University; John Belling, of the Carnegie Institution, and Josiah W. Votey, dean of the College of Engineering, University of Vermont, and the doctorate of engineering on Harold S. Boardman, dean of the Maine College of Technology.

Tribute to the services of Dr. John Deaver and Dr. John Marshall, who retire at the end of the present academic year as professor of surgery and professor of chemistry and toxicology, respectively, was paid at the last meeting of the Board of Trustees of the University of Pennsylvania, by the passage of the following resolutions:

Resolved, That the trustees receive with very great regret the resignation of Dr. John B. Deaver as John Rhea Barton professor of surgery in the School of Medicine, taking effect June 30, 1922, and the secretary be instructed to convey to Dr. Deaver the regret of the trustees at the ending of his distinguished term of service.

Resolved, That the trustees are gratified to learn that Dr. Deaver will remain on the university instructional staff, retaining his position of professor of surgery in the Graduate School of Medicine.

Resolved, That the trustees receive with very great regret the resignation of Dr. John Marshall as professor of chemistry and toxicology, in the School of Medicine, taking effect June 30, 1922, and the secretary be instructed to convey to Dr. Marshall the gratitude of the university for his long and faithful service as a teacher and officer of the university, and their regret at the severing of his connection with the institution.

Having reached the age limit of seventy years on May 1, Professor Ramón y Cajal was retired from his connection with the chair of histology and pathologic anatomy at the University of Madrid. Spain and Latin America are taking the lead in organizing a tribute to him. Among the early features of this is the Cajal number of the *Archivos de Medicina* of Madrid.

A dinner in honor of Professor Edwin G. Boring, professor of psychology, was given by the faculty of Clark University on May 31, with Professor Arthur G. Webster, of the department of physics, as toastmaster. Professor Boring is leaving Clark University to go to Harvard University.

The annual Walker prizes of the Boston Society of Natural History were this year awarded as follows: A first prize of $100 to James W. Mavor, of Union College, Schenectady, N. Y., for his essay "On a modification of the mechanism of inheritance produced by X-rays"; and a second prize of $50 to Frank J. Wright, of Bridgewater College, Bridgewater, Virginia, for an essay on "The physiography of the upper James River basin in Virginia." At the annual meeting of the council of the society it was voted to elect Professor William Bateson, director of the John Innes Horticultural Institute, London, England, an honorary member.

The Academy of Natural Sciences of Philadelphia has appointed Dr. R. A. F. Penrose, Jr., a delegate to the Thirteenth International Geological Congress in Brussels and Dr. Wm. P. Wilson a delegate to the Twentieth International Congress of Americanists at Rio de Janeiro.

Eleven of the twelve members of the committee of the League of Nations on International Cooperation in Intellectual work have been selected. These include in the sciences Madame Curie; Professor Albert Einstein; Miss Bonnevie, professor of zoology at Christiania; Dr. A. De Castro, of the medical faculty of the University of Rio de Janeiro; and Dr. L. De Torres Quevedo, director of the electro-medical laboratory of Madrid. The commission will include a consideration of the three following topics: (1) possibilities of encouraging and improving the organization of scientific research by means of congresses, commissions and institutes; (2) the international relations between universities and means for the organization of an international bureau of universities, and possibly an international university; (3) international organization of scientific bibliography, and exchange of scientific publications.

THE officers elected in Section III of the Royal Society of Canada at the annual meeting in May were: *President*, Professor J. Watson Bain, of the department of chemistry of the University of Toronto; *vice-president*, Dr. J. S. Plaskett, director of the Astro-physical Observatory, Victoria, B. C.; *secretary*, J. Patterson, Meteorological Service, Toronto.

DR. NATHANIEL W. FAXON, assistant director of the Massachusetts General Hospital of Boston, has accepted the position of director of the Strong Memorial Teaching Hospital, which will be built in connection with the School of Medicine and Dentistry at Rochester University.

DR. J. C. WITT has been appointed a consulting chemist in the Bureau of Mines, and from time to time will cooperate with that bureau in the study of some phases of portland cement manufacture.

DR. A. G. JOHNSON, associate professor of plant pathology at the University of Wisconsin and pathologist of the Office of Cereal Investigations, Bureau of Plant Industry, U. S. Department of Agriculture, formerly stationed at Madison, Wisconsin, has transferred headquarters to Washington, D. C., where he will continue his work in the Office of Cereal Investigations. He has resigned his university appointment.

MR. R. L. HOWARD, who has been associate professor of chemistry in the Medical College of Virginia, has been awarded the research fellowship in pharmacology at Western Reserve University.

VICTOR K. LAMER, instructor in chemistry at Columbia University, has been granted a leave of absence for the coming year to accept the Cutting traveling fellowship for study abroad.

PROFESSOR L. MICHAELIS has received leave of absence from the University of Berlin to lecture on physiologic chemistry at the Japanese University of Nagoya.

MR. ERNEST E. HUBERT, assistant pathologist in the Office of Forest Pathology, cooperating with the Forest Service at the Forest Products Laboratory, left on June 7 for a field trip through Illinois, Missouri, Tennessee, Mississippi, Louisiana and Georgia. The purpose of the trip is a general survey of the problem of sap stains and molds on lumber. The methods of controlling the enormous losses due to these organisms will be studied in detail, and special attention will be given to the steaming and seasoning of sap gum and other lumber and to the treatment of southern yellow pine to prevent blue stain.

NEIL M. JUDD, curator of American archeology in the U. S. National Museum, left for New Mexico on May 1 to resume direction of the National Geographic Society's Pueblo Bonito Expedition. During Mr. Judd's absence John L. Baer will again serve as acting curator of American archeology.

DR. T. S. PALMER addressed the Biological Society of Washington on May 13 on "Twenty years of federal protection of the bison." A historical sketch of attempts to prevent the extinction of the bison was given; in 1922, there were over 10,000 bison in existence.

THE annual Jones' Lectures of the University of Oregon Medical School were given this year by Sir Thomas Lewis. The subjects were as follows: "The nature of auricular flutter and fibrillation as these occur in man," "The action of cinchona alkaloids," and "Digitalis."

THE annual meeting of the Canadian Medical Association will be held at Winnipeg from June 20 to 23, inclusive. Dr. Lewellys F. Barker, of Baltimore, is to give the address in medicine, and Dr. J. M. T. Finney, also of Baltimore, has been asked to give the address in surgery. The scientific work of the meeting will be carried on in a surgical section, a medical section, an eye, ear, nose and throat section, and a general section; and, instead of a formal pathological section, a series of pathological demonstrations will be given. The Canadian Society of Anesthetists and the Canadian Radiological Society will also hold their annual meetings in Winnipeg at the same time.

The Metals Committee of the Federal Specifications Board has been organized with Dr. G. K. Burgess, of the Bureau of Standards, as chairman, and Mr. Freeman, also of the bureau, as technical secretary. Several subcommittees have been appointed, and progress has been made in the formulation of metal specifications. The metals are being taken up in the following order: Ingots, castings and wrought metal. The subject of chains is also being considered by this committee. The American Society for Testing Materials methods of chemical analysis have been recommended for government check analyses.

The National Committee on Exhibits Showing Advances in Sanitary Science has recently been formed in Washington, for the purpose of collecting and preparing material for a public health exhibit in the capitol. The members of the committee include: Surgeon General Hugh S. Cumming, U. S. Public Health Service, *chairman;* Dr. D. B. Armstrong, National Health Council; Surgeon General M. W. Ireland, M. C., U. S. Army; Dr. Victor C. Vaughan, National Research Council; Dr. C. D. Walcott, Smithsonian Institution, and James A. Tobey, National Health Council, *secretary*. Space for the proposed exhibit has been placed at the disposal of the committee by the Smithsonian Institution. Plans are under way to install exhibit material secured from official and voluntary health agencies. The secretary's office is in the national headquarters of the American Red Cross at Washington.

Mr. Marconi left Southampton on May 27 on board his yacht *Electra* on a voyage of wireless experiment to America. According to a report in the *London Times,* two technical assistants accompany him. He proposed to carry out experiments on the Atlantic with direction finders on short wave and long wave transmission. At New York he will conduct a number of tests in cooperation with some of the modern American stations, and demonstrate to the Americans what can be accomplished in the high speed dispatch and reception of messages. Over long distances, such as from America to England, messages are now received at a rate of eighty to ninety words a minute, and Mr. Marconi will use improved instruments by means of which speed can be increased up to one hundred words a minute and over. On June 20, Mr. Marconi, who has received from the Institute of Radio Engineers, New York, the medal of the institute, will deliver a lecture at a joint meeting of the Radio Institute and the American Institute of Electrical Engineers. His subject will be "Radio Telegraphy," but the question of wireless telephony will also be dealt with. Besides his other experiments, Mr. Marconi will carry out tests for the Meteorological Office in London during his voyage. These will have special reference to the collection of reports of the weather in the areas of the Azores and the Bermudas. He expects to be absent from England until the middle of July. On his return journey, he hopes to visit Canada and Newfoundland. The *Electra,* a steam yacht of 700 tons, will make the Azores her first objective, and thence will proceed to America, or, if the weather proves bad, to Bermuda.

The United States National Museum has recently secured by purchase, through the cooperation of the United States Department of Agriculture, the large private herbarium of Dr. Otto Buchtien, formerly director of the Museo Nacional, La Paz, Bolivia, built up by him through many years of botanical exploration in South America and through exchanges with institutions in many parts of the world. The herbarium consists of approximately 45,000 specimens, and is notable for its large proportion of tropical American species, particularly of the floras of Bolivia, Chile, Argentina and Paraguay.

Yale University has acquired a collection of 566 mounted game heads and skulls with horns, and miscellaneous zoological specimens and implements used by native hunters. This is the gift of Mr. Thomas D. M. Cardeza, sportsman and naturalist of wide reputation, who has hunted big game animals in most parts of the world. For the time being the collection will be set up in the Osborn Zoological Laboratory. Eventually it will occupy a prominent place in the new Peabody Museum, which has not yet been erected. It contains 179 fully mounted heads of large game animals with the front parts of their bodies in many cases. These heads range in size from that of an African elephant measuring eight feet six inches betwen the tips of the ears, to the diminutive dik-dik antelope, which approximates the size of a cat and which is the smallest of the ruminants. Among the African fauna are species of antelopes, including gnus, hartebeests, bushbucks, waterbucks, reedbucks and gazelles. One of the most striking exhibits is that of a great hippopotamus, the open mouth of which measures twenty-three inches between the lips. There are also included several rhinoceroses, zebras, buffaloes and wart hogs.

THE Prudential Insurance Company has made an unconditional gift of the public health, medical and scientific sections of its library to the Surgeon General's Library of the United States of America at Washington, D. C. This collection of books, documents and data is estimated to represent about ninety per cent. of the entire public health material for the civilized world, representing between fifty and one hundred thousand volumes and publications. The books will be transferred gradually to Washington, for re-installation on the main floor of the Surgeon General's Library, where a large section is being cleared for the purpose, to be hereafter known as the statistical division. The library includes countless reprints, articles and clippings on medical and related subjects, brought together during the last thirty years by Dr. Frederick L. Hoffman, the Prudential statistician. The books are down to date, and, as far as practicable, the series of official reports is historically complete. The library is arranged on the subject-index plan, readily accessible, while all possible facilities will be extended by the Surgeon General's Library to students in search of information generally out of reach. It is hoped to complete the installation by the first of next year. The gift has been approved by the surgeon general of the army, Major General M. W. Ireland, and the secretary of war, John W. Weeks.

IN line with the purpose of the Department of Commerce to make the textile section of the Bureau of Standards more available and of better service to the textile industry, a conference was called on May 20 of representatives of the various branches of the textile trade. The best means for bringing about the desired results and the formulation of a general plan for carrying on research work throughout the textile industry were discussed. Those present were much pleased with such a plan, and it was arranged that the various delegates should take up with their individual branches of the trade the question of the formation of committees, consisting of twelve to fifteen men each, for the purpose of working up the necessary plans and of holding meetings whenever desirable. A general meeting will be held in Washington in the autumn. This is the first opportunity of the kind given to the textile industry for carrying on collective research work.

CONSOLIDATION of the Bureau of Markets and Crop Estimates and Office of Farm Management and Farm Economics of the Department of Agriculture in order to bring the gathering of all data on the economics of production and marketing under one bureau, in accordance with recent legislative provision, will be completed by July 1. It is stated that the adjustment is being made in response to the demand from farmers for a closer correlation of economic data on production and marketing, to enable them to adjust production to meet changing marketing conditions in this country and abroad.

An expedition from the department of medical zoology of the School of Hygiene and Public Health of the Johns Hopkins University, will go to Porto Rico this summer to investigate hookworm disease. The expenses of this expedition will be paid by the International Health Board of the Rockefeller Foundation. The party will include Mr. D. L. Augustine, Mr. N. R. Stoll and Dr. W. W. Cort, from Johns Hopkins University, Dr. W. A. Riley, of the University of Minnesota, and Dr.

and Mrs. G. C. Payne, of the International Health Board. The expedition will be under the direction of Dr. W. W. Cort. The party will leave the United States early in June and will return about the first of October. The headquarters in Porto Rico will be Utuado, where a small hospital has been furnished by the Porto Rican Department of Sanitation for laboratory and living quarters. The expedition will work in cooperation with Dr. R. B. Hill, director for Porto Rico of the International Health Board, and Dr. W. F. Lippitt, commissioner of health of Porto Rico. The work of the expedition will include a continuation of the researches on the life of hookworm eggs and larvæ in the soil which were begun in Trinidad during the summer of 1921. Field studies will also be made of the sources of human infestation under the conditions in Porto Rico.

UNIVERSITY AND EDUCATIONAL NOTES

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 from which is to be used for scientific research with special reference to preventive medicine and the cause, prevention and cure of diseases. This bequest is to be known as the Seymour Coman Research Fund. By the will of Alexander D. Thomson, of Duluth, Minn., the sum of $50,000 is bequeathed to the university for use in the medical department, to be expended under the direction of Dr. Wilber E. Post, a graduate and trustee of the university, and Dr. Herman L. Kretschmer.

It is reported that Wake Forest College School of Medicine is entitled to receive the principal of a trust fund, amounting to $1,375,000, which was created in 1892 by Jabez A. Bostwick, a director of the Standard Oil Company.

Dr. D. Wright Wilson, of the Johns Hopkins University, will succeed Dr. John Marshall in the chair of chemistry in the Medical School of the University of Pennsylvania.

G. F. Reddish, Ph.D. (Yale '22) has been elected associate professor of bacteriology, and Paul A. Warren, Ph.D (Michigan '22) has been elected professor of botany in the Medical College of Virginia.

Dr. Calvin P. Stone, of the University of Minnesota, has been appointed assistant professor of psychology at Stanford University.

W. L. Eikenberry has resigned as associate professor in the School of Education of the University of Kansas, to take the position of professor and head of the science department in the Pennsylvania Normal School at East Stroudsburg, Pa.

Dr. Colin G. Fink has been appointed lecturer in electrochemistry and will have charge of that division of the department of chemical engineering of Columbia University, beginning on July 1. He will continue his services as secretary of the American Electrochemical Society, office facilities having been arranged at Columbia for this.

Professor Mayer, who has recently held the chair of physiology in the Strasbourg Faculty of Medicine, has been appointed successor to the late François Franck at the Collège de France.

DISCUSSION AND CORRESPONDENCE

THE ORIGIN OF SPECIES

The recent address by Professor Bateson, at Toronto, has been variously interpreted. Among other things he is quoted as saying that "as to the origin of species we have no clear answer to give. Faith has given place to agnosticism . . . Although our faith in evolution remains unshaken, we have no acceptable account of the origin of species."

This statement must mean one of two things. It may be a large and generous gesture disclaiming for science any approach to omniscience, for the most that science can do is to record the "observed sequence of events." Or we may interpret it as a revelation of the speaker's ignorance of the researches of field investigators and of students of geographical distribution generally. It is evident that Bateson fails to distinguish between these and the taxonomists who, mostly in museums, have as he says "built up a vast edifice of knowledge which they are willing to share with us and which we greatly need . . . The separation between the laboratory man and the systematists already imperils the work, I may say the sanity of either."

It is true that the accumulation of facts in regard to each one of hundreds of thousands of individual species shows endless variety in the details of modified divergence. It is therefore impossible to condense in a single phrase all that we know of its phases, unless with Darwin we use the term "Natural Selection" as the antithesis to supernatural creation and adjustment, thus including in one word not only the results of the Survival of the Fit, but also all other natural processes which may be coincident with it.

As a matter of fact, no phenomenon of nature is better understood than that of the origin of species, taking the word species in its original and natural definition as a definable form of animal or plant life as now existing on the globe. In the study of any one of these, we find the inherent factors of heredity and variation, the survival of individuals adapted to their environment, thereby perpetuating in a general way their particular traits. The groups thus formed lose their unity through "biological friction," "mating by propinquity," isolation, segregation or by whatever term we choose to indicate the effects of barriers. There is no better term than the one used by Moritz Wagner, *"räumliche Sonderung."* Thus taking the inherent life forces into consideration, adaptation is the result of sifting, species-moulding the result of bars to free movement within the species. Independent of the matter of adaptation, *sundering* separates groups with some differences in parentage and subjects them to new incidence of selection, so that in a longer or shorter time specific differences, usually non-adaptive, appear and become permanent. Whether the special variations are great or small in degree, mutations or fluctuations, is a secondary question, the latter most usually, but neither can become permanent except through *räumliche Sonderung.*

The origin of individual species of animal or plant runs closely parallel with that of individual words in a language. Each one of these springs from a "root"; through ancient documents (fossil records) the roots of words can be traced more perfectly than the roots of animal or plant species. Yet one may know the derivation of thousands of words while yet "expressing agnosticism" as to the origin of language.

The laws of distribution as to words or species alike may be summed up in simple propositions. Every word and every species is found in every part of the globe, unless (*a*) it has never found its way there, (*b*) it has failed to maintain itself, or (*c*) maintaining itself, it has been, through environment sifting or obstruction (selection or segregation), transformed into something tangibly different.

The Origin of Species for the most part is defined by proposition (*c*). The origin of any given species of the British fauna or flora, for example, can be traced from England to the Continent of Europe just as surely though not as accurately as a given word in the English language. The biological relations of words differ from those of animals or plants, but *räumliche Sonderung* produces corresponding results in both cases.

DAVID STARR JORDAN

THE KAIETEUR FALLS

TO THE EDITOR OF SCIENCE: I read with much interest in a recent issue of SCIENCE the account of the expedition of the New York Zoological Society to the Tropical Research Station at British Guiana. In this account was included a description of a visit to Kaieteur Falls, which were claimed to be the highest in the world. It seems a little unfortunate that the writer overlooked the fact that he has in his own country a magnificent waterfall which is several times as high as the one he described.

Quoting directly from the article, we find, "The Kaieteur Falls are the highest in the world, eight hundred and ten feet in all, about five times as high as Niagara." The statistics published by the Department of the Interior of the U. S. government give the height of the Yosemite Falls in the Yosemite Valley in California as more than twenty-five hundred feet in all, while the first sheer drop is fourteen hundred and thirty feet. I do not want to go on record as discouraging any one from visiting the Kaieteur Falls if the opportunity presents itself but I do agree with the advertising slogan of our railroads that we should "See America First."

Arthur C. Hardy
Rochester, N. Y.

MUSEUM PESTS FEEDING ON GLYCERINE JELLY SLIDES

Recently I accidently found, in an ordinary box of 100 microscopic slides, two Dermestid beetle larvæ, exhibiting what is an apparently new feeding habit for these museum pests, as far as I can ascertain from entomologists here.

The two larvæ I saw at different times actually feeding on the black rim of asphaltum encircling the cover glass of a few slides, two in one part and five in another part of the box. From these was removed from one fourth inch to fully one half of the periphery, exposing the mounting medium at the edge. Excess asphaltum on the upper surface was not touched, which shows, as well as do other points given below, that the asphaltum was not the chief attractive food substance in the case.

Glycerine jelly was the mounting medium in all these slides. All slides touched were fairly thick mounts, all practically thick enough for at least a small larva to get in beneath the cover glass. Two slides show rather large, broad, irregular tunnels in the jelly. I did not actually see larvæ at work in the jelly, but sufficient evidence was there. Besides these spaces in the jelly, which could not have been due to any flow of material, or made by any other agent, a great many larval hairs were stuck around the cover glass, and in decreasing numbers, on other parts of the slide, and a cast skin was stuck to one.

One of these larvæ was inadvertently crushed, and the other one later died. A couple of big Dermestid larvæ were secured and offered fresh glycerine jelly. They ate of it readily, but I also noticed that they became badly stuck up in a rather short time, and soon died. Such result would be rather fortunate for the slide owner, thanks to the consistency of the glycerine jelly. If there are few larvæ there probably will not be much damage then. Still some good specimens may be exposed to injury, and this happen long before the injury is noted. It is a feeding habit which the writer believes should be taken into account.

W. C. Kraatz
Ohio State University

NECTARINA IN TEXAS

My attention was first called to the presence of *Nectarina lecheguana* within the limits of the United States by a letter from a beekeeper living in the lower Rio Grande Valley, stating that there were insects there which made nests like the hornets and yellow jackets but stored honey like bees. He also stated that they swarmed like bees. An investigation of available literature failed to mention anything fitting the description given. A few months later, on visiting the region, several beekeepers confirmed the account and I was shown a number of abandoned nests but could find none which were occupied. My interest continued and I endeavored to secure specimens from friends living there. A few live insects were sent me in an ordinary queen cage. These were forwarded to the National Museum for identification and were identified by S. A. Rohwer as *N. lecheguana.* This species is recorded commonly from Mexico to Brazil, but so far as can be ascertained there is no previous record of its appearance north of the Rio Grande River. I have been unable to find any indication of its occurrence farther north than about twenty miles of Brownsville, Texas.

In the early summer of 1920 I secured a large colony which was shipped in its original nest to Hamilton, Illinois, in a cage by express. A few days after the nest was placed in the open, the insects absconded and were not located again for some time. They built a new nest as large as the old and at least one division established itself, but the third nest was much smaller. Since the insects can stand but little frost they could not survive an Illinois winter in the open.

These insects are remarkable in possessing so many characteristics of both bees and wasps. As already stated they make large paper nests like the wasps but they store up honey like the bees. When they sting, they lose their stings as do the honeybees. They show little resentment when one approaches the nest and I found no difficulty in observing their actions at close range. When a forager returned from the field it would pass from one to another of those remaining on the outside of the nest and offer the new nectar which was eagerly accepted. From five to a dozen individuals would thus be fed before passing inside the nest where it was lost to sight.

This and other species of *Nectarina* are discussed at length by R. du Buysson in Annales de la société entomologique de France, Vol. 74 pp. 537-566.

FRANK C. PELLETT

HAMILTON, ILL.

SCIENTIFIC BOOKS

Geodetic Operations in the United States, January 1, 1912, to December 31, 1921. By WILLIAM BOWIE. Pp. 26, illustrated. (Washington, Government Printing Office, 1922, 20 cents).

This is a report which was presented in Rome in May, 1922, at the meeting of the section of Geodesy of the International Geodetic and Geophysical Union. It is reviewed from the point of view of a scientist. Otherwise the reviewer might call attention more directly to certain points in the report which are of interest to any one who would like to see all of the United States mapped well and soon.

The perusal of this publication, showing the contributions to geodesy by the Coast and Geodetic Survey in the past ten years, arouses admiration for the rapid progress which has been made in spite of the delays and disturbances due to war. The rate of accumulation of new observations for use in geodesy has been greater in the United States in this decade than in any previous decade. Along with this progress in observing there have also been notable improvements in instruments and methods.

One hundred and twenty-four determinations of the intensity of gravity, corrected for topography and isostatic compensation, were available in the United States before 1912. In the past ten years 162 such determinations have been added, making the total now available 286. This is a very substantial addition to the data of geodesy.

There are two lines of attack on the problem of determining the figure and size of the earth and on all associated matters such as isostasy. These two lines together are substantially the whole of geodesy. The primary data for one line of attack are observed values of the intensity of gravity as given by pendulum observations. The primary data for the other line of attack are observations of the relative directions of gravity at various places as given by astronomic determinations of the latitude, longitude and azimuth of points connected with continuous triangulation. The preceding paragraph shows that the available data for the first mentioned line of attack has been more than doubled in the United States in the past ten years. The paragraphs which follow give some of the points from the report which show that the strength available for the second line of attack mentioned has also been greatly increased on this continent in the past decade.

During 1912-1921 102 determinations of astronomic azimuth scattered widely over the United States have been made. The total number of such azimuth determinations before 1912 was 285. Similarly in this decade more than one fourth has been added to the number of determinations of astronomic longitude in the United States and 124 determinations of astronomic latitude have been made. To the network of primary triangulation in the United States which existed before 1912 there has been added in the last decade arcs of an aggregate length of 4,659 miles, or more than 66 degrees of a great circle on the earth's surface. Clarke's classical computation of the figure of the earth in 1880 depended on arcs measured by various nations of an aggregate length of only 89 degrees. In connection with the new triangulation of the past decade 20 new base lines have been measured with probable errors of one part in a million as a rule.

The accuracy with which the figure and size of the earth may be derived from a given continuous network of triangulation and the connected astronomic determinations increases very rapidly as the extreme dimensions of the network are increased. Within the decade under consideration, by cooperation on the part of Canada and Mexico, the continuous triangulation has been extended from the United States far into each of these countries and the computations are made on one standard datum.

This renders it possible to deal with the triangulation of all three of these countries in one grand computation,—a possibility not equalled anywhere else in the world at present.

More than 15,000 miles of precise leveling has been done in the United States in the past decade, all of the highest standard of accuracy. The total for the United States previous to 1912 was 30,000 miles, of which a part was of a lower grade of accuracy than the recent work. This leveling is primarily for engineering purposes for the control of surveys upon which good maps depend. But in due time the reviewer believes it will be found of much value to science as a means of measurement of the slow geological changes in the relative elevation of different parts of the earth's surface. Such changes may be detected at the coasts by direct reference to the mean surface of the sea. In the interior of a continent the precise leveling, repeated for this purpose, will furnish the only means for determining changes in relative elevation comparable in accuracy with the shore studies just referred to.

Among the more important improvements in apparatus made in the past ten years may be mentioned: (1) improvements in the precise leveling instrument, which many years of use had already shown to be the best instrument for its purpose in the world; (2) improvements in the precise level rods; and (3) improvements in the half-second pendulum apparatus and its auxiliaries intended to enable one to make the observations more rapidly and economically without any reduction of accuracy.

The brief statements which have been made show the character of the information given in the report, and some of the reasons why all who are interested in geodesy should have a copy. The report contains numerous especially well prepared maps showing the places at which each of the various classes of observations—astronomic observations, triangulation, gravity determinations, precise leveling—have been made. It also contains the best available summary, in several separate topical lists, of the bibliography of geodesy and closely related subjects in the United States in the past decade.

JOHN F. HAYFORD

SPECIAL ARTICLES

A HAPLOID MUTANT IN THE JIMSON WEED, "DATURA STRAMONIUM"

THE normal Jimson Weed is diploid (2n) with a total of 24 chromosomes in somatic cells. In previous papers[1] the finding of tetraploids (4n) with 48 chromosomes and triploids (3n) with 36 was reported, as well as unbalanced mutants with 25 chromosomes represented by the formula $(2n + 1)$. The finding of two haploid or 1n plants, which we are now able to report, adds a new chromosomal type to the balanced series of mutants in *Datura*. This series now stands: 1n, 2n, 3n, 4n. Since a series of unbalanced mutants has been obtained from each of the other balanced types by the addition or subtraction of one or more chromosomes, it is possible that a similar series of unbalanced mutants may be obtainable from our new haploid plants, despite the great unbalance which would thereby result.

The haploid individuals were two from a number of plants of abnormal appearance secured in an attempt to induce chromosomal irregularities by the application of cold as a stimulus. The large amount of bad pollen consistently found in its flowers—80 per cent. and more empty grains have been counted—indicated, even before chromosome counts were made, that we were not dealing with a mutant of a previously known type. A detailed study of the assortment of chromosomes and of the possible breeding behavior is being undertaken. The cytological data so far as obtained, however, may be briefly summarized.

The late prophase, or metaphase, of the first division in pollen-mother-cells shows 12 unpaired chromosomes only. The cortex of the lateral roots also shows 12 chromosomes.

The 12 chromosomes in the pollen-mother-cell undergo a "reduction" into $3+9$, $4+8$, etc. These reduced groups divide in the second division forming usually 4 nuclei and subsequently 4 cells. The resulting young pollen grains with less than 12 chromosomes apparently all abort.

[1] SCIENCE, 1920, N. S. 52: 388-390; *Amer. Nat.*, 1921, 55; 254-267; *Amer. Nat.*, 1922, 56: 16-31.

Non-reduction takes place in some cells, as already described in triploid plants[2], resulting in 2 giant cells from each pollen-mother-cell instead of the 4 pollen grains expected after reduction. The pollen-mother-cells are about half the volume of the pollen-mother-cells of diploid Daturas. Apparently the giant cells form the surviving pollen grains of the haploid. Since they are half the size of mother-cells from which they arise (or one quarter the size of the mother-cells of diploids) they are equal in size to normal pollen grains of diploids and may be expected to function in the same manner.

Haploidy is the normal condition in gametophytes of all plants and is a regular occurrence in the males of such insects as honey bees, which, however, fail to undergo reduction at the formation of gametes. It has been reported as an occasional phenomenon in sporophytes of ferns.

A haploid plant in *Datura* is a genetic novelty among flowering plants for two reasons: first, it is a sporophyte and yet has the somatic chromosome number characteristic of the gametophyte of the species; and second, the chromosomes while in monosomes, or sets of one each, still undergo a process of reduction though without synaptic mates.

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THE MASS OF THE ELECTRON AT SLOW VELOCITY

ALL assumptions regarding the form of the electron in motion, with the possible exception of the Parsons magneton, lead to expressions for the longitudinal and transverse masses such that the mass of the electron at slow velocity is a constant, m_o, independent of the direction in which the inertia test is applied.

An experimental confirmation is being carried out with an apparatus similar to that previously used by one of the authors[1] except that the cold cathode is replaced by an incandescent filament to assure the presence of all possible velocities at the same time.

If an electron beam accelerated by a given discharge voltage emerges from a tube in the anode into the region between two horizontal metal plates forming an electrostatic field and if the electrostatic field be produced by the same voltage as the discharge, or a constant fractional part of it, then the point where the beam will strike the lower (positive) plate is independent of the discharge voltage and hence independent of the velocity of the electrons provided the transverse and longitudinal masses be equal. This will be the case for velocities below 10,000 volts.

Visual results show the position of the spot on the phosphorescent screen deposited on the lower metal plate to be independent of the exciting voltage, thus confirming the equality of the masses at slow velocity. The photographic record of spot position and a more complete description will be given later.

The method is equally applicable to electrons of high velocity. The experimental work of verifying the expressions for the transverse and longitudinal masses at high velocity is being continued.

L. T. JONES
H. O. HOLTE

THE HYDROGEN-ION CONCENTRATION OF SOILS AS AFFECTED BY DRYING[1]

MUCH interest has been manifested of late in the determination of the concentration of hydrogen-ions in agricultural soils and in the study and possible correlation of data thus secured. It was my privilege to attend the meetings of the American Chemical Society in New York last fall and, in one of the sections, to listen to a somewhat lengthy discussion of the probable effect of drying and heating soils on their P_H values. The discussion was of necessity largely a matter of opinion due to the paucity of experimental data bearing directly upon this phase of the subject.

During the past few months, in connection with research projects relating to the subjects of acidity and aluminum toxicity in soils, the

[2] Belling, John, and A. F. Blakeslee: "The assortment of chromosomes in triploid Daturas." In press for *Amer. Nat.*

[1] L. T. Jones: *Phys. Rev.*, 8, p. 52, 1916.

[1] Contribution 286 of the Station.

writer has had occasion to make large numbers of H-ion determinations, the gas-chain-electrometric method originally proposed by Hildebrand[2] and later modified for soil work by Sharp and Hoagland,[3] being employed.[4]

As is widely known, the Rhode Island Station has conducted several series of field plot experiments representing different rotations and various methods of fertilization, with but slight change over a period of more than thirty years. It is thus possible, by a proper choice of plots, to secure field samples of surface soils varying in P_H from 4.4 to 7.8 with a difference of but a few tenths of a P_H unit between successive samples. The following table presents data from such a series of samples, which are thought to be representative of the plots sampled.[5] The moist composite soil samples in tight Mason jars were brought to the laboratory immediately, rubbed through a ¼inch sieve, and the H-ion determinations made the same day as collected. Column 2 in the subjoined table presents the H-ion concentrations of these fresh soil samples. Portions of these same samples were then air-dried in the shade, and other portions oven-dried at 103° C. for a period of six hours. The last two columns give the P_H data secured from these dried soils.

The following conclusions may be drawn from the accompanying figures. Drying *acid*

H-ION CONCENTRATIONS OF FRESH AND DRIED SOILS

Soil No.	P_H Fresh, moist soil	P_H Air-dried soil	P_H Oven-dried soil
1	4.36	4.38	4.30
2	4.77	4.73	4.63
3	4.67	4.67	4.46
4	5.20	5.00	4.82
5	5.47	5.41	5.17
6	6.05	5.82	5.97
7	6.15	6.07	6.15
8	6.30	6.32	6.41
9	6.56	6.50	6.49
10	7.00	6.98	7.00
11	6.86	6.47	6.54
12	7.55	7.32	7.20
13	7.42	7.19	7.00
14	7.78	7.57	7.39

soils, either at room temperatures or at 103° C., has but little effect on their H-ion concentrations as subsequently determined, although there appears to be a tendency toward slightly increased acidity at the higher temperature in practically every case. Drying *alkaline* soils, however, renders them decidedly less alkaline (decreases the OH-ion concentrations). This is especially noticeable where a temperature of 103° C. is used. In the case of soil 13, a decrease of 0.42 of a P_H unit is recorded, while soil 14 shows a decrease of 0.39 of a P_H unit. In the case of an exactly neutral soil (No. 10), drying has practically no effect. The reasons for these differences are somewhat obscure, although drying is doubtless accompanied by oxidation which is in itself an acidic process. It should be recalled that the soils in question are granitic soils of high potential acidity. Drying, heating, or otherwise profoundly changing them might conceivably present newly exposed surfaces to the solvent, possibly by removing certain enveloping colloidal materials of more or less alkaline nature; the definite fracture of certain of the mineral particles, thus directly exposing freshly abraded surfaces to the solvent is also by no means impossible. Further work will be necessary to establish a definite explanation. It is hoped that similar data from soils of widely different genesis may be forthcoming.

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[2] Hildebrand, J. H., 1913, "Some Applications of the Hydrogen Electrode in Analysis, Research and Teaching." *Jour. Am. Chem. Soc.*, 35, p. 847-871.

[3] Sharp, L. T., and Hoagland, D. R., 1916, "Acidity and Adsorption in Soils as Measured by the Hydrogen Electrode." *Jour. Agr. Res.*, VII, p. 123-145.

[4] The hydrogen electrode vessel was constantly shaken during saturation by a device operated by a small motor. This vessel carried two platinized electrodes, thus permitting duplicate voltage readings on the same solutions. This has been found by the writer to be a necessary precaution, as occasionally an electrode will "go bad" in slight degree only, and if no check is available, wrong results are unwittingly reported. Both electrodes in all of the above-listed results gave identical readings.

[5] The soil of all the plots is classified by the United States Bureau of Soils as Miami silt loam.

THE AMERICAN PHILOSOPHICAL SOCIETY

THE general meeting of the American Philosophical Society was held in Philadelphia on April 20, 21 and 22. The following papers were presented:

Our contradictory economic policy: E. M. PATTERSON.

The distribution of human ability in Europe: ELLSWORTH HUNTINGTON. The ability of a country depends not only on training and social environment, as has long been recognized, but also on inheritance, as is now rapidly becoming apparent, and on health or energy, a factor which has been much neglected. Europe affords one of the best fields in which to differentiate the influence of these three factors. Four lines of evidence are here used for this purpose: (1) the kind of contribution to human progress made by about 8,600 eminent Europeans who were born since 1600 and who are mentioned in the *Encyclopedia Britannica;* (2) the distribution of progress and of civilization according to the opinion of fifty experts in North America, Europe and Asia; (3) the distribution of health and energy as measured by the death rate; and (4) the distribution of climatic conditions that are favorable or unfavorable to health.

The eminent men mentioned in *Britannica* have been classified as follows: (1) religion and philanthropy; (2) philosophy and education; (3) natural sciences; (4) mathematical and chemical sciences and inventions; (5) history and economics; (6) literature; (7) art; (8) politics, and (9) war and adventure. This classification shows striking differences from country to country. For example: in proportion to the number of its people Switzerland, with its 107 representatives in *Britannica,* is very strong in religion, philosophy and the two branches of science, but falls low in all other lines; Scotland and Germany resemble Switzerland, except that the contrast between the extent to which their great men have devoted themselves to religion, philosophy and science on the one hand and to other lines of effort on the other is relatively not quite so great as in Switzerland; France, on the contrary, tends in the opposite direction, for religion and philosophy are comparatively neglected, while literature, art, politics and war are the lines toward which the French type of mind turns most strongly; Ireland follows the French type except that religion also receives emphasis, while the relative importance of war and especially politics rises very high.

Such contrasts and many others are presumably due in part to social environment but probably they also depend partly on racial inheritance. There seems to be no sociological reason why among the 1,737 eminent Frenchmen and 1,185 eminent Germans who appear in the encyclopedia the adjusted index numbers showing the extent to which the two countries have excelled in the various lines of human effort should be as follows: war, France 125, Germany 70; politics, France 105, Germany 49; history, 101 and 171; and philosophy, 83 and 214. Or take the following contrasts between the relative numbers for the 604 Scotch and 292 Irish: politics, Scotland 83, Ireland 164; mathematical sciences, 139 against 72, and natural sciences, 140 against 65. It seems as if these figures might be a rough index of certain deep-seated racial tendencies which manifest themselves in the whole social organization and history of the various countries.

When an attempt is made to show the geographical distribution of mental tendencies among the eminent men of Europe, the result is a series of erratically spotted maps which in many cases indicate little or no connection with environmental factors. Nor do they correspond at all closely to the fairly gradual and progressive character of the changes in social and sociological conditions from one part of Europe to another.

A map of the progressiveness or civilization of the countries of Europe as judged by fifty experts before the war, shows an aspect wholly different from that of the maps of special types of achievement. It displays an almost perfect gradation from higher to lower levels as one proceeds away from the regions bordering the North Sea. There are no sudden breaks from country to country. The distribution seems to be governed by factors which vary gradually and regularly from region to region instead of spasmodically and irregularly as in the previous cases.

A map of health based on the death rate before the war is almost identical with the map of civilization. The figures for all countries have been reduced to a standard population. Children under one year of age and old people of seventy-five or more have been omitted because an analysis of the statistics shows that in many countries the records of deaths at these two extremes of age are peculiarly unreliable. The way in which the map of health shows a decline in human strength and ability as one proceeds away from the North

Sea suggests a controlling factor akin to that which determines the distribution of civilization. Among the physical factors most likely to be related to human ability, climate holds high rank. A map of climatic energy based on a comparison between climatic factors on the one hand, and millions of deaths, thousands of cases of disease, and the work of thousands of factory operatives on the other, is almost identical with the maps of civilization and of health, but wholly different from any of the maps showing the distribution of particular types of achievement.

The resemblance of the maps of civilization, health and climatic energy is so great that it seems almost certain that there must be some common cause. Civilization undoubtedly has an influence on the distribution of health, but it cannot possibly affect the distribution of climate. Health likewise influences civilization, but cannot influence climate. Climate, on the other hand, may have some direct bearing on civilization, and it certainly produces indirect effects through agriculture, food and otherwise. It also has a great influence upon health, and its action upon civilization in this way is probably greater than its direct effect or perhaps than the indirect results arising through agriculture and food. The most reasonable explanation of the similarity of the three maps seems to be that climate influences health and health influences civilization.

The similarity of climate, health and civilization in their distribution in space appears to be supplemented by an equally strong similarity in their distribution in time. This matter has not yet been investigated in Europe, but in the United States variations in the weather from season to season and year to year are reflected with great fidelity in variations in the death rate and in the amount and character of work done by factory operatives on the one hand and students on the other. In other words, the quality and rapidity of people's work, that is, their ability, varies in harmony with the general health of the community and both vary in harmony with the weather. The order of the relationship can scarcely be other than weather, health, ability. Thus, whether we consider space or time, climate seems to be one of the determinants of the degree of ability of a race. On the other hand not only is racial inheritance presumably an important factor in determining the energy of a race, but in Europe, at least, it seems to be of great weight in determining the direction in which human energy shall direct its activities. Thus sociological environment seems to be largely the result of the interaction of human energy whose general distribution is greatly influenced by climate, and of racial inheritance which determines the lines along which nations shall express themselves in ideas and institutions.

George Hammond and Robert Liston—British ministers in Philadelphia, 1791-1800: J. F. JAMESON.

The Three Trinities: E. WASHBURN HOPKINS. Trinities must be sharply differentiated from triads; every trinity is a triad, but few triads are trinities. Examples from Greece and Persia. In India the first triadic union was that of the three fires, of earth, atmosphere, sky; but this was rather one god in three places than three forms of a god. The popular trinity of Brahman, Vishnu and Shiva was a theological compromise and has never had philosophic support. But the later trinity of the Ramanuja sect implies a Father God, an Absolute Brahma, and an incarnate human form of the godhead. A similar development is to be traced in the theistic Buddhism which has always been more potent than the doctrine of the Madhyamikas. The Christian or Greek trinity combines in the same way the ideas of godhead, personal God and incarnate divinity. At the base, all three are attempts to express the same religious-philosophical conception of a spiritual source of the world manifested as personal spirit in heaven and in human form on earth. Possibility of subsuming these three trinities under one head, a new trinity that might unite the three great religions.

The use of devices for indicating vowel length in Latin: JOHN C. ROLFE. In the pronunciation of Latin of the classical period great importance was attached to the quantity of vowels. From the time of Sulla until about 300 A. D. the Romans employed various devices for indicating vowel length, especially the apex, which usually had the form of an acute accent, and a tall I, to indicate the long form of that vowel. These marks are found in inscriptions, but all the long quantities are almost never indicated in any one inscription. The paper attempts to discover some of the principles according to which the marks are used. The examination of the "Monumentum Ancyranum," a copy of the inscription in which the Emperor Augustus recorded the deeds of his reign, of the speech of Claudius at Lyons in 48 A. D., and of several thousand shorter inscriptions indicates that the marks are frequently used with personal names, with titles of honor and for emphasizing some other words, with words denoting family relationships, with suffixes, prefixes and case-endings, and sometimes, apparently, to indicate punctuation. Although Quintilian says that their proper use was to distinguish words and case-endings which are alike in spelling but different in quantity, that rule is comparatively seldom followed in the extant inscriptions.

A sketch of the modern faeroe dialect: J. Dyneley Prince.

The novæ or "new stars": E. E. Barnard. This paper dealt with the peculiarities of the novæ or "new stars." These are not new stars in the ordinary sense of the word. They are stars whose original condition was very faint or even beyond the reach of any telescope, that suddenly, from some unknown cause, become very bright even to the naked eye—in some cases increasing their light as much as a hundred thousand fold. They then fade away, perhaps never to become bright again. All of this great increase of brightness occurs within a few hours' time, or a few days at most. The outburst of light is very sudden; the decline is at first rather rapid, then slower, and with many halts and minor outbursts they finally in a few years' time, say from eight to ten or fifteen years, return to their original brightness. This interval seems to vary with different stars. Some of these wonderful objects, such as the great nova of 1572, have become visible to the naked eye at midday. Two of them in recent years became brighter than the first magnitude. One of these, Nova Aquilae of 1918, for one day outranked every star in the entire heavens except Sirius and possibly Canopus. At first we did not know anything of the previous history of these strange stars. They suddenly appeared as if a new star had just been created. But in recent years photography has added much to our knowledge of them. Now when a nova appears we search for it on our photographic plates made before the star's outburst. Sometimes we find that previous to this outburst the star was beyond the reach of even the photographic plate, while in other cases they are shown to have formerly existed as very small stars with nothing to distinguish them from the millions of other small stars that dot the sky. In several instances we have found that previous to its outburst the nova had existed as a faint variable star, rhythmically changing in brightness by a small amount. The great star of 1901, Nova Persei, is one of these that had probably existed for ages as a small variable before it became a nova. Watched carefully now, this star fitfully varies through a couple of magnitudes, as it probably did in its original condition. What causes the tremendous outburst of light in these wonderful stars is not known.

The message of a meteorite: Monroe B. Snyder.

The effect of diurnal variation of clock rates upon longitude work: R. H. Tucker. From observations with the meridian circle, pendulum clocks appear to run faster at night than the average rate during a period of one day. The excess each hour is small, but the daily rate at midnight appears to be from two to three tenths of a second larger than the daily rate at noon. The largest error that would occur in predicting the correction to an astronomical clock would be between two and three one-hundredths of a second. The observed variation may be due to a diurnal variation in the meridian plane. Such a variation, with a period of fourteen months, does occur, owing to the deviation of the axis of rotation of the earth from the axis of figure of the earth. There is a small diurnal term in the observed latitude at the Lick Observatory, the full amplitude of which is about three tenths of a second of arc. Small corrections to the adopted astronomical constants of aberration, or nutation, may be indicated by these anomalies of observation. An exchange of longitude signals between two stations, ninety degrees apart, might give a resulting difference of longitude from two to three one-hundredths of a second in error. Between two stations on opposite sides of the earth the error might be double that amount. Exchange of wireless signals, sent automatically by clocks across the Atlantic, may give us a test of a variation in clock rates.

Discussion of a kinetic theory of gravitation, II; and some new experiments in gravitation: Charles F. Brush.

Arc spectra and ionization potentials in dissociated gases: K. T. Compton, with O. S. Duffendack and P. S. Olmstead. The great complexity of spectra of gases is due, in part, to the fact that the molecules of the gas may exist in various states of dissociation, association and ionization, each type of molecule or atom giving rise to its own characteristic spectrum. A discovery of the exact state of the atoms or molecules giving rise to each part of the spectrum of a substance is of great importance as regards both the theory of spectral emission and the theory of atomic and molecular structure. At the Palmer

Physical Laboratory this problem is being attacked from three different angles. This paper presents some discoveries relating to the excitation of radiation and ionization in hydrogen and nitrogen.

Hydrogen: Two methods of investigation have been employed. In the first, an arc was produced in hydrogen by the electronic discharge from an incandescent tungsten wire to a surrounding coaxial tungsten tube, which could be electrically heated. The voltages at which discontinuities appeared in the current between the electrodes and especially the voltage at which the arc struck indicated the critical potentials for the setting in of radiation or ionization. With the outer tube cold the hydrogen was in the ordinary molecular state. With the outer tube at a temperature near the melting point of tungsten, the hydrogen was completely dissociated into *atomic* hydrogen. Thus the effects due to the molecule and those due to the atom could be definitely distinguished from each other. This is the first experiment ever performed in an atmosphere of pure atomic hydrogen. The following results were obtained: (1) An arc can not be produced or maintained in molecular hydrogen at voltages less than 16 volts, which is the ionizing potential of the molecule. (2) In atomic hydrogen the arc struck easily at 13.5 volts and, with very large electronic currents, at 10.1 volts. These are, respectively, the ionizing and radiating potentials of the hydrogen atom as given by Bohr's theory. (3) The hydrogen line spectrum was observed whenever the arc struck. It was not observed below 16 volts in molecular hydrogen, but was observed as down to 10 volts in atomic hydrogen. (4) The hydrogen secondary spectrum was not observed below 16 volts and the only lines found in this spectrum were those of the group which shows no Zeeman effect. (5) The Balmer series lines were reversed in the hot tube, provided the gas was ionized. The second method was that of Franck and Hertz, modified to permit a variation in the relative proportions of atomic and molecular hydrogen by use of a grid of hot tungsten wires, and to enable effects of radiation to be distinguished from those of ionization. These results corroborated those of the above method and showed, further, that the hydrogen molecule can be ionized without dissociation and that the lines of the Lyman series can probably be separately excited at successively higher voltages.

Nitrogen: In the hot tungsten tube, there was no certain evidence of dissociation into atomic nitrogen by heat alone, but there was evidence that nitrogen was more easily dissociated by electron impacts in the hot than in the cold tube. The atomic nitrogen was chemically active, combining with the tungsten of the tube furnace, and it greatly increased the conductivity of the gas between the electrodes. The presence of atomic nitrogen was indicated by this increased conductivity of the gas or by the emission of lines of the nitrogen line spectrum. The following conclusions have been reached with regard to the nitrogen spectrum: (1) The three groups of positive bands are all due to the neutral nitrogen molecules. (2) The negative bands are due to the ionized nitrogen molecules. (3) The bands of the third positive group are excited at about 7 volts, those of the second positive group are excited below the ionizing potential and decrease in intensity as the voltage is raised above the ionizing potential, those of the first positive group were not observed below the ionizing potential and increased in intensity with increasing voltage, and the negative bands were first observed at one or two volts above the ionizing potential and increased greatly in intensity with increasing voltage. (4) Several new components of bands in the first group of negative bands were discovered, and their wave lengths agreed accurately with those predicted by Deslandre's formula. (5) The line spectrum was not observed below 70 volts, which is also the voltage at which evidence of atomic nitrogen is obtained. The minimum arcing voltage, about 16.5 volts, is due to ionization without dissociation of nitrogen molecules. The relation of these results to observations made in other connections is briefly considered.

Recent developments in vacuum tubes and their use: J. H. MORECROFT.

A primary standard of light: HERBERT E. IVES. The standard investigated is one developed after the suggestion of Wardner and Burgess, namely, the black body or complete radiator at the melting point of platinum. In order to realize this practically, hollow cylinders of platinum are raised to the melting point by the passage of a heavy electric current. The light emitted from a small opening is observed by a photometer upon whose field an image of the cylinder is thrown by a lens. It is found that with highly purified platinum the value obtained for the brightness of the black body is 55½ candles per square centimeter. This standard appears to be more reproducible than any now available, and can be directly correlated with other physical constants.

Surface equilibrium of certain colloid solutions: P. LECOMTE DU NOÜY.

Notes on the ecology of the clovers (trifolium): JOHN W. HARSHBERGER.

The cytoplasm in development and heredity: E. G. CONKLIN. It is generally recognized that the chromosomes of the germ cells are the seat of the inheritance factors or genes, while the cytoplasm of those cells is the chief if not the exclusive seat of embryonic differentiation. Nevertheless it is generally recognized that there is a mutual interaction between the chromosomes and the cytoplasm, and that each may be said to be environment to the other. It is extremely probable that in the course of development the chromosomes and genes undergo little if any differentiation. On the other hand, it is perfectly evident that the cytoplasm does undergo such differentiation. The mechanism of differentiation consists in the reaction of identical chromosomes upon different kinds of cytoplasm. It is therefore impossible to assume that all factors for heredity and differentiation are located in the chromosomes.

The supposed serial arrangement of the genes and its relation to theories of crossing-over in inheritance: H. S. JENNINGS. This paper was a mathematical investigation of the laws according to which hereditary characteristics are distributed to organisms. It was shown that these laws agree in great detail and in many diverse ways with what is mathematically required if the substances on which the hereditary characteristics depend are arranged in the germ cells in serial order, as held by the so-called linear theory.

The relation of the retinal image to animal reactions: G. H. PARKER.

Parallel mutations in oenothera: GEORGE H. SHULL.

Some climatic and topographic characters in the rings of the yellow pines and sequoias of the Southwest: A. E. DOUGLASS. The average growth of the giant sequoia in the General Grant National Park region was found to be 7.6 cm. per century in the last five hundred years. It varies from half of this to double this amount in locations with respectively unfavorable and favorable water supply. Evidence of the climatic origin of cycles in tree growth is found in the extensive areas over which such cycles prevail, and in the historical agreement between variations in tree growth and solar activity. The eleven-year sun-spot cycle appears both in the Arizona pines and in the California sequoias. This cycle has been operating since before 1400, but largely disappeared from about 1640 to 1715, at which time there was a prolonged sun-spot minimum.

The probable action of lipoids in growth: D. T. MACDOUGAL. Renewed interest in the fundamental composition of protoplasm, especially with respect to the importance of the lipoids, or fatty substances, has been aroused by the investigations of the last two years. Czapek in Prague has made additional demonstration of the universal presence and abundance of such material in plant cells, especially in the growing stage. Hansteen-Cranner in Norway claimed to have demonstrated a peripheral deposit of lipoids in the cell with meshworks extending into the wall and into the mass of the protoplasm where it constitutes the fundamental structure. Kahho at Dorpat finds that the contraction and expansion of lupine roots in solutions of neutral salts is in accordance with a condition of permeability which might be due to the presence of such a lipoid layer. Boas at Weihestephan saw that when solutions such as those of saponin, which displace or liquefy lipoids, are applied to plant cells, their permeability is notably increased. Other workers hold to the theory of the primary importance of proteins in the plasma, and as forming the outer or plasmatic membrane. The results of my own work justify the conclusion that all substances which form watery emulsions or set as reversible gels, principally albuminous compounds, mucilages, soaps and lipoids, are to be included in the hydration or growth mechanism. The present paper treats of the results of two series of experiments bearing upon the action of the lipoids. The effects of lecithin were tested by the use of the artificial cell designed in 1921. This lipoid was found to exert but little effect on absorption when incorporated in the "plasma," but to influence absorption in a very marked manner when used as a peripheral layer or "plasmatic" membrane. The solutions which affect the living cell, supposedly by dissolving the lipoidal layer, have a similar effect on the artificial cell. The reactions of living and of dead cell-masses to soponin and hydroxides include variations in swelling and in permeability, which are of a character suggesting the liquefaction of a lipoidal layer. These experiments do not offer decisive evidence of the actuality of such a layer, yet it is notable that nothing was found which could be interpreted adversely to such an arrangement of material in the cell: Material which is abundantly present and which would tend to assume a peripheral position in a colloidal mass of this character. Furthermore, it is to be noted that the argument against the possibility of a lipoidal membrane on the ground that it would not permit the passage of both fat-soluble and water-soluble material, is voided by the fact that the lipoids may occur in a system in which a disperse phase swelling in water but not soluble, is held in a medium consisting of water-soluble lipoid. Organic substances, fats and salts, would readily pass through such a system.

Possible explanation of eocene climates: Edward W. Berry. This paper discusses the contrast in the floras of the upper Eocene with latitude, and their probable climatic significance. After analysing the fossil floras of the far North in the light of paleogeographic conditions, the speaker suggests that the indicated mild climate in high latitudes during the upper Eocene was the result of the widespread submergence of lands during middle Eocene times, with expanded seas in the equatorial regions and free access of warm ocean currents to Artic seas.

The power and impotence of man: Vernon Kellogg.

Hydracodons from the Big Badlands of South Dakota. The small entelodonts of the White River Oligocene: W. J. Sinclair. These papers present the results of evolutionary studies on two unrelated animal groups, the swift running (cursorial) rhinoceroses and the entelodonts or so-called "giant pigs," both extinct, but formerly inhabiting South Dakota and adjacent areas. In the case of the hydracodons, a progressive evolution is indicated, an increasing complexity of the structure of the upper premolar teeth, with a series of size variants under each of the four structural types recognized. Among the entelodonts, while the extremes of the series studied are far enough apart to appear specifically distinct, there are so many intermediate stages and the grouping of characters is so irregular that almost every specimen would have to be made a separate species or else the lot referred to one species, apparently made up of several inter-breeding strains which differ by various small unit characters or combinations thereof, transmitted to the individual from the various pure lines which enter into its ancestry.

Lithology of White River sediments: H. R. Wanless. The White River sediments of the Big Badlands are composed of the following types of sediments: (1) channel sandstone; (2) fresh-water limestone; (3) nodular layers; (4) volcanic ash beds; and (5) clay beds. A petrographic study of these sediments has shown that most of them are derived from erosion of the rising dome of the Black Hills during the Oligocene period. In the channel sandstones many fragments of garnet, tourmaline and other schist and pegmatite minerals point to direct derivation from the Precambrian core of the hills. Traces of volcanic glass and pumice are present throughout the series, but form the majority of the Leptauchenia beds (the upper division of the White River), which is about two hundred feet thick. Eolian action, as evidenced in rounded sand grains, is only locally present, and forms a negligible part of the whole. Ground water circulation is indicated by chalcedony veins, mineral fillings of cavities in the ash beds, and deposition of oxides of iron at the bottom of the series in and on the impervious Pierre shales. The series as a whole is formed as a flood plain deposit, with shallow shifting channels, local ponds and local sand dunes.

Lava domes and their composition in the Malay Archipelago: H. A. Brouwer.

The application of bio-physical researches to physiological problems: George W. Crile and Hugo Fricke. Following researches on the electric conductivity of animal tissues already presented, a further attempt to apply bio-physical methods to the interpretation of physiological problems has been made by making measurements of temperature variations of various tissues in living animals under varying conditions by means of specially constructed copper-constantan thermocouples. These were used in connection with a specially designed potentiometer and mirror-galvanometer, one division on the galvanometer scale corresponding to 0.01° C. In most of the experiments simultaneous measurements of the temperature variations in two different organs have been made. The principal tissues thus far studied have been the brain, the liver, the thyroid, the adrenals, the voluntary muscles, the spleen, the pancreas, the intestines, the kidneys and the blood stream. The effects produced on the temperature of one or more of these organs by emotion, by adrenalin, by ether, by nitrous oxid, by calcium, by magnesium, by cyanides, by the excision of certain organs, etc., have been noted. The results show that this method of bio-physical measurement offers new criteria for the interpretation of certain operations of the animal mechanism, and emphasizes the value of the application of bio-physical methods of the study of this operation of the animal mechanism.

Experiments in epidemiology: Simon Flexner.

The experiments in epidemiology, carried out with Doctor H. L. Amoss, have been made with an infectious disease arising among mice to which the name of "mouse typhoid" has been given. The bacilli inciting the disease are readily grown outside the body and reproduce the natural disease when fed to healthy mice. The purpose of the experiments, which have extended over three years, is the elucidation of the factors responsible for the epidemic spread of disease among man and animals. Hitherto these factors have been sought chiefly by the analysis of records of disease and death in man; this study represents an effort to obtain more accurate data through direct observation of an epidemic disease purposely induced in small laboratory animals.

Fishes used in Guayaquil for mosquito control against yellow fever: CARL H. EIGENMANN.

The carbonic acid of the blood in health and disease: LAWRENCE J. HENDERSON.

Some recent experiments concerning the nature of the function of the kidney: A. N. RICHARDS.

The Biblical manna: PAUL HAUPT. The biblical manna was manna-lichen mixed with tamarisk-manna and alhagi-manna. The manna-lichen (Lecanora esculenta) was ground in querns, or pounded in mortars, and mixed with the honey-like drops exuding from the soft twigs of tamarisks or with the exudation of camel's thorns. After this mixture had been baked it tasted like honey-cake (Exod. xvi. 31) or like pastry baked in sweet-oil (Numb. xi. 8). In the early morning the tamarisk-manna is like wax, but it melts in the heat of the sun (Exod. xvi. 21). The accounts in Exod. xvi. 14-36 and Numb. xi. 7-9 are inaccurate and embroidered. The ancestors of the Jews were at that time, not on the Sinaitic peninsula, but in northwestern Arabia.

The earth inductor compass: PAUL R. HEYL and LYMAN J. BRIGGS. A model of the U. S. Air Service earth inductor compass, as developed at the Bureau of Standards, and to which the society awarded its magellanic medal, was shown and demonstrated. This instrument is designed for use in aircraft, where the ordinary magnetic compass is unreliable. The fundamental principle of its action is not new, but no previous attempts at the construction of a compass on this principle have given satisfactory results. In the Air Service model a revolving coil of wire is installed in the rear part of the airplane, where the magnetic disturbance from the engine is negligible. Current from this coil is led by wires to the instrument board, where, by an entirely new device called a dial switchboard, the pilot can so arrange the electrical connections that an indicating galvanometer before him will read zero only when the vessel lies in the desired course. An effective compensation for rolling and pitching is provided, and by the judicious use of iron in the core of the coil the size of the instrument is kept down sufficiently to permit of its installation in the limited space available in an airplane.

The age of the earth from the geological viewpoint: T. C. CHAMBERLIN.

Age of the earth from the paleontological viewpoint: JOHN M. CLARKE. The age of the earth from the point of view of the student of the life upon it, can be expressed only in comparative terms. The paleontologist has been accustomed to accept without much debate the allotments of time that astronomers and students of celestial mechanics have been disposed to assign for its age as a planetary body. Life could not have begun until long after the earth had started on its individual planetary existence. No one knows how long it takes a species of animal or plant to acquire its specific characters or to attain changes in characters that would show the passage of one species into another. Animal and plant life have grown under all possible differences of physical surroundings, and the rate of growth and change is in direct relation to the environment. Some animals have endured through geological ages without change while others have developed changes explosively. It is improbable that there will ever be a basis for estimating how long it takes or has taken for one species to pass into another, or to estimate concretely the endurance of the life of any single species. The beautifully preserved fossils of the ancient life of the Cambrian Period which lies almost at the base of the record of life as registered in the rocks, show such perfection of anatomical detail and such an advanced degree of specialization in organs and functions, that though they stand near the very threshold of the recorded panorama of life, their structure demonstrates that it has taken uncountable ages for them to arrive at such a high degree of specialization. In other words, inasmuch as starts are slow and as the starting point was the nuclear cell, the length of time required in rising from the undifferentiated cell by evolutionary processes to the extraordinary animals of the very ancient Cambrian period must have been vastly greater than all the time that has passed since the Cambrian period to the age of man. The same fact has been made very evident in the history of plant life. Life came from the sea; it emerged from the surface of the salt waters, but the plant life of the sea which first migrated from the waters to the earliest continents of the earth was of a high order of seaweed or algal growth, that is to say they were algae which had developed strong permanent tissue and special organs. In the view of modern students of paleobotany these so-called "algae of transmigration" were of a higher specialization than any algae now existing in the sea. The time when they got their footing on the land is indicated by the fact that in the ancient Precambrian rocks which make the basement or foundation upon which all later rocks have been laid down, there is positive evidence that at different periods in their own history these rocks were exposed to the air and suffered weathering and so produced a soil, the evidence of which could not have been preserved to this day except through the agency of a contemporary vegetal covering, so that the time of the emergence of plant life of a high order from the sea to the land is far back in the dawn of the time records of the rocks; and the duration of time required for their development longer even than is indicated for the animals. As all estimates of concrete expressions of time for the age of the earth based on biological data are bound to fail, the comparative expressions given herewith must serve to intimate a time duration for the organic history of the earth so vast as to be beyond the possibility of human expression.

Age of the earth from the astronomical viewpoint: Ernest W. Brown.

The age of the earth: William Duane. In estimating the age of the earth one should choose as a clock to measure the time that has elapsed some process in nature that takes place in one direction only, and that does not change its rate when conditions (temperature, pressure, etc.) alter. In most of the estimates of geological periods of time that have been made the clocks employed do not fulfill these conditions. Estimates based on the temperature of the earth or sun, for instance, cannot be reliable, for the temperature of a body may rise or it may fall, and, further, the rate of its change depends upon a variety of conditions, such as the amount of radiation, the supply of energy to it, etc. In the study of radioactivity during the last twenty-five years a large number of transformations of one chemical element into another have been found. Students of the subject agree that these transformations take place in one direction only, i. e., from an element of higher atomic weight to an element of lower atomic weight. Further, nobody has been able to alter the rate of a radioactive transformation by any process whatsoever, although numerous attempts have been made to do so. These radioactive changes, therefore, seem to offer a reliable means of estimating certain periods of time. Among the radioactive changes appears one in which the metal uranium transforms itself into the metal lead and into the gas helium. The rate of transformation is such that five per cent. of a quantity of uranium would change into lead and helium in about three hundred and seventy millions of years. If, therefore, we determine the amount of uranium, lead and helium in a mineral we can form an idea as to how long these elements have been in contact with each other. Estimates that have been made from the quantities of helium in uranium ores vary between eight and seven hundred million of years, according to locality. Since some of the helium (it being a gas) may have leaked out of the ores, these intervals of time must be regarded as minimum estimates only. Calculations based on the quantity of lead in uranium ores vary from three hundred and forty to one thousand seven hundred millions of years according to locality. Here another complication appears. All the different kinds of lead do not come from uranium. Only lead of atomic weight, about two hundred and six, may be regarded as produced from uranium. Until, therefore, it has been determined exactly what the atomic weights of the lead in the various ores really are we must consider the estimates as maximum estimates only. The atomic weight of the lead in a few ores has been found to be very close to two hundred and six. In one of these the age of the mineral has been estimated at a little over nine hundred millions of years. The calculation of the age of the uranium deposits rests upon the laws of nature as we now believe them to be. It would be a waste of time to speculate on future discoveries or upon a possible evolution of natural law. The calculated ages are the lengths of time during which we may suppose the chemical elements to have been in more or less close mechanical contact with each other. They do not represent the time that has elapsed since the earth may have reached a state capable of supporting organic life as we now know it.

Arthur W. Goodspeed,
Secretary

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CONTENTS

RESEARCH INSTITUTES AND THEIR VALUE[1]

IN this restless, drifting world in which we now live, even intelligent people are not always appreciative of the fact that many if not most of the great intellectual achievements in various fields have been accomplished only when the thinker has been protected from the interruption and annoyance of passing events and permitted to work out his ideas somewhat apart from the general current of existence. In the Middle Ages, the alchemist, the philosopher or the mathematician retired to a garret or cellar and there achieved his purpose, and even to this day the idea that starvation and a garret are successful stimulants to scientific investigation clings persistently to the popular mind, together with so many of those superstitions by which humanity is still largely guided. Truth is that the thinking man in the middle ages was driven into a garret and often compelled to accept poverty because his thoughts or discoveries had no commercial value or popular interest, and, if published, sometimes led to controversies settled once for all by that unanswerable argument of authority, the fagot and the stake. The example of Servetus must surely have been a severe blow to hasty publication. One of the early masters of medicine, he died a martyr to his printed opinions at the early age of 42, his old friend, John Calvin, seeing to it, it is said, that the fire was well started.

But the time when important extensions of the boundaries of knowledge, especially in science, can be accomplished in garret or cellar with no material except brains, a little sealing wax, some wire and a few pieces of glass,

[1] An address delivered at the opening of the new laboratory building of the Collis P. Huntington Memorial Hospital, Harvard University, May 15, 1922.

which was about the equipment with which Faraday made some of his most valuable discoveries in electricity, has long since passed. Brains are still the chief essential, but modern science has gone in most of its phases beyond the stage of easy discovery of important principles. No clearer demonstration of the fallacy of the popular belief in the capacity of the man in the street to solve complex problems exists than the report of the Naval Consultation Board in which it is shown that of one hundred and ten thousand suggestions received only one in a thousand were even worth considering, and of this one hundred and ten only one was put into production. A few highly trained scientific men, on the other hand, made most of the useful discoveries. To-day scientific advance in most fields depends upon the use of equipment of great delicacy and precision, and unfortunately only too often of very high cost. The time calls, therefore, for the organization and classification of research problems and a higher degree of collaboration between scientists than has ever been had before, and it is characteristic of that vision which has so often been a quality of Harvard thought and action that we are gathered together to celebrate the opening of a laboratory devoted to investigation in a field of science but newly set aside, that of biophysics. The name is new, though the science itself is not. When the professor of anatomy in the University of Bologna first used frogs' legs as a galvanometer to reveal the presence of electric currents, he was studying biophysics, even if in a somewhat elementary form. In our own times this new field for research has been sequestered from the disciplines of biology and physics as a special region, possibly because the knowledge of the chemistry and the physics of the human body has reached a point in its advance at which there is a little slowing-up in the rate of important discovery. In such a dilemma a shrewd scientist does not keep up a frontal attack, but quickly shifts to a slightly different approach to the problem. Thus, by the combination of the technical methods of physics and of chemistry in the study of living matter there is promise of an ample yield of valuable knowledge within the next few years and of a material advance which may possibly again illuminate the purely physical and chemical methods of attack on the secrets of life and in consequence lead to still further achievements in those fundamental sciences. Illustrations of the fertilizing value of this method of shifting the line of approach can be culled from the lives of many successful investigators. Pasteur is said to have started early in his life on the study of tuberculosis, but to have dropped it quickly when he found that he could make no headway with the technique then in use. If he had persisted, his name would not be known to-day. Paul Ehrlich spent several years investigating the problem of cancer, but as soon as he found that progress was slow and far-reaching results were doubtful, he quickly shifted to the more profitable field of an attack on parasitic diseases by means of chemical compounds, and there achieved a great and deserved success.

As it is one of the marks of genius to overcome obstacles with the least possible waste of energy, so the fact that this special field of biophysics has been selected for a concentrated attack affords an admirable criterion for the intelligence of those controlling the funds for cancer research in Boston. The world will profit by the investigations which in the future will be made in this laboratory, for in contrast to the worker of the older days, who so often concealed the results of his studies in order that he might reap some benefit from them, the modern scientist gives freely and at once to the public everything he achieves. He does not conceal or patent a valuable discovery which would in any way relieve human suffering.

The true investigator's chief stimulus is the love for his science and ambition for his institute; and the responsibility imposed by the great opportunities at his disposal will be, if he is the right sort, one of the strongest forces in sustaining the arduous labor of research. This concentration of responsibility and the development of intellectual power and leadership as problem after problem is solved is an important factor in the success of a truly scientific institute, a factor the psychology of which has often been overlooked by those administrators who wish to impose the regulations of the machine shop in order to obtain quantity production in science.

Besides the direct way in which an institution like this, devoted to research in some phase of pure or applied science, benefits humanity, there is also an indirect influence, not so fully appreciated. This is the reflex effect upon the university as a whole, for only by the possession of such centers of intellectual concentration does the university become a university in fact rather than in name. Every great teaching institution should be surrounded by a constellation of independent institutes such as this, devoted to the amassing of pure knowledge, without a view necessarily to its future use or practicality and without the encumbrances to effective thought which go with administrative work of the teaching of large numbers of immature students. Our men of genius in the universities still do too much undergraduate instruction and teach the teachers too little. This is one of the great defects of the present scheme of education, in that it accentuates routine and overlooks the spirit. When a university possesses a genius he should be tenderly protected and cherished. The ragweed will outgrow the orchid, as has been proved a thousand times. Why sacrifice another orchid to the test? But in research institutions lies true freedom of thought in the university. While to the undergraduates we must temper somewhat the boldness of our theories, in the research laboratory everything must be free. No one can foresee in what direction investigation must proceed. No hampering politicians, as in some state institutions, should be allowed to control the direction and type of investigation to be done, their equipment for this function as regards the natural sciences being usually somewhat less than that possessed by our Great Commoner, who is making so brave and useless a fight against the dangerous theories of evolution.

Who in his wildest moments could have imagined that the classification and anatomical study of the fleas which infest lower animals could ever have been of use in the saving of human lives? Yet when the Oriental plague threatened this country, in the results of such studies was found the means of combatting the disease, the uncontrolled ravages of which can best be learned by a reading of that old classic of Daniel Defoe's, "A Journal of the Plague Year." When we realize that because of our knowledge of public health obtained by research on apparently unimportant matters the repetition of such a plague is now impossible, we must be grateful to some of those who have made heavy sacrifices in the cause of science.

A few institutions like this will answer most effectively the statement recently made in the daily press that the foot-ball coaches had done more for Harvard than all the professors would ever accomplish—and this of a university which can claim Agassiz, Lowell, Norton, Child, Gibbs, Shaler, Royce and William James as only a few among those who have passed on. To enumerate the names of the living who are still doing for Harvard what these men did would be an insult to the intelligence of my audience.

The new building which we are gathered to inspect shows in its very architecture the thoughtfulness of those who planned it—simple as every workshop should be, for that is all a laboratory is, a place for labor. It shows that the money which has been given has gone on the inside rather than on decoration. I look forward to a day when architects will sacrifice all their art for the practical in laboratory building, and reserve the demonstration of their skill for libraries, museums and other structures which may properly give room for the display of artistic qualities.

But the building is not important. An institution of this type is always, it has been well said, the lengthened shadow of a great man. Those who are to work in it are far more important than any physical structure. The name in itself gives promise of long and useful service, bearing as it will the title of a line of famous surgeons. The annual reports of the Harvard Cancer Commission show how much has already been achieved. There are few groups of investigators in any country who have produced with relatively small means so much of sane, cautious, solid research work in cancer, biology and physics as have those who in the past have worked in the Huntington, and who are now to enjoy greater facilities, and so may properly be expected to do more and more as the laboratory expands. For expand it inevitably will. It is said that opportunity knocks but once at the door, but this is the opportunity of receivers, not of givers. To the latter there is no limit. If this building had been built and equipped five years ago, we might not have had to share with our great scientific rival on the continent the discovery of many capital facts concerning the X-ray, for it was only the lack of equipment which kept the brilliant group of physicists who, under the leadership of Professor Duane, have made so many important advances in the theoretical study of X-rays, from covering many of the practical phases developed instead by our continental colleagues. The verification of the quantum relationship between the frequency of the X-ray and the voltage applied to the tube, as demonstrated by Duane, Hull and Webster, is a shining achievement which might easily satisfy any university for a long period of time. The work of Tyzzer on animal tumors especially laid the foundation for much recent research, while the demonstration by Bovie of the relationship between certain light rays and the coagulation of protein and the killing of cells is also a most important contribution to the newer aspects of biophysics. Whether the problem of cancer—that last great and as yet unanswered question in medicine—will be solved here, no one can say. But I am sure that the attack will be a brave one and that the results will be characterized by the same scientific caution and freedom from attempt at dramatic effect that have marked the work of the Harvard Cancer Commission in the past. We all look to this laboratory as the source of the highest type of scientific investigation combined with an unusual amount of common sense on the human side, due obviously to the influence of the director, Dr. Greenough. There is no reason to think that with the passing of time there will be any change in this high standard.

Let us all hope then that this building and its equipment and staff represent merely a beginning from which research will go forward on a broader and broader scale, until at some future time we may have a better insight than at present into what has hitherto successfully evaded human inquiry—the nature of life and growth. When that goal is achieved the solution of the cancer problem will be in sight.

Francis Carter Wood
Institute of Cancer Research,
Columbia University

THE EFFECT OF THE NATURE OF THE DIET ON THE DIGESTIBILITY OF BUTTER

It is estimated that in the United States about 18 pounds of dairy butter are consumed per capita yearly and of this amount the larger portion is used for table purposes. This indicates quite conclusively that in spite of the increasing variety of fats available for table and culinary purposes, dairy butter still remains one of the most popular and widely used edible fats. Formerly it was very generally believed that the principal if not the entire food value of butter was due to the energy which it supplied to the diet. The recent discovery that dairy butter contains a relatively large amount of vitamin A, which has been shown to be essential for an adequate diet, has served to further increase the popularity of this extensively used fat.

The very general use of butter for food purposes is no doubt responsible for the early and continued attention that has been given to a study of its nutritive value by physiological chemists and nutrition experts. Many digestion experiments have been carried on both in this country and in Europe to determine its digestibility, but since the experimental procedures of the different investigators were not uniform the results obtained do not permit of direct comparison. The lack of uniformity in experimental conditions is perhaps most noticeable in the wide variation of the nature of the basal ration used by the different investigators. However, this variation in the nature of the foods comprising the experimental diets permits to some extent a comparison of the effect

Note: Since dairy butter is a common constituent of nearly all diets the following résumé of digestion experiments, conducted by the author while employed as nutrition expert at the U. S. Dept. of Agri., is given to supply information concerning the effect of other food materials on the digestibility of butter.

of the nature of the diet on the digestibility of butter. Rubner, in a lengthy series of experiments, reports three different values for the digestibility of butter—for a simple diet of butter and potatoes[1] 96.3 per cent., for a diet of green beans and butter[2] 91.5 per cent., and for the latter diet with a larger portion of butter[3] 97.3 per cent.

Malfatti studied a diet of polenta (a porridge of Indian corn meal) and butter and found that butter was 97.7 per cent. digested.[4] Mayer determined the digestibility of butter[5] eaten as a part of a simple diet and reports 98 per cent. and 97 per cent. respectively as an average of three periods of three days each with a mature subject and a nine year old boy. Atwater conducted digestion experiments on a diet of fish and butter and found the butter[6] to be 91 per cent. digested. Huldgren and Landergren, who served as their own subjects, found the digestibility of butter,[7] eaten in conjunction with hard rye bread, was 95.4 per cent. Luhrig studied the digestibility of butter[8] served with a basal ration of meal, bread and vegetables and reports a digestibility of 96 per cent. for butter. Von Gerlach determined the digestibility of butter[9] when it was eaten with a basal ration of rice, zweiback and oatmeal and found it to be 97 per cent. digested. Since in the metabolism experiments noted above that are not uniform there are many factors, such as food, habits, occupations, and races of people employed as subjects, it is unwise to attempt to generalize to any extent on the effect of the nature of the diet on the digestibility of butter.

However, in view of the very general and wide spread use of dairy butter in conjunction with many kinds of food materials, it appears of interest to summarize briefly a number of digestion experiments in which butter has been included as a part of the experimental ration and which have been conducted under identical experimental conditions, as regards the type of subjects, the length of experimental period, and methods of chemical analysis. In many of the digestion experiments conducted by the writer to determine the digestibility of cereals, legumes, meats, vegetables and flours, butter has been employed as a source of fat for the experimental diet. The butter included in the experimental rations was uniform in that it was always obtained from the same source. Since the digestion experiments considered here were made during a period of four or five years, no attempt was made to use a single lot of butter for the entire series of experiments, but it is believed that this butter obtained from a single creamery and presumably from a constant source of milk supply was typical of the ordinary commercial butter purchased by the average consumer.

The table on p. 662 contains the data essential for the consideration of these experiments and the text which follows includes a discussion of the details of the different types of diets.

The first group of experiments referred to in the table, eight in which dairy butter was the food material studied, are discussed in detail in the initial paper[10] of a series which has appeared from time to time reporting the results of digestion experiments conducted to determine the digestibility of a large number of edible fats and oils. To secure data concerning the relative digestibility of edible fats and oils several digestion experiments with each of the fats studied were conducted under uniform conditions. The experimental ration consisted of commercial wheat biscuit, fruit, sugar, tea or coffee and a special cornstarch pudding or blancmange in which was incorporated the fat under consideration. In order to mask any noticeable flavor or odor of the fats studied, the blancmange was heavily flavored with caramel which gave a uniform characteristic caramel flavor and odor to all the

1 *Ztschr. Biol.*, 15 (1879), No. 1, pp. 136-147.

2 *Idem.*, 16 (1880), No. 1, p. 127.

3 *Idem.*, 15 (1879), No. 1, pp. 174-176.

4 Sitzber, K., *Akad. Wiss. (Vienna) Math. Naturw. Kl.*, 90 (1884), III, No. 5, pp. 328-335.

5 *Landw. Vers. Stat.* 29 (1883), pp. 215-232.

6 *Ztschr. Biol.*, 24 (1887), No. 1, p. 16.

7 *Skand. Arch. Physiol.*, 2 (1890), No. 4-5, pp. 373-393.

8 *Ztschr. Untersuch. Nahr. u. Genussmtl.*, 2 (1899), No. 6, pp. 484-506.

9 *Ztschr, Phys. u. Diätet: Ther.* 12 (1908.9), No. 2, pp. 102-110.

10 "Digestibility of Some Animal Fats," *U. S. Dept. Agri. Bul.*, 310 (1915), pp. 22.

SUMMARY OF DIGESTION EXPERIMENTS IN WHICH DAIRY BUTTER HAS BEEN INCLUDED IN A VARIETY OF EXPERIMENTAL DIETS

Number of experiments	Nature of food material studied	Amount of fat eaten per subject daily, grams	Per cent. of butter in total fat consumed	Digestibility of entire ration		
				Protein per cent.	Fat per cent.	Carbohydrate per cent.
8	Butter	100	98	70.5	97.0	96.4
10	Dasheen	127	99	80.8	96.1	97.6
7	Soy-bean press-cake	92	62	86.6	94.2	96.3
4	Peanut press-cake	117	46	90.4	96.5	97.2
3	Kafir	67	99	49.5	91.6	97.0
4	Feterita	59	94	49.9	92.3	98.2
4	Milo	72	88	36.3	92.1	97.5
5	Kaoliang	76	89	13.3	90.2	97.0
5	Fine wheat bran	134	67	52.6	94.6	82.7
6	Unground wheat bran	107	65	39.9	93.7	84.4
7	Hard Palates	127	78	87.3	94.6	97.6

experimental diets which included edible fats and oils. Eight tests were made with this type of diet to determine the digestibility of butter and it was found that on an average butter was 97 per cent. absorbed by the body.

The studies of the food value and culinary possibilities of the dasheen, a variety of the taro (*Colocasia esculenta*), which is a staple constituent of the diet in large areas of the tropical countries, included a number of digestion experiments.[11] Since the advisability of the introduction of the dasheen into the subtropical regions of the country where the white potato can not be successfully grown or stored was under consideration, it was of considerable importance to have data concerning its digestibility. The basal diet for the digestion experiments with dasheen consisted of milk, which supplied the larger portion of the protein of the diet, fruit, and butter, which, with the fat from the milk, supplied the fat of the diet. The carbohydrate portion of the diet was largely derived from the dasheen. The results of these experiments show butter to be 96 per cent. digested when eaten as a part of a diet in which the carbohydrates were largely starch, derived from a starchy vegetable.

During the World War when it became necessary to conserve all resources to the utmost, the writer became intensely interested in promoting the use of the soy-bean and peanut press-cakes for human food. The expression of oil, under sanitary conditions, by the "cold process" from sound, clean soy-beans or peanuts produces a virgin oil and a high grade press-cake rich in protein. These legume proteins glycinin (soy-bean) and arachin (peanut) yield on hydrolysis a large amount of lysine, the amino acid essential for growth. The reported results of the chemical and biological examination of soy-bean and peanut proteins demonstrate beyond a doubt their high nutritional value. In order to supplement this data with information concerning the digestibility of these proteins, digestion experiments[12] were conducted in which the soy-bean and peanut press-cake flour combined with wheat flours was served in the form of biscuits. The experimental diet consisted of biscuits, fruit, butter, sugar and tea or coffee. Butter was served as a spread for the biscuits and lard was used as "shortening" in their preparation, accordingly the values reported for digestibility apply to the total fat of the diet rather than to either individual fat, but as both butter[13] and lard[13] have been reported as being 97 per cent. digested, it is of interest to note the effect of the soy-bean and peanut flour diets on their digestibility. Since butter constituted a half or more of the total fat of the experimental diets and since the reported digestibility for the total fat of the diets was for the soy-bean experiments 94 per cent., and

[11] "The Digestibility of the Dasheen," *U. S. Dept. Agri. Bul.*, 612 (1917), pp. 11.

[12] "Digestibility of Protein Supplied by Soybean and Peanut Press-cake Flours," *U. S. Dept. Agri. Bul.*, 717 (1918), pp. 28.

[13] "Digestibility of Some Animal Fats," *U. S. Dept. Agri. Bul.*, 310 (1915), pp. 22.

for the peanut experiments 97 per cent., it is evident that the digestibility of butter was lowered little if any by the other constituents of this type of diet.

From the results of the many attempts that have been made to find cereals suited for cultivation in the semiarid regions of this country it appears that the so-called non-saccharine grain sorghums are best adapted for the purpose. While these cereals are extensively included in the dietary of India, China, Abyssinia and South Africa, there is little recorded data relative to their digestibility. Accordingly digestion experiments were made to secure information concerning their value for human nutrition. Of the many non-saccharine grain sorghums which may be grown in the semiarid regions four, Dwarf Kafir, Feterita, Milo and Kaoliang, were chosen as typical. To determine the effect of cooking, etc., upon digestibility, experiments with the non-saccharine sorghums prepared in a variety of forms have been made by the writer but for the discussion here only those in which the sorghums were cooked and served as a mush will be considered since in these diets butter constituted practically the entire fat content of the diet. In this type of digestion experiments[14] with the grain sorghums the diet consisted of the cereal cooked as mush, apple sauce, butter, sirup, sugar and tea or coffee if desired. As may be noted from the above table the results of the digestion experiments with the non-saccharine sorghums show that their proteins are very incompletely absorbed by the body, due probably to the proteins being inclosed in the very tough cellular structure of the cereal. This coarse, rough, cellulose also may increase peristalsis to such an extent that the diet passes more rapidly than normal through the alimentary tract. If this theory is tenable it may also explain the lowered digestibility of butter, which was for the kafir experiments 92 per cent., for those with feterita 92 per cent., for those with milo 92 per cent., and for those with kaoliang 90 per cent.

For a long time considerable attention has been given to the desirability of including or excluding wheat bran in milling wheat flours. Inasmuch as the annual per capita consumption of wheat[15] is approximately five bushels this question assumes considerable importance, and among the factors to be considered in arriving at an intelligent solution of the problem is the extent to which the bran is digested by the human body. To obtain data in this connection a number of digestion experiments were made with coarse unground wheat bran and bran which had been ground to resemble flour in fineness. In these experiments[16] the bran was incorporated in a gingerbread and served in conjunction with potato, fruit, butter, sugar, and tea or coffee. As in the soy-bean and peanut flour experiments, lard was used as "shortening" in preparing the gingerbread and butter was served as a spread for the bread. Hence the values reported for the digestibility of fat refer to total fat of the diet. However, since a large portion of the total fat consumed was butter and since in the fine wheat bran experiments the total fat was 95 per cent. digested and in the unground bran experiments it was 94 per cent. digested, it is evident that for practical dietetics this type of diet did not lower the digestibility of butter.

According to reports[17] the large packing houses use the "hard palates" of cattle, which are taken from the roof of the mouth of beef animals, in the manufacture of potted meats and sausage in amounts varying from 2,500 lbs. to 6,000 lbs. monthly. Since chemical analysis showed that hard palates contain approximately 20 per cent. of protein it was decided to determine to what extent this protein was digested by the human body and seven digestion experiments[18] were made in which the ration consisted of potato, crackers, butter,

[14] "Studies on the Digestibility of the Grain Sorghums," *U. S. Dept. Agri. Bul.*, 470 (1916), pp. 30.

[15] *U. S. Dept. Agri. Bur. Crop Estimates Rept.*, 3 (1917), No. 10, pp. 99.

[16] "Experiments on the Digestibility of Wheat Bran in a Diet without Wheat Flour," *U. S. Dept. Agri. Bul.*, 751 (1919), pp. 20.

[17] "Digestibility of Certain Miscellaneous Animal Fats," *U. S. Dept. Agri. Bul.*, 613 (1919), p. 8.

[18] "Digestibility of Hard Palates of Cattle," *Jour. Agri. Research*, 6 (1916), No. 17, pp. 641-648.

sugar, tea or coffee and the hard palates served in the form of meat loaf. Butter was used in the preparation of the meat loaf and it was also served as a spread for the potatoes and crackers. From the results of the digestion experiments with the hard palate it was found that the total fat of the diet was 94.6 per cent. digested. Since the greater portion of the fat consumed was butter this figure is virtually that for the butter included in a protein rich diet—an average of 131 grams of protein was ingested daily by men employed at sedentary occupations. This should be sufficient indication that butter is very completely absorbed when eaten in conjunction with a high protein diet of this character.

SUMMARY

From the foregoing results of numerous digestion experiments it is evident that dairy butter is very completely utilized by the human body. In those diets in which the accessory foods were very nearly if not entirely absorbed by the human body, butter was found to be practically completed digested. When coarser materials, particularly those which provided considerable refuse, were included in the diet it was found that butter was somewhat less completely absorbed by the body. The general conclusion to be drawn from the results of the digestion experiments cited above is that butter eaten in conjunction with ordinary food materials is very completely digested and that for the diets studied, the nature of the diet does not produce a marked difference in the amount of butter absorbed by the human body.

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ARE SCIENTISTS ENCOURAGING POPULAR IGNORANCE?

I heartily agree with the view of Mr. Halsey that readers of Science should become familiar with the anti-metric case as presented in the recent report of the National Industrial Conference Board, The Century Company, $2.00. This report gives the pro-metric argument as well as the anti-metric argument and is, therefore, signed by the metric members of the committee, but not as Mr. Halsey states, "because they could not do otherwise." Scientists do not need to be told the pro-metric argument, but they should know the character of the arguments advanced by the so-called American Institute of Weights and Measures against the metric system, Mr. Halsey being their paid commissioner. Beyond quoting them at length no comment of mine is necessary.

For years . . . . the minds of children have been trained to believe in it (the metric system) as the only scientific system certain to become universal. Children leave school imbued with the metric fallacy. . . . Editors of newspapers knowing practically nothing about the subject have aped the schools and colleges, taught the fallacy and increased the ignorance. In the encouragement of the popular ignorance lies the chief danger to our established standards. p. 193.

Advocates of the English system deny most emphatically that there is any demand worth serious consideration in favor of a change to the metric system in the United States. The deductions drawn from lists of names presented by the metric advocates . . . are wholly fallacious and misleading. . . . If this is the best the pro-metrics can show, only 60,000 to 80,000 people in the United States out of a population of one hundred millions—less than one tenth of one per cent. of the whole—favor a change. Such a demand . . . could be accounted for by the scientific group in this country, which comprises about this proportion of the population and is known to advocate the metric system. . . . The propaganda in favor of the metric system has emanated from one or two propaganda organizations working for the purpose, which have spread broadcast throughout the United States literature of an essentially misleading character. . . . The prominent individuals most frequently quoted as favoring the metric cause are not industrialists and business men, but such professional men as teachers, doctors, inventors and others who are interested chiefly in the scientific aspects of the question and have nothing of material value at stake or have espoused the cause as fallaciously represented by metric propagandists without having given due consideration to the practical side of the issue. p. 192.

We note that the American Association for the Advancement of Science, the American

Chemical Society, etc., have repeatedly passed strong resolutions in favor of the metric system and if we have been duped it is time to know it, because scientific men and teachers do have something at stake in the prosperity of America. We should be informed as to who these propagandists are who are spreading ignorance, what their motive is, and convincing evidence should be given and not merely dogmatic affirmations.

Practically all the real sentiment in favor of a change . . . comes from teachers, scientists, some engineers and from a few manufacturers making refined instruments or other articles requiring a minuteness of measurement. p. 194. Science stands in a unique position. Its methods are ever changing and are easily changed. . . The number of persons and interests involved in the field of scientific activity are small compared with those involved in other fields. For these reasons, . . . the usefulness of parts of the metric system in scientific work and in fine instrument making can not be taken as an indication of the advisability of adopting it gradually in the United States. p. 145. In fact, it is the so-called 'absolute' or centimeter-gram-second (C. G. S.) system rather than the metric system which is actually employed in scientific work. p. 145. In engineering practice it is, as in scientific work, a mixture of other units that is used and has been found of advantage in some connections rather than the metric system exclusively. This is demonstrated in electrical engineering . . . where a 'mongrel system' comprising the C. G. S. or absolute system, the metric system with the centimeter instead of the millimeter as a unit, and English feet, inches and square inches, is used. The units of electrical measurement, the ohm, ampere, volt and others . . . are not intrinsically more metric than English. p. 147.

Whether the absolute system bears the stigma of a "mongrel" system because of the use of the centimeter instead of the millimeter or because of the character of the gravitation constant or because there are 60 seconds in the minute is not clear, but it is hardly an argument against the adoption of the metric system in any case.

English measures and weights are no haphazard modern invention, but have come down to us from prehistoric times. p. 4.

This will be news to many who have been led to suppose[1] that the English yard has been recently established on the basis of the standard meter, replicas of which are kept by the U. S. Bureau of Standards. But the report says:

In fact, the Anglo-Saxon measures of length down to the present have remained on the same basis as is given in the statute of Edward II (1324) where a statement in statutory form of what has since become the well-known rule that 'three barley corns round and dry make an inch, etc.' p. 5.

"The organic growth and selection of the fittest units in the English system make it infinitely better adapted to different uses than the metric system. p. 138. In short, from every angle, the metric system is devoid of the English system's handiness and convenience; its units are either too large or too small for general everyday requirements. . . . The character and names of its units are so tied in with every-day experience that they are readily learned and retained; and the features just mentioned make the English system, as compared with the rigid and inflexible metric system, much more comprehendible to the average mind, and more convenient, adaptable, and comprehensive in filling the needs a system of weights and measures is called upon to fill. p. 140.

The current extensive use of decimals in connection with English units in modern calculations has made the work of computations in that system as easy as in the metric system. The rapid development and extensive use of calculating machines, slide-rules, etc., has . . . enabled computations of whatever kind to be made with equal ease in any system, so that the metric and English systems have in present practice been put on the same footing in this regard. . . . Supporters of the English system deny that there would be any saving of time through the more general use of the metric system in the schools. p. 143.

[1] U. S. Bureau of Standards Bulletin 1, 380 (1905).

"History of Standard Weights and Measures of the United States," by L. A. Fischer.

The United States yard and the British imperial yard were found to differ in length by one ten-thousandth of an inch, but the imperial yard differs in length from its authentic copies by amounts which are at least as great as this. Consequently, it was hopeless to obtain the exact length of the yard and on April 5, 1893, the meter was taken as the standard unit of length for the English system in the United States and containing exactly 39.37 inches.

The same argument in England is made in regard to English money.

> The English system . . . has been found acceptable to the great majority of the Latin-American importers and the imports into these countries consist in preponderant degree of manufactured products into which the English system of weights and measures is definitely incorporated,'' in spite of those countries being metric. p. 158. ''Of the millions of dollars worth of machine tools which . . . have (been) sold to France and Germany, the great majority have been sold without request or suggestion that any of the dimensions be made in accordance with the metric system. p. 159.
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> It would be impossible gradually to substitute new metric standards and equipment for the old as the latter wore out without catastrophic confusion to industrial processes through a protracted period. Even if the change were made suddenly, . . . a long transition period fraught with confusion and disorder would inevitably follow. p. 175.

The proposal actually made by scientists that as far as possible metric designations be used for our existing English standards the report dismisses briefly by saying that it

> is impractical and in any event would be quite pointless because it could hardly be considered an adoption of the metric system. p. 175.

Of the well-known case of the Baldwin Locomotive Works building locomotives for Russia purely on metric specifications without changing their equipment, or working force or suffering any inconvenience or delay, the report says:

> If we continue to make equipment to existing standards and merely apply metric designations as was done in the case of the 'metric' locomotives built by the Baldwin Locomotive Works, this would be neither the adoption nor the use of the metric system. It would merely be expressing in terms of the metric system, with which the English is incommensurable, an existing standard dimension which is integral and exact in the English system. Such a change, it is held, besides being quite meaningless, would, if feasible, simply introduce confusion and error through calling things by wrong names. p. 176.

So the report proceeds to tell all of the dire calamities that will certainly befall us when the befuddled teachers and scientists have their way over the practical every-day business man.

> No possible advantages could result from a change to the metric system, but on the contrary, through such a change Great Britain and the United States would lose the vast trade they now possess with non-metric countries and with respect to metric trade they would surrender their advantages to such metric countries as France and Germany. p. 160.

In spite of Mr. Halsey's statement given above that products incorporating the English system can be used in countries which have adopted the metric system, it appears that if we adopted the metric system *we* could not do the same.

> Some conceptions of the difficulties which would be involved in such a destruction of standards is given in the following: . . . All rules, tables, formulæ, used in calculations involving measures of length. All drawings of manufactured articles. All measuring scales and measuring tools, calipers, verniers, etc. . . . All machine tools, leading screws of lathes, . . . locomotives, cars, railroads, and their appurtenances, all marine and stationary engines, all ships. p. 177. We can not regard the use of both systems on the same machine as a thing to be tolerated, much less deliberately encouraged. p. 179.
>
> The man who can estimate or indicate in words the value of mechanical standards to this country does not live. The cost of attempting to change air-brake hose couplings is not represented by the value of the tools for making the couplings in the Westinghouse Works, but by the infinite confusion of the railroads in getting from one standard to another. p. 187.

Finally the report attempts to show that whereas every civilized country except Great Britain and the United States is metric, this is only nominally the case.

> The statement that the countries named (France, Germany, Norway, Sweden, Belgium, Switzerland, Italy, Japan, the Central and South American countries, etc., and the Latin acquisitions of the United States) customarily employ the metric system is a pure assumption. No evidence of this is submitted, while, on the contrary, all available evidence shows that in some of these countries the system is used but little, and in none of them is it universal. p. 168.

Hence the report suggests

> that a conference of Great Britain, the United States and other countries be called to study carefully all natural systems of weights and measures

with a view to a more complete standardization of the inch and the foot the world over and to draft legislation . . . legalizing it in various countries as a world standard along with, if not superseding the metric system. p. 211.

The reader is referred to the report to see that the true spirit of the argument of the report has been preserved and also to get the pro-metric side.

Such a tissue of deliberate misrepresentation needs merely to be presented to scientific men for its refutation line upon line. Were it true that American scientists and teachers are spreading ignorance, this report would deserve to be a "best seller." But the challenge which it contains should not go unmet. The Council of the American Chemical Society at its recent meeting voted to ask the various scientific, educational, engineering, medical and pharmaceutical societies to send representatives to the Pittsburgh meeting of the society in September to consider what further steps can be taken toward the gradual introduction of the metric system. Here is an opportunity to answer the challenge.

The best answer to Mr. Halsey's contention that it can not be done is that *it is being done.* There has just come to hand the current schedule of chemicals of the national government, which is class 4, which has practically all pure chemicals listed in metric units only. Henceforth all pure chemicals appearing on the general schedule of supplies will be listed and purchased entirely in the metric system for the sixteen bureaus of the government.

In a volume which has just come from the press entitled *Metric System for Engineers,* written by Charles B. Clapham, a London engineer, the author gives an unbiased answer to many of the anti-metric arguments. For example, he says:

All the metric screws likely to be required can be cut on the usual English and American lathes, well within the accuracy required for manufacturing purposes, if *one additional change wheel* is provided. p. 33.

He says significantly, p. 148:

In considering the cost and inconvenience aspect, it is to be feared that many false objections have been put forward; etc.

He notes that a hundredweight contains 112 pounds, that a "stone" if used in weighing potatoes consists of 14 pounds, but when weighing butcher's meat contains only 8 pounds! This is far surpassed, however, by the complexity of the United States bushel. The use of the metric system is steadily growing, every school-boy talking of wave-lengths in hundreds of meters. Much further information on metric progress is given in an excellent work on *World Metric Standardization* published by the World Metric Standardization Council of San Francisco.

The *Valve World* for May, 1922, states:

More than 215 member organizations of the Chamber of Commerce of the United States have gone on record in favor of gradual metric standardization. More than 15,000 manufacturers and engineers have petitioned Congress to enact metric standards legislation, and these represent concerns capitalized at several billions of dollars. The states of Maine, Connecticut, New Hampshire, Utah, Illinois, California, North Dakota and Tennessee have officially memorialized Congress to adopt the metric system as the sole system of weighing and measuring for the benefit of all the people of the United States.

One is reminded of an old couple up in Vermont who went to town; and, passing a shop window, Lucy remarked, "George, why don't you buy a new hat in place of that disgraceful old thing?" To which George replied without going inside to inquire the price of the hat he saw, "I can't afford it. I'd have to get used to a new one. Besides I like the old one and I couldn't wear two."

EUGENE C. BINGHAM

AMERICAN COMMITTEE TO AID RUSSIAN SCIENTISTS WITH SCIENTIFIC LITERATURE

RUSSIAN scientists have been almost completely cut off from access to western European and American literature since 1914. This isolation, coupled with great physical hardships, is naturally interfering with the progress of their work, although it has by no means entirely put a stop to it.

Through many sources appeals are coming from Russian botanists, zoologists, chemists, physicists, geologists, engineers and others for the recent literature in their respective fields. The craving of these men for contact with the rest of the scientific world is very great. At various times scientific groups in this country have suggested the desirability of sending literature from this country to Russian scientists.

These suggestions have now resulted in the formation of an American Committee to Aid Russian Scientists with scientific literature. The committee has arranged with the American Relief Administration, of which Mr. Herbert Hoover is chairman, to receive the literature collected by the committee and assume the entire care and cost of its overseas transportation and delivery to the distributing agency in Moscow.

The literature will be distributed in Russia among the universities, scientific societies and individual scientific investigators by a special committee representing the Academy of Sciences and other recognized Russian scientific organizations in cooperation with the American Relief Administration which has representatives in Moscow, Petrograd, Kiev, Kharkov, Kazan and other university and academic centers.

The American Committee to Aid Russian Scientists is a voluntary and temporary organization of scientific men. Its activities will continue only until the regular channels for the shipment of scientific literature to Russia are reopened. It has no funds for the purchase of scientific books or scientific periodicals. It must appeal, therefore, to the generosity of the scientific societies of America, government and state scientific bureaus, individual scientists and publishers of scientific books.

The committee desires chiefly to obtain scientific books, scientific periodicals, authors' reprints, publications of government and state scientific bureaus, scientific institutions and university presses which are of an original scientific character or contain technical information, and which have appeared since 1914.

There is in Russia a fairly large number of scientific institutions. It is out of the question at the present time to undertake to supply adequately all those institutions with literature, but the committee hopes to provide at least six copies of each publication, since it feels that this number may meet at least the more urgent needs of the Russian centers of scientific endeavor at Moscow, Petrograd, Kazan, Kiev, Odessa and a few other principal university cities. If more than six copies can be spared, so much the better. On the other hand, if this number should be burdensome, a smaller number of copies will be of service.

The committee has at its disposal only a limited fund to cover the necessary clerical work. It will, therefore, appreciate it if the contributors of literature will 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.

The committee hopes that the response to this request will be whole-hearted and universal. The assistance that American scientists can give to the Russian scientists who are in distress, besides being a good Samaritan act, will be a real contribution to the progress of science. It may also be the means of re-establishing the normal exchange of scientific results between the Russian and American scientists, and will be a fine manifestation of the cooperation of men in science throughout the world.

Contributors should send, in triplicate, with each consignment a list of the publications forwarded by them. These lists, together with all letters containing advices of shipments, express and shipping receipts, should be addressed to the American Relief Administration, Russian Scientific Aid, 42 Broadway, New York, N. Y.

The publications themselves should be sent by express, or, if very heavy, by freight, to the American Relief Administration, care of Gertzen Company, 138 Jane Street, New York, N. Y.

Requests for further information should be sent to the American Committee to Aid Russian Scientists, 1701 Massachusetts Avenue, Washington, D. C.

VERNON KELLOGG,
Chairman
L. O. HOWARD,
DAVID WHITE,
RAPHAEL ZON,
American Committee to Aid Russian Scientists with Scientific Literature

SCIENTIFIC EVENTS

THE AGITATION AGAINST THE TEACHING OF EVOLUTION

PROFESSOR J. V. DENNEY, president of the American Association of University Professors, addressed on June 14 the following letter to the moderator of the conference of the Northern Baptist churches meeting in Indianapolis:

As president of the American Association of University Professors, I desire to call attention to the peril confronting our higher institutions of learning at the present time because of the "Fundamentalist" or "anti-evolution" movement which has appeared in two state legislatures and in the constituencies of several colleges controlled by or affiliated with the religious denominations.

Letters from presidents and professors indicate widespread anxiety lest the cause of higher education suffer serious injury through attempts at coercive measures, interfering with the professor's duty to teach the truth of his subject as determined by the body of past and present laborers in his own field and as confirmed by his own conscientious studies and researches. The chief injury is not merely to the professor who loses his position or to the particular institution that sacrifices a permanent aim to a passing fear. It is in the degradation of the office of teacher; in the establishment of distrust and suspicion in the public mind towards all colleges and universities; and in the immediate loss to both church and state of strong forces for good through the slackening of devotion and enthusiasm and the encouragement of casuistry, subtlety and insincerity among those who are called to teach with an eye single to truth.

The colleges controlled by or affiliated with religious bodies are public institutions in the sense that they solicit and receive students on terms common to all good colleges. They impose on applicants no political or religious tests. They forewarn the public of no doctrine in history, economics, literature and the sciences that is essentially at variance with the body of free and accepted teaching in these departments of learning throughout the country. Their professors cooperate in the work of all of the learned societies, and are bound by the code of honor in scientific research and by the obligation of scrupulous honesty of statement in teaching. Any invasion of this high obligation is an attack on manhood in teaching and destructive to real education.

Any college or university, whatever its foundation, that openly or secretly imposes unusual restrictions upon the dissemination of verified knowledge in any subject that it professes to teach at all, or that discourages free discussion and the research for the truth among its professors and students will find itself shunned by professors who are competent and by students who are serious. It will lose the best of its own rightful constituency and will cease to fulfill its high ministry. The same results, disastrous to true education, will follow whether the restrictions are adopted voluntarily by the college itself, or are forced upon its administrative officers by the state legislature, an ecclesiastical body or by powerful influence operating through trustees. The question of legality and of good motive is also irrelevant so far as moral and educational results are concerned.

The five thousand members of the American Association of University Professors in active service in some two hundred colleges and universities of the United States are of one mind on the fundamental necessity of preserving the integrity of the teaching profession. They realize that their work is a sacred trust that can be fulfilled only in freedom of conscience, loyalty to the truth, and a profound sense of duty and of personal responsibility. They claim the support of all good Americans whatever their creed in resisting measures that will prove ruinous to our institutions of higher learning.

THE PROPOSED BOMBAY SCHOOL OF TROPICAL MEDICINE[1]

WE learn from India that the government of Bombay has declined to proceed with the project for establishing a School of Tropical Medicine at Bombay. The news is not a little surprising, for the government of Bombay had very definitely expressed its intention to establish the school, and Sir Dorab Tata had promised to contribute a lakh of rupees a year towards the expenditure which was to be incurred. The Bombay School of Tropical Medicine was to have been opened on April 1 last, and all arrangements were made for this purpose. It was only at the last moment that the Bombay government determined to cut out of the budget the whole sum allotted to the school, and issued orders that the scheme should not be proceeded with. In consequence Sir Dorab

[1] From the *British Medical Journal*.

Tata has withdrawn his offer, which was contingent on the government founding a school of tropical medicine at Bombay. As will be seen, matters had gone very far before the government of Bombay repudiated the undertaking it had given. They had gone even further than we have so far indicated, for rather more than a year ago the Royal Society was asked to select professors for the chairs of clinical medicine and therapy and of protozoology in the school. The Royal Society, acting through its Tropical Diseases Committee, issued advertisements widely—in this country, in the dominions and in America. From among the applicants it selected two, one for each chair. The protozoologist selected was an American, but he, we understand, subsequently, on private grounds, withdrew his acceptance. The successful applicant for the other chair, an Australian (Professor N. Hamilton Fairley), resigned his appointment in Australia to become Tata professor of clinical medicine in the Bombay School. The government of Bombay has now given him notice that it will dispense with his services on October 31. The situation thus brought about is obviously most unsatisfactory, and the matter can not be allowed to rest where it is. When the Royal Society acts for the Indian government and invites applications for positions on definite terms, the candidates selected assume that a written contract is superfluous. Clearly the Royal Society has been placed in a very false position. At the request of the government of India it undertook to select suitable persons to occupy the two chairs. With the authority of the government of Bombay the Royal Society, through its committee, issued advertisements inviting candidates to come forward and stating the terms and conditions of the appointment, which was to be in each case for a term of five years in the first instance, "but may be extended by the government." It is now left in the lurch by the government of Bombay, which professes to find that it has miscalculated its resources and is not in a financial position to carry out its bargain. The Royal Society will, we feel sure, have the support of public opinion in any action it may take, and the medical profession in particular will be anxious to see that justive is done to Professor Fairley, if not by the government of Bombay, then by the government of India, which can not absolve itself from responsibility for the acts of the provincial government. We understand that a new central research institute for India may shortly be established, probably at Delhi; this may afford the government of India a way out of the false position in which it has been placed by the government of Bombay.

THE ROYAL ACADEMY OF BELGIUM[1]

The Royal Academy of Belgium celebrated the one hundred and fiftieth anniversary of its foundation on May 23 and 24 in the presence of a large number of its members and of delegates from other academies and learned institutions. On the Wednesday afternoon, May 24, numerous congratulatory addresses were presented at the Palais des Académies, and the members and visitors were afterwards received at the Hôtel de Ville by the Mayor of Brussels, M. Adolf Max, and his aldermen, MM. Steens, Vande Meulebrouck and Coelst; a reception was held at the Palais des Académies in the evening, where an exhibition of medals and portraits connected with the history of the academy had been arranged. The anniversary celebration itself was held in the large hall of the academy on the afternoon of May 25 in the presence of the king, the minister of arts and science, M. Hubert, formerly rector of the University of Liége, Cardinal Mercier, and the English, French, Dutch, Spanish and Japanese ambassadors. The president, M. Vauthier, in an address of welcome, briefly sketched the history of the academy and its influence on the intellectual development of Belgium. The minister of justice, M. Masson, tendered the congratulations of the Belgian government, and Monseigneur Baudrillart spoke in the name of the Institut de France. Sir William B. Leishman, as vice-president of the Royal Society, represented the British universities and learned societies; he referred to the activities of Belgian bacteriologists and paid a high tribute to the work of M. Jules Bordet. MM. Lameere, Pirenne and Verlant, representing respectively

[1] From *Nature*.

the classes of science, of letters, and moral and political sciences and of fine arts, contributed summaries of the activities of their several sections of the academy. Later the visitors were received by the king and the queen at the Palace of Laeken, and in the evening a banquet was held at the Hôtel Astoria.

THE ROYAL GEOGRAPHICAL SOCIETY

AT the annual meeting of the Royal Geographical Society on May 29 Lord Ronaldshay was elected president of the society in succession to Sir Francis Younghusband, and the following were elected vice-presidents: Sir Francis Younghusband, Colonel Sir Charles Close, Mr. D. W. Freshfield, Lord Edward Gleichen, Sir T. H. Holdich, and Sir J. Scott Keltie.

The royal medals were presented, the founder's medal being awarded to Lieutenant Colonel C. K. Howard-Bury for his distinguished services in command of the Mount Everest Expedition, 1921, and the patrons' medal to Mr. Ernest de K. Leffingwell, Los Angeles, California, for his surveys and investigations on the coast of northern Alaska. Mr. Oliver B. Harriman, first secretary at the American embassy, on behalf of Mr. Leffingwell, who could not attend, accepted the patrons' medal.

The other awards of the council were made as follows: The Victoria medal to Mr. J. F. Baddeley, for work on the historical geography of Central Asia; the Murchison grant to Mr. Charles Camsell, deputy minister of mines, Canada, for explorations and surveys in northern Canada (accepted, on Mr. Camsell's behalf, by Mr. Peter Larkin, high commissioner for Canada); the Back grant to Khan Bahadur Sher Jang, for surveys on the Indian frontier and in adjacent countries; the Cuthbert Peek grant to Mr. F. H. Melland, for explorations in Northern Rhodesia; and the Gill Memorial to Mr. A. R. R. Boyce, of the Sudan Survey, for triangulations in the Sudan.

The address of the retiring president was chiefly concerned with the Mount Everest Expedition.

SIGMA XI AT UNIVERSITY OF KENTUCKY

THE thirty-seventh chapter of Sigma Xi to be known as the Kentucky Chapter was installed at the University of Kentucky on May 5. The petitioning group numbered seventeen. These were already active members of the society, having been elected to such while connected with other educational institutions.

The installation exercises were conducted by Dr. Henry B. Ward and Dr. Edward Ellery, president and secretary of the national organization. The charge to the chapter was delivered by Dr. Ellery and the symposium was conducted by Dr. Ward.

The following officers were elected:

President: Dr. Paul P. Boyd
Vice-president: Dr. W. D. Funkhouser.
Secretary: Professor E. S. Good.
Treasurer: Professor E. N. Fergus.

A banquet was held in the evening at the Phoenix Hotel, Lexington. The chapter had as its guests Dr. Ward, Dr. Ellery, Judge R. C. Stoll, chairman of the executive committee, University of Kentucky, Dr. Glanville Terrell, chairman of the Graduate School, Professor W. S. Anderson, president of the Research Club, Dr. Thomas B. McCartney, acting-president of Transylvania College, Dr. Robert C. Hinton, of Georgetown College, and Dr. Frank L. Rainey, of Center College.

Besides those of the Kentucky Chapter present at the banquet were the following members of the society resident in Lexington: Dr. A. F. Hemmingway, Dr. J. A. Gunton, Professor Mary Brown, Dr. J. A. Herring and Dr. Philip P. Blumenthal.

Dean P. P. Boyd acted as toastmaster and toasts were responded to by Judge Stoll, Dr. Ward, Dr. Ellery and Dr. McCartney.

DEAN OF THE SHEFFIELD SCIENTIFIC SCHOOL

THE Yale Corporation has elected as dean of the Sheffield Scientific School in succession to Director Russell H. Chittenden, Professor Charles Hyde Warren, since 1900 a member of the faculty of the Massachusetts Institute of Technology, where he has been professor of mineralogy since 1915.

The dean-elect of the Sheffield Scientific School served as an assistant in chemistry and mineralogy in that school from 1896 to 1900, studying in the Graduate School during this period and receiving the degree of doctor of philosophy in 1899. In addition to his teaching at the Massachusetts Institute of Technology he has been extensively occupied with expert work for various mining and manufacturing chemical concerns. He also carried out a large quantity of research work of a purely scientific character.

Professor Warren is a member of the American Academy of Arts and Sciences and of the Geological Society of America. He is also a member of the Yale Chapter of the honorary society of Sigma Xi. His published works include "A Manual of Determinative Mineralogy" (1910), and contributions to American and German technical journals.

Dr. Russell H. Chittenden has been a member of the Yale faculty since his graduation from the Sheffield Scientific School forty-seven years ago. He has been head of the Sheffield Scientific School since 1898, when he succeeded Professor George Jarvis Brush, first director of the school. Dr. Chittenden offered his resignation to be effective a year ago, but conceded to a wish that he spend another year in office until a suitable successor might be found.

SCIENTIFIC NOTES AND NEWS

The joint meeting of the American Association for the Advancement of Science and its Pacific Division is being held this week at Salt Lake City. The address of the president of the Pacific Division, Dr. Barton W. Evermann, given on Thursday evening, is on "The conservation and proper use of our natural resources." At the dinner on Friday evening, Professor James Harvey Robinson gives an address on "The humanizing of knowledge."

The gold medal of the Linnean Society of London, which is given in alternative years to a botanist and a zoologist, was this year awarded to Professor E. B. Poulton at the anniversary meeting on May 24. In making the presentation, the president, Dr. A. Smith Woodward, referred to Professor Poulton's long labors in entomology, and his keepership of the Hope Collection at Oxford.

The Charles P. Daly medal of the American Geographical Society for 1922 has been awarded to Lieutenant Colonel Sir Francis Younghusband, president of the Royal Geographical Society. It has been forwarded through the Department of State for presentation at London by the American ambassador. The medal bears the inscription: "Lieutenant Colonel Sir Francis Younghusband for explorations in northern India and Tibet and for geographical publications on Asiatic and African borders of the Empire."

Rutgers College has conferred the degree of doctor of science on Mr. Thomas A. Edison.

At its annual commencement held on June 6, the University of Utah conferred the honorary degree of doctor of laws on James E. Talmage, who was formerly president of, and professor of geology in, the institution. On the same occasion the honorary degree of doctor of science was conferred on Dorsey Alfred Lyon, of the U. S. Bureau of Mines.

The University of Maryland at its commencement on June 10 conferred the honorary degree of doctor of science upon Eugene Amandus Schwarz, honorary custodian of coleoptera in the U. S. National Museum. Mr. Schwarz began official work as a specialist in beetles for the Division of Entomology under the U. S. Commissioner of Agriculture in 1878.

At the commencement of the University of Pittsburgh on June 14, the honorary degree of doctor of laws was conferred upon Mr. Alfred Cotton Bedford, chairman of the board of directors of the Standard Oil Company of New Jersey. This honor was bestowed upon Mr. Bedford in recognition of his activities in the development of the American petroleum industry and for his foresight in the encouragement of the application of scientific research.

Professor H. O. Hofman, professor of mining and metallurgy at the Massachusetts Institute of Technology, and Professor A. E. Burton, dean and professor of topographical engineering, have retired from active service.

Professor Oakes Ames has resigned as director of the Harvard Botanic Garden. It is expected that he will continue as assistant professor of botany at the Bussey Institution.

Professor E. Kraepelin has asked to be relieved from delivering the course on psychiatry at the University of Munich, as he wishes to devote all his energies to research on psychiatry at the special institution for this purpose, which is practically his creation.

RECENT appointments to industrial fellowships in the Mellon Institute of Industrial Research of the University of Pittsburgh include the following: E. R. Clark, B.A. (Yale); H. E. Dierich, A.B. (Kansas); Marc Darrin, B.S. and M.S. (Washington); O. B. J. Fraser, B.S. (Queen's); A. W. Harvey, B.S. (Syracuse), M.S. and Ph.D (Pittsburgh); C. R. Texter, B.S. (Pennsylvania State); and B. B. Wescott, B.S. and M.S. (Pittsburgh).

ALEXANDER WEINSTEIN, Ph.D., now holding the Sigma Xi fellowship and working in the laboratory of Professor T. H. Morgan at Columbia University, has been appointed to a Johnston scholarship in the Johns Hopkins University.

DR. ALEŠ HRDLIČKA, curator of the Division of Anthropology of the Smithsonian Institution, has consented to serve the Children's Bureau of the United States Department of Labor in an advisory capacity on matters related to the field of anthropology.

PROFESSOR WILLIAM TRELEASE, of the department of botany in the University of Illinois, sailed for Europe on June 3, to complete an intensive study of certain plant groups. Professor Trelease will visit herbaria at Kew, Paris, Geneva, Berlin, Stockholm and Copenhagen.

DR. ALBERT JOHANNSEN, professor of petrology in the University of Chicago, will spend the summer in Europe, doing geological work and visiting various universities. He sailed from New York on June 21.

PROFESSOR OLAF P. JENKINS, of the State College of Washington, is to take charge of geological investigations of the coal of Whatcom and Skagit counties, Washington, for the State Division of Geology, Department of Conservation and Development.

HARLAN I. SMITH, archeologist of the Victoria Memorial Museum of Ottawa, is at Bella Coola, British Columbia, continuing his investigations into the material culture of the Bellacoola Indians.

DR. VERNON KELLOGG, permanent secretary of the National Research Council, gave the annual Phi Beta Kappa address at the University of Virginia on June 13.

ON June 7, Dr. D. S. Jordan delivered the commencement address to the University of Denver, Colorado, his subject being "The melting pot."

ON June 11, Dr. H. P. Nichols, rector of Holy Trinity Church, New York, delivered the baccalaureate address at the University of Colorado. He took as his subject "Evolution, and its highest product, man."

PROFESSOR ERNST FUCHS, of Vienna, gave a Mayo Foundation lecture at the Mayo Clinic June 9. His subject was "Syphilis and its relation to diseases of the eye." On June 1 Dr. H. Berglung, of the department of biochemistry, Harvard Medical School, lectured on "The chemistry of the nonprotein nitrogen of the blood."

ON June 16, Mr. Edward R. Weidlin, director of the Mellon Institute of Industrial Research of the University of Pittsburgh, addressed the fourth annual convention of the National Lime Association on "The value of research to industrial associations." This convention was held in Cleveland, Ohio.

A PUBLIC meeting of the British National Union of Scientific Workers was held at University College, London, on June 15, when an address was given by Mr. F. W. Sanderson, headmaster of Oundle, on "The duty and service of science in the new era." The chair was taken by Mr. H. G. Wells.

THE Yale Corporation has voted that the Botanical Garden shall be known as the Marsh Botanical Garden, in order that the memory of Othniel C. Marsh and of his generosity to the university may be more effectively perpetuated. Othniel C. Marsh was a graduate of Yale College in the class of 1860 who became the first professor of paleontology in the university. Professor Marsh died in 1899, bequeathing to the university his former residence, which has since been used as the School of Forestry. The Botanical Garden is connected with this school.

JAMES MCMAHON, emeritus professor of mathematics at Cornell University, died on June 1 at the age of sixty-six years.

Dr. Edward Hall Nichols, professor of clinical surgery in the Harvard Medical School, died on June 12, aged fifty-nine years.

Dr. W. H. R. Rivers, of the University of Cambridge, known for his work in anthropology and psychology, died on June 4, at fifty-eight years of age.

Nature notes that the first meeting of the "Institut International de Chimie Solvay" was held in Brussels on April 20-27, under the presidency of Sir William Pope. It will be remembered that before the war the late M. Ernest Solvay set aside a capital sum to be expended in the course of thirty years by the International Institute of Physics, and that meetings under the auspices of this institute have been held in Brussels both before and since the war. More recently M. Solvay set aside a further capital sum of one million francs, also to be expended in thirty years, for the promotion of the science of chemistry. The meetings of the institute are attended by delegates from different countries, the number being limited to about thirty, so that the discussions may be as free and as informal as possible. The recent meeting was devoted to the consideration of a number of those questions which affect the foundations of modern chemistry, and its program included the presentation of papers on isotopes, by Soddy, by Aston, and by Perrin and Urbain; on X-ray analysis and molecular structure, by W. H. Bragg; on the electronic theory of valency, by Mauguin; on optical activity, by Pope and by Lowry; and on chemical mobility, by Job.

The *Journal* of the American Medical Association, quoting from the *Preusa Medica*, describes the centennial of the foundation of the Academia Nacional de Medicinia at Buenos Aires, April 18. The rector of the university, Dr. José Arce, presided. The historical address was delivered by the president of the academy, Dr. Eliseo Canton. Among the announcements made was that of the institute of experimental medicine, the first of its kind to be founded in South America. A prize of a gold medal and $5,000 was awarded to Dr. P. Belou for his "Stereoscopic Atlas of the Anatomy of the Ear"; a silver medal and $3,000 to Dr. C. Lagos García for his work, "Human Sexual Malformations," and a copper medal and $2,000 to Dr. F. Garzón Maceda for his "Manual of Zoopharmacy." A work by Dr. P. P. Rojas on the structure of the myocardium received honorable mention. Three days were devoted to the centennial ceremonies.

Dr. R. S. McBride, scretary of the Gas and Fuel Section of the American Chemical Society, announces that the new section will meet with other sections of the society at the fall meeting to be held in Pittsburgh September 4 to 9. Among the topics to be discussed will be the general subject, "Combustion," in the form of a special symposium to be conducted under the chairmanship of Professor R. T. Haslem, of Massachusetts Institute of Technology. It will include a program of papers on chemical methods underlying fuel utilization. Officers of the section are: Dr. A. C. Fieldner, Bureau of Mines, Pittsburgh, *chairman,* and R. S. McBride, Colorado Building, Washington, D. C., *secretary.* Dr. McBride has requested that any members of the society having papers to present at the meeting of this section should forward them in full or in abstract form to the chairman or secretary or should notify these officers regarding their intention to prepare the papers.

The following resolution was passed by the faculty meeting of Kenyon College, on May 29: "Voted that the faculty deplores agitation against the explanation of natural phenomena known as the theory of evolution, and regards such propaganda as dangerous to scholarship, education and the progress of civilization."

A gift of £10,000 has been made to aid cancer research by Mr. and Mrs. G. F. Todman, of Sydney, N. S. W., in memory of their daughter. At the request of the donors Sir Joseph Hood, M.P., has allocated the sum as follows: £4,000 to the Imperial Cancer Research Fund, Queens Square, Bloomsbury; £1,000 each to the Middlesex Hospital, the Cancer Hospital, Fulham Road, London, the Christie Hospital, Manchester, the MacRobert Endowment, Aberdeen University, and the Cancer Hospital, Glasgow; and £500 each to the Radium Institutes of London and of Manchester.

UNIVERSITY AND EDUCATIONAL NOTES

Announcement is made that the residue of the estate of the late Hamilton B. Tompkins, of New York City, left in his will to Hamilton College, amounts to $650,000.

The salary endowment fund of Vassar College has reached the sum of $3,030,000.

A research fellowship of $1,000 for the study of orthopedics in relation to hygiene and physical education will be offered by Wellesley College, beginning in September and continuing for one year.

Dr. Frank I. Kern, professor of botany, has been appointed dean of the newly established Graduate School of the Pennsylvania State College.

M. D. Hersey, associate professor of physics, R. P. Bigelow, R. R. Lawrence and H. W. Shimer have been promoted to full professorships at the Massachusetts Institute of Technology. Dr. Bigelow will be professor of zoology and parasitology; Professor Lawrence is a member of the electrical engineering department; Dr. Shimer will be professor of paleontology.

Dr. R. E. Coker, M.S. (North Carolina), Ph.D. (Johns Hopkins), head of the division of scientific inquiry of the U. S. Bureau of Fisheries, has been elected to a professorship of zoology in the University of North Carolina.

Geographers who received their doctorates at Chicago have recently been promoted as follows: To a professorship, Carl O. Sauer, at the University of Michigan. To associate professorships, Stephen S. Visher, at Indiana University; Wellington D. Jones and Charles C. Colby, at the University of Chicago. To assistant professorships, Robert S. Platt and Derwent S. Whittlesey, also at Chicago.

At the University of Kansas, assistant professor Curt Rosenow has been promoted to an associate professorship in psychology and Dr. Hulsey Cason (Columbia, '22) has been appointed assistant professor of psychology.

Dr. Elwood S. Moore, dean of the School of Mines of the Pennsylvania State College, has resigned, to take charge of the work in economic geology at the University of Toronto.

Dr. John Macpherson, lately retired from the post of commissioner of the Board of Control for Scotland, has accepted for three years the professorship of psychiatry at the University of Sydney.

DISCUSSION AND CORRESPONDENCE

OBSERVATIONS OF FALLING METEORITES

To the Editor of Science: The numerous recently reported occurrences of falling meteorites are so contradictory and so at variance with what reason would lead one to expect as to make one quite cynical concerning the value of human testimony.

Few natural phenomena, it may be stated by way of introduction, are more likely to unduly excite the imagination than those attendant upon a fall of meteorites. The suddenness, the unexpected nature of the occurrence, the light and noise, and perhaps above all the sensation of fear aroused when a solid body is suddenly projected from seemingly empty space, all have effect, and it is not surprising that accounts are widely variable—dependent upon the flexibility of the imagination, more perhaps than upon powers of observation. Few persons, however well trained, can look calmly and critically upon the phenomena. Fewer yet can, in the brief space of time, estimate the height of the body when first seen, or note such facts as may be of service in calculating its direction and rate of progress.

A peculiar feature of the case is the lack of ability on the part of an observer to locate the place of fall unless, indeed, he happens to actually see it strike the ground. This is due to several causes, and, in part at least, to the low angle at which the stones sometimes enter our atmosphere, which permits a continuation of flight for some distance, even miles, beyond the point at which they seemingly must strike the earth, and in part to the fact that one is unable to correctly estimate the distance, which may be much greater than supposed. No less an experienced student and collector than the late H. A. Ward once told the writer of his experience in such matters. He was sitting in front of a house occupying a somewhat elevated position with reference to the rest of the town. Suddenly a meteorite appeared descending from the sky, and fell, he was sure, within a certain square on the lower level. He at once proceeded to the spot, only to find that he was mistaken but that it had fallen a "few blocks away." At this second point the same experience was repeated, and the stone finally located some twenty miles beyond the point where he was "certain" he had seen it strike.

An equally good illustration was offered in the flight of a meteorite over the city of Washington on Sunday, January 12, 1919. This was first called to my attention by a man some eighty miles south of Washington who saw it, as he assured me, strike the ground within one half a mile of where he was standing. Inasmuch as the meteorite had been observed passing over Washington in a northeasterly direction his statement was not accepted. Further reports of the fall in the immediate vicinity of the city and a few miles away were also received. Taking the direction along which the meteorite was traveling, I followed it up by correspondence for a distance of over 300 miles into northeast Pennsylvania where it became lost. The last reports received indicate that it was going in two directions at once (!) and it is very probable that it actually fell somewhere in that vicinity, nearly 400 miles from where first *seen* to fall.

Experiences similar to the above are common. In many other instances stones which were "seen to fall" have proved to be of strictly terrestrial origin. There comes a sudden flash and report, the observer goes quickly to the spot and there finding an object which had not previously attracted attention, assumes it to be a meteorite and in perfectly good faith writes some museum announcing his discovery and willingness to dispose of the same. There is probably not a museum of importance in the world that does not annually receive from one to many announcements of this kind. The receipt even of glacial boulders which were "warm when picked up" or "which set fire to the grass at the point where they fell" is not unusual.

This leads to the second point to which attention need be directed—that relating to the reported temperature of the fallen body, which is often to the effect that "it was too hot to touch," or has been the cause of fires. As in a great majority of cases it is impossible to investigate the actual temperature after the first report has been made it may be well for the moment to consider the probabilities.

While the original source from which meteorites are derived is problematical it yet 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 they are cold throughout to a degree of which we can have no conception. During the few seconds in which they are passing through our atmosphere, they become intensely heated on the immediate surface, but these portions are immediately stripped off, and, as we have absolute proof, the heat never extends to a distance of more than two or three millimeters. Before striking the ground the speed of the body is so far checked that it ceases to glow and the thin film of molten material quickly congeals. Cooling of the surface, owing to the intense cold of the interior, must follow rapidly and it is questionable in the writer's mind if a large majority of the reports of the heated condition of the meteorite when found are not based upon expectation rather than fact. He even goes so far as to suggest that when it shall become realized by the public at large that the chances are in favor of a meteoric stone being cold rather than hot when found, it will be so reported.

GEORGE P. MERRILL
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ORIGIN OF SOIL COLLOIDS

DR. WHITNEY[1] has advanced an interesting theory as regards the origin of soil colloids. He says, in part:

> My present view is that particles of matter derived from silicate rocks and other soil-forming minerals when they approach a diameter of .0001 mm. contain relatively so few molecules that the

[1] SCIENCE, 54: 656, 1921.

bombardment of the water molecules in which the particle is immersed shatters the particle beyond the ability of the molecules in the solid to hold together as a solid mass. The atoms of calcium, magnesium, potassium and sodium in the molecule of the silicate would go for the most part into true solution, while the atoms of silicon, aluminum, and iron would go chiefly into colloidal solution forming the basis of the colloidal matter or the ultra clay of the soil. It should be possible for the mathematical physical chemist, from physical constants now known, to determine empirically the relative size of the particle of matter which could withstand such bombardment without complete disintegration. This is a problem which has not yet been worked out.

This is one way of looking at their origin, but the results of our experimental work on soil colloids force us to adopt quite a different view. One that is not based on bombardment of water molecules, but one based largely on chemical reactions.

Many soil particles are hydrated silicates which contain varying amounts of aluminium, iron, silcon, sodium, potassium, calcium, magnesium and other elements in smaller quantities. Soil chemists claim that these particles are surrounded with a water-film, and that this film is held tenaciously. In the light of this the salts in the outer layer of these soil particles are subjected to constant hydrolysis. The hydrolytic products of the soluble compounds of sodium, potassium, etc., are partly taken up by this water film by way of solution, and part of them are adsorbed by the hydrolytic insoluble products of the iron and alumina salts which form a gel casing for the soil particle, that is, there is an equilibrium of the soluble salt between the water film and the insoluble gel which now surrounds the soil particle.

When the soil becomes flooded as after a rain, and the water moves down through the soil, the soluble salt of the water film is partly removed by diffusing into the moving water. This destroys the salt equilibrium between the water film and the incasing gel, and, hence, some of the soluble adsorbed salt is released to the water film. This continues until most of the soluble material is leached from the outer layer of the soil particle. This leaching may be continued until the incasing hydrolytic gel products of alumina and silica, and ferric oxide may pass into colloidal solution. Not only will the freedom of electrolytes tend to bring the incasing gel into colloidal solution but some of the soluble salts themselves or some salts that are moving through the soil under the proper hydrogen ion concentration will very much hasten their pepitization.

The pepitization of the hydrolytic insoluble compounds removes the encasing gel and the soil particle is again exposed to hydrolytic action, and in this way the weathering of the silicate particles proceeds. The pepitized gel or hydrosol moves through the soil, provided the pepitization is great enough, until it encounters a coagulating electrolyte or different hydrogen ion concentration, when it comes back as the gel and may be deposited on a soil particle, or come down as a precipitate where it remains as an adsorbent and reservoir for plant food until the conditions are sufficiently changed for it to pass back into the hydrosol; that is, the process is reversible

$$\text{hydrogel} \rightleftarrows \text{hydrosol}$$

and whether it is a hydrosol or a hydrogel depends on the soil environment.

Certain soil salts in our work have brought about a very beautiful pepitization, while other salts have brought about an equally definite coagulation. Then there are salts that lie in between these extremes. Again the same salts and same concentration have brought about both coagulation and pepitization by changing the hydrogen ion concentration.

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A CRAYFISH TRAP

IN ponds and streams where crayfish are abundant they can be readily taken by means of a trap constructed as follows: A rectangular box of any convenient size, sixteen by twenty-four inches for instance, is built of one-fourth inch mesh galvanized screen wire. Into one end of this box a removable funnel of like material is fitted. This funnel should project about eight inches into the box and have a flattened opening about four inches wide and an inch and a half deep. In setting the trap it should be placed in shallow water on a sloping bank and partially embedded in the mud or sand so that the bottom of the funnel is even with the bottom of the pond. The rest of the trap extends out toward the deeper water. A dead fish wired securely to the bottom of the trap makes an excellent bait. Attracted by this bait, the crayfish crawl into the trap and seem to be unable to find their way back out. A single night-set with such a trap will reward the trapper with at least a water bucket full of crayfish for laboratory use, or for the more immediate purpose of supplying the camp with an exceedingly delectable breakfast.

E. C. O'Roke

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SPECIAL ARTICLES

NOTE ON THE RELATION BETWEEN THE PHOTIC STIMULUS AND THE RATE OF LOCOMOTION IN DROSOPHILA

It is a fact demonstrated by many investigators that *Drosophila melanogaster* (ampelophila) is negatively geotropic and positively phototropic. In addition it is also known that light acts as a kinetic stimulus as well as a directive one. When the individual is illuminated, therefore, its movement is determined by the three factors operating simultaneously. If light acts in opposition to gravity the rate of upward crawling of the fly is lowered; and if light acts with gravity the rate is increased. Since the stimulus of gravity is always constant, and the photokinetic stimulus constant within wide limits, the rate of upward crawling is a measure of the effect of the phototropic stimulus.

Definite quantitative results have been obtained by measuring with a stop-watch the time necessary for wild flies to crawl to the top of a glass cylinder under three different intensities of light. Illuminated from above with a light of 1,500 candle meters the time taken for 50 per cent. of the experimental flies to reach the top (a distance of 172 mm) was found to be 6.17 seconds. With an intensity of 750 c.m., 7.6 seconds; and with an intensity of 75 c.m., 10.89 seconds. Each of these determinations is the average of 50 trials with 87 animals selected from five different cultures. The age of the flies varied between six and nine days. Under the illumination of a ruby lamp giving only enough light to enable observation, the time consumed in reaching the top was 11.3 seconds. There is then a definite relationship between the intensity of illumination and the rate of movement, which may be expressed by the Weber-Fechner law, as was done in the case of the Japanese beetle.[1] Figure 1 ex-

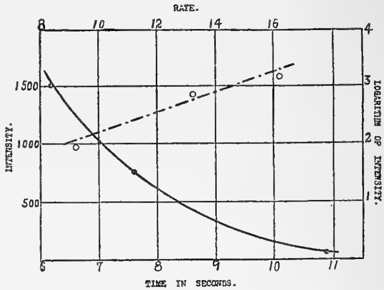

Fig. 1. Two graphs indicating the relation between light intensity and the phototropic orientation of *Drosophila*. The circles are points, at which Rate $= \frac{100}{\text{Reaction time in seconds}}$, plotted against the log of the intensity. The solid dots show the reaction time plotted against the intensity.

presses this relationship. The broken line is obtained by plotting the logarithm of the intensity against the rate of locomotion, where rate equals 100 divided by the reaction time in seconds. From this graph it may be concluded that the sensation is proportional to the logarithm of the intensity of the stimulus. The continuous line is obtained by plotting the reaction time in seconds against the intensity of light and leads to the same conclusion.

It was found by McEwen[2] that the mutants

[1] Moore, A. R., and Cole, W. H.: "The response of *Popillia japonica* to light and the Weber-Fechner law," *Jour. Gen. Physiol.*, 3: 331, January, 1921.

[2] McEwen, R. S.: "The reactions to light and to gravity in *Drosophila* and its mutants," *Jour. Exp. Zool.*, 25: 49, February, 1918.

of *Drosophila* known as *white* and *vestigial* show variations from the reactions of wild flies to light. He decided that the *vestigial* flies are not oriented by light, a conclusion apparently verified by experiments in which wild flies, whose wings had been removed, were used. The *white* race oriented positively to light, but with less regularity and precision. In my experiments it was also found that *white* flies are less precise in their photic orientation, it being many times impossible to secure satisfactory readings on 50 per cent. of the individuals, since after reaching the top of the cylinder some would crawl back to the bottom, even under an intensity of 1,500 c.m. No results, therefore, are presented for the *whites*. In the case of *vestigial* flies it was found that a mechanical factor retarded orientation. When the glass cylinder was used for these flies it was discovered that the reason they did not reach the top was because they continually lost their foothold, when part way up, and fell back to the bottom. This also happens with wild flies whose wings are normal, but immediately the wings are spread and the animal secures a new foothold very near where he was before. The upward movement is then continued, very little time having been lost. This difficulty with *vestigials* was removed by lining the cylinder with very thin Japanese rice paper. This may easily be done by moistening the paper, pressing it against the glass and allowing it to dry. With paper-lined cylinders the *vestigial* flies are strongly phototropic and reach the top in almost the same time as wild ones. The results are as follows: with illumination of 1,500 candle meters the time was 6.81 seconds; with 750 c.m., 7.92 seconds; and with 75 c.m., 11.1 seconds. In darkness the time for *vestigials* was 12.2 seconds. From this data it is evident that *vestigial Drosophila* is positively phototropic, the degree being only slightly less than in wild flies, as measured by the rate of locomotion. Some of this difference is undoubtedly due to the aid rendered by the flying of the wild individuals, although, as far as possible, all cases of extended flight were omitted from the averages.

It may be stated, therefore, that the effect of light on the locomotion of *Drosophila melanogaster* is related to the intensity of the photic stimulus according to the Weber-Fechner law, and secondly that the race of flies known as *vestigial* is positively phototropic, and may be demonstrated as such if the animals are given a rough surface on which to crawl.

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THE STRUCTURE OF BENZENE

THE writer has shown, in his thesis for the master's degree[1] and in an article soon to be published, that the benzene model first proposed by Körner,[2] and later advocated by Marsh,[3] Vaubel,[4] and others, interpreted in the light of the Lewis theory of the atom,[5] has a sound theoretical basis. By applying a theory of conjugation resembling in many respects that presented by Erlenmeyer, Jr., in 1901,[6] all objections to this benzene structure but one—that ortho and meta di-substitution products should, according to the theory, give stereoisomers which have not yet been resolved—have been removed.

In this model the six carbon tetrahedra have their bases all in the same plane, the hydrogen atoms and the points of the tetrahedra to which they are bonded being alternately above and below this plane. There are six electrons grouped around the center of each hexagon, and two at each of the hexagon corners and on the centerlines between each hydrogen and the carbon to which it is bonded.

In a paper written in October, 1920,[7] the

1 Written in April, 1920; on file in the Library of the University of California.

2 *Gaz. chim.*, 4: 444 (1874).

3 *Phil. Mag.*, 26: 426 (1888).

4 *J. prakt. Chem.*, [2] 44: 137 (1891); 49: 308 (1894); 50: 58 (1894. "Lehrbuch der theoretischen Chemie [J. Springer, Berlin, 1903],I, 468.

5 *J. Am. Chem. Soc.*, 38: 762 (1916).

6 *Ann.*, 316: 43, 71, 75 (1901).

7 This paper was revised and submitted for publication in April, 1921. It is expected that it will soon be published.

author has shown that the structure of graphite, as determined by X-ray analysis,[8] is exactly what would be obtained if it were built of layers of benzene hexagons of the type just described, the carbon-hydrogen bonds of the benzene molecules being replaced by carbon-carbon bonds between the layers. Such an arrangement not only accounts for the symmetry of the substance and for the observed spectra, but also for its known chemical and physical properties.

There are quite a number of aromatic compounds, including benzene itself, in crystals of which, according to the author's conjugation theory, we might expect the molecules to be in layers of much the same type as the layers in graphite. Assuming this to be the case, if the densities, axial ratios and axial angles are known, the dimensions of the hexagon in these crystals can be calculated. This has been done for a considerable number of substances, and in every case in which large distortions would not be expected, due to substituted groups, *the dimensions of the hexagon are very close to the corresponding dimensions in graphite.* If this result were obtained for one or two crystals, it might be considered merely a coincidence, but it is found to be general; the dimensions are found to correspond best where least distortion would be expected; and the axial ratios and angles, and the crystal form, symmetry and cleavage, as well as the actual distances, are found to conform to the structures assumed. Hence *this structure for the benzene nucleus must be considered proved.*

This method of proof was reported on by the author in a paper presented at the twenty-fourth special meeting of the California Section of the American Chemical Society, held in conjunction with the annual meeting of the Pacific Division of the American Association for the Advancement of Science, at Berkeley, California, on August 5, 1921, at which time the structures of quinol, pyrocatechin and triphenyl carbinol were used as examples. The density of solid benzene was not then to be found in the literature. This is now obtainable, and from it and the axial ratios, by assuming close packing of the molecules in each layer, the hexagon dimensions can be computed. They again check with those in graphite.

A paper is now being prepared in which the method of proof and its application to a large number of aromatic compounds will be given in detail.

Maurice L. Huggins

University of California,
Berkeley, Calif.,

[8] Debye and Scherrer, *Phys. Zeit.*, 17: 277 (1916); 18: 291 (1917); Hull, *Phys. Rev.*, 10: 661 (1917).

The author's interpretation of the experimental results is a compromise between that of Hull and that of Debye and Scherrer.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

MEETING OF THE EXECUTIVE COMMITTEE OF THE COUNCIL

The spring meeting of the executive committee was held in the board room of the Cosmos Club, Washington, D. C., on April 23. It was called to order at 4:10, with Dr. Simon Flexner in the chair and with all members present, and it adjourned at 11:30, a recess of an hour and a half having been taken for dinner. The main items considered are shown below.

(1) Minutes of the last meeting (December 31, 1922), and of two actions taken by mail ballot in the interim were approved. These interim actions were (1) the formal vote to authorize the summer meeting with the Pacific Division, which is to occur on June 22-24, at Salt Lake City, and (2) the election of Dr. J. McK. Cattell to succeed himself as a member of the Board of Science Service.

(2) The permanent secretary presented a report on the affairs of the association for the half-year ending March 31. A summary of that report is appended to the report of this meeting.

(3) It was voted that all members of the American Medical Association who are not already members of the American Association for the Advancement of Science may become members of this association without the payment of the usual entrance fee ($5). The A. A. A. S. is unable each year to invite all

new members of the A. M. A. to join the more general association, as they have the privilege of doing according to the rules for affiliated societies of the A. A. A. S., and the special privilege is now made general to all members of the A. M. A., without reference to when they joined.

(4) It was voted that the permanent secretary should prepare an invitation letter to be sent (about October 1) to each member of the American Medical Association resident in New England, Iowa and Oregon, asking him to become a member of the American Association for the Advancement of Science if he is not already a member; these special invitations are to be signed by the president of the American Association for the Advancement of Science (Dr. J. Playfair McMurrich), the chairman of the Executive Committee of the Council (Dr. Simon Flexner), the permanent secretary and several others. It is planned that a special invitation of this kind shall be sent to other American Medical Association members resident in other regions next year, etc., the entire list of the Medical Association being cared for in perhaps four or five years.

(5) The budget for the current year was increased by the following items: Salaries, \$180; printing, \$520; summer meeting, \$500.

(6) The permanent secretary was asked to secure good, readable reports of the meetings of all sections and of their related societies at the fourth Boston meeting, to have these published in SCIENCE about the last week of January, 1923, and to have this special issue of the journal sent to all members who do not receive SCIENCE regularly. The retiring president's address is to be published in the first issue of SCIENCE after the meeting, and reprints of this are to be made available, on request, to members who do not regularly receive the journal. It is planned that members in good standing who do not attend the annual meeting may receive copies of the general program, if they request them from the permanent secretary's office before the meeting.

(7) The making of arrangements for a speaker for one of the evening sessions of the summer meeting at Salt Lake City was referred to the general secretary with power.

(8) Dr. D. T. MacDougal reported that the committee on Cooperation with Mexican Men of Science recommends that Dr. E. L. Hewett, of the School of American Research, Santa Fé, N. M., be appointed special commissioner to consult with officials of the Mexican government regarding the organization of Mexican men of science. Dr. Hewett was appointed and was requested to serve the association in this capacity on his forthcoming trip to the City of Mexico. A committee consisting of Drs. Howard and MacDougal was instructed to prepare a suitable letter of credentials for the use of Dr. Hewett, this to be addressed to the Secretario de Agricultura y Fomento, to be engrossed, and to bear the seal of the association.

(9) It was voted that the expenses of the Committee on Grants be paid from the funds in charge of the permanent secretary.

(10) Dr. T. Wingate Todd, Western Reserve University, Cleveland, Ohio, was elected vice-president for Section H (Anthropology).

(11) Dr. Bird T. Baldwin, Iowa Child Welfare Research Station, State University of Iowa, Iowa City, was elected vice-president for Section Q (Education).

(12) The election of Dr. S. C. Prescott as chairman of the local committee for the fourth Boston meeting was ratified.

(13) Thirty-three members were elected to fellowship, on proper nominations.

(14) The resignation of Mr. Herbert A. Gill, auditor of the association, was accepted with regret, and with great appreciation of the very valuable services he has given the association in past years, and the permanent secretary was instructed to secure an auditor, preferably a well-known scientist, the clerical expense to be met by the permanent secretary's office.

(15) The Committee on Convocation Week was completed so that it is constituted as follows: Dr. J. McK. Cattell, Garrison-on-Hudson, N. Y., *chairman;* Dr. E. H. Moore, University of Chicago, Ill.; Dr. J. P. McMurrich, University of Toronto, Toronto, Canada; Dr. H. S. Jennings, Johns Hopkins University, Baltimore, Md.; and Dr. Edwin B. Wilson, Massachusetts Institute of Technology, Cambridge, Mass.

(16) The Canadian Society of Technical Agriculturists was constituted an affiliated soci-

ety of the association. Its officers are: *President*, Mr. L. S. Klinck, University of British Columbia, Vancouver, Canada; *secretary*, Mr. Fred H. Grindley, Gardenvale, P. Q., Canada.

(17) The Executive Committee reaffirmed the desirability of holding the 1925 meeting in Kansas City, and expressed its appreciative thanks to the persons and organizations from whom invitations to meet in that city have been received.

(18) The policy of Section N (Medical Sciences) was approved, by which it is planned that the program of this section, at the annual meeting, shall deal with such fields of work as parasitology, medical entomology, public health service, and others, where many medical scientists have common interests with those working in other fields of biology.

(19) A committee was appointed, consisting of the president, the general secretary and the permanent secretary, to arrange for the sending of delegates to the Hull meeting of the British Association for the Advancement of Science.

(20) The proposed federation of biological societies was considered at length, and the committee expressed itself as in sympathy with the general aims of the societies involved. The hope was expressed that the organization of the association may be of service to the new federation.

(21) The controversy aroused by recent popular publications regarding the theory of evolution was considered, and a committee of three was appointed to deal with this matter and make recommendations at the meeting of the executive committee. The committee on the evolution controversy consists of Dr. Edwin G. Conklin, Princeton University; Dr. C. B. Davenport, Station for Experimental Evolution; and Dr. Henry Fairfield Osborn, American Museum of Natural History, New York City.

(22) The permanent secretary was asked to secure manuscripts for the general program for the fourth Boston meeting as early as may be, to the end that the difficulties of publication may be obviated as far as possible.

(23) The section committee of Section Q (Education) was authorized to publish a separate section program for the fourth Boston meeting—the expense, not to exceed $25, to be met by the permanent secretary from current funds.

(24) The permanent secretary was authorized to provide suitable messenger service for the sessions of the biological societies meeting at Boston.

(25) It was voted that it is desirable for the association to secure a distinguished European scientist for an evening lecture at the fourth Boston meeting.

(26) The committee adjourned to meet in New York City (in the offices of the Science Press, by invitation of Dr. Cattell) on Saturday, October 21, 1922.

Burton E. Livingston,
Permanent Secretary

PERMANENT SECRETARY'S REPORT FOR THE HALF-YEAR ENDING MARCH 31, 1922[1]

The last volume of the Summarized Proceedings, published in October, 1921, is now nearly out of print. The total cost of publication was $6,744.16 and sales have amounted to $2,587.00, making the net cost, at the present accounting, $4,157.16. The volume is being sold to members for $2.00 and to others for $2.50. Fifty copies remain to be sold, besides twenty copies reserved for complete sets.—A booklet of information for prospective new members, which contains a statement of the organization and work of the association, was published in January. Copies may be secured from the permanent secretary's office.—The resolution regarding the United States Forest Service, adopted at the recent Toronto meeting, was printed as a leaflet and sent to all members of Congress and to other officials.

Invitations to join the association have been sent to 28,303 persons, of whom 830, or 3.4 per cent., have already joined. From September 30, 1921, to March 31, 1922, 1,111 new annual members and 9 new life members have been enrolled, and 22 members have been reinstated; the total gain was 1,142. During the same period 67 deaths were recorded, and 265

[1] Presented to the Executive Committee of the Council on April 23, 1922.

resignations, and 705 names were dropped (October 1) because of over two years of arrearage); the total loss was 1,037. Four members were transferred from annual to life membership. The net gain in total membership, for the half-year, is 105. The membership data for the last year and a half are tabulated below:

	Sept. 30, 1920	March 31, 1921	Sept. 30, 1921	March 31, 1922
No. of members in good standing..	10,002	9,637	10,160	9,911
Total enrollment..	11,442	11,524	11,547	11,652

It is clear that the membership is gradually increasing, but there still remain many persons in the United States and Canada who are vitally interested in scientific and educational progress but who are not yet enrolled in the association. Members of the association should do all in their power to increase the membership and thus strengthen the organization.

A local branch of the association was organized in the fall of 1921 and is in successful operation. This is the State College (Pennsylvania) Local Branch. Its officers are: *chairman*, A. J. Wood; *secretary*, J. Ben Hill. It has an enrollment of 53 members of the association. Fifteen new members have been secured through its activities. The State College Branch holds occasional meetings throughout the year.

Plans for the summer meeting of the association, jointly with the Pacific Division, which is to occur at Salt Lake City, June 22-24, 1922, are progressing satisfactorily. Details of these plans are in charge of Mr. W. W. Sargeant, Golden Gate Park, San Francisco, secretary of the Pacific Division, and the general secretary of the association, Dr. D. T. MacDougal, Carmel, California. The chairman of the local committee for the Salt Lake City meeting is Professor E. G. Titus, 215 S. Third East, Salt Lake City, Utah.

Card lists of all the members enrolled in each section of the association have been prepared and will soon be in the hands of the secretaries of the respective sections, together with a steel cabinet for each set of cards. These section lists will be kept continually corrected, by means of cards sent out from the permanent secretary's office. Each member's addressograph plate now shows, besides his name and address and the formula of his membership status, one, two, or three letters denoting the section or sections in which he is enrolled. Thus, ABD indicates that the member on whose plate this letter combination appears is enrolled in Sections A, B and D, and a corresponding card is found in each of the three section lists. When a member has indicated more than three sections as his preferences, the first three on his list have been indicated on the plate. In cases where no section has been named by a member, it has been impossible to enroll him in any particular section, and he is regarded as a member of the association in general. When members receive cards, etc., from the permanent secretary's office, they are requested to scrutinize the addressograph impression and inform the office if any corrections are needed with respect to their section enrollment.

Financially, the association is more than holding its own. The permanent secretary's reserve or emergency fund amounted (on March 31) to $5,855.09, $1,500 having been transferred to this fund on March 25. Of this, $1,000 is specially reserved from the current funds of 1922 for meeting the extra expense of publishing the next volume of Summarized Proceedings, which is to appear in the spring of 1925, following the next four-yearly (Washington) meeting. After all liabilities are cared for, over $2,000 is available (March 31, 1922) for appropriation from the current funds of the present fiscal year, which ends October 1, 1922.

SECTION M—ENGINEERING AND ASSOCIATED SOCIETIES

THE resuscitation of Section M at the recent Toronto meeting of the American Association for the Advancement of Science resulted in a program of considerable length and much diversity. The attendance was good, and the interest was sustained to the end. Sir Clifford Sifton, formerly chairman of the Commission of Conservation, Canada, gave the opening address on Tuesday afternoon, his subject being "Some Views on the Development of the Natural Resources of Canada." He dealt, among other things, with the fuel problems of Canada in their relation to the development of hydro-electric power, and with the general conditions obtaining at the present time in the rural districts.

Papers by Paul Heymans, now of the Massachusetts Institute of Technology, and Professor Charles Mannebeck, of the University of Louvain, Belgium, on "Optical Determination of Stress in Engineering Structures" and "Return Current along Submarine Cables," respectively, were read by the authors.

At the morning session on December 28, Mr. John Murphy, electrical engineer for the Department of Railways and Canals, Ottawa, gave an address on "Ice Formation and Prevention with Special Reference to Frazil and Anchor Ice." Mr. Murphy advocated keeping certain metal parts of hydro-electric installations a small fraction of a degree above 32°F. with the aid of artificial heat. This can be and is being done at certain plants on the Ottawa River to which Mr. Murphy made reference. "Engineering Standardization" was discussed by Mr. R. J. Durley, secretary of the Canadian Engineering Standards Association. Other papers were "Fifty Years of Progress in Mining in Canada" by Mr. John E. Hardman, "Metal Mining in Canada," by Thomas W. Gibson, deputy minister of mines, Ontario; "Gold Mining in Canada" by Mr. A. F. Brigham and "Nickel Mining and Smelting" by W. L. Dethloff, chief engineer of the Mond Nickel Company.

The morning session on Thursday, December 29, was given over to an illustrated address on "Toronto Harbor Development" by Mr. George Clark, chief designing engineer of the Toronto Harbor Commission, and to a discussion on Scientific and Industrial Research by Dr. R. A. Ross, chairman of the Honorary Advisory Council for Scientific and Industrial Research, Canada, who emphasized the economic importance of obtaining a satisfactory method of carbonizing the lignites of Western Canada. Mr. H. K. Wicksteed read a paper on "Railway Development in Canada" treating his subject chiefly from an economic standpoint. In the afternoon Messrs. A. M. McQueen and James McEvoy read papers on "Exploration for Oil in Western Canada" and "Coal Mining in Alberta" respectively. Sir Adam Beck, chairman of the Hydro-Electric Power Commission of Ontario, gave in Convocation Hall an address to all sections of the American Association for the Advancement of Science in the afternoon at 4 o'clock. This address was well attended and was illustrated by motion pictures. Sir Adam drew a comparison between the cost of Niagara generated hydro-electric energy in Windsor, Ont., and steam generated electric energy in Detroit, Mich., the prices being 3½ and 8 cents per kilowatt hour, respectively.

The Friday sessions, with the exception of Mr. D. B. Dowling's address on the Mackenzie oil fields, were given over to the discussion of problems pertaining to Engineering Education. Works Commissioner Harris, City of Toronto, gave the employer's viewpoint with respect to the qualifications of the young engineer. Professor Charles F. Scott, president of the Society for the Promotion of Engineering Education, contributed a paper on "Professional Engineering Education for the Industries." Dr. F. W. Merchant, director of industrial and technical education, Ontario, addressed the section on the function of the secondary technical school. Professor Dugald C. Jackson's paper on the same subject was read by Professor C. R. Young in the absence of the author. Discussion following all of these papers was very general.

Regarding the sessions of the Society for the Promotion of Engineering Education, held at Toronto on December 30, 1921, the reader is referred to the *Canadian Engineer,* Vol. 42, No. 1, p. 109, Jan. 3, 1922, and Vol. 12, No. 2, p. 133, Jan. 10, 1922.

The closing function was a dinner in Hart House on Friday evening at which one hundred were present. Mr. J. B. Tyrrell, chairman of the section, presided at all sessions. The committee in charge of arrangements consisted of the chairman, Mr. Tyrrell, and Professors R. W. Angus, Peter Gillespie and C. R. Young, all three of the University of Toronto.

Peter Gillespie,
Acting Secretary, Section M

Toronto, Canada

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CONTENTS

THE RELATION OF THE ENDOCRINE GLANDS TO HEREDITY AND DEVELOPMENT[1]

Since the object of the Eugenics Research Association is the advancement of knowledge that will contribute to the improvement of the human race by inheritance, its members can scarcely fail to be interested in the discussions that are now going on regarding the glands of internal secretion and their relations to heredity. As a medical man, deeply interested in the problems of constitution and of condition and profoundly impressed with the recognizable influences of internal secretions upon form and function in both normal and pathological states, I welcomed the suggestion of Dr. Davenport that I deal in my presidential address with the topic announced. The progress of research in endocrine domains and in heredity has of late been so rapid that no single person can keep pace with its strides. My remarks, therefore, will make no pretence to completeness of discussion of the reciprocal relations of heredity and endocrinology. They are intended rather to direct the attention of the members of the association to some of the more important facts that have been established and to stimulate interest in some of the newer problems that are emerging and clamoring for solution.

THE ENDOCRINE ORGANS AND THEIR PRODUCTS

It is only comparatively recently that the significance of the so-called ductless glands and of the substances they manufacture has become recognized, but, in a very short time, a considerable body of knowledge concerning their structure, their functions and their inter-relations has been accumulated. At the moment, studies of the internal secretions, or, as many now call them, the "incretions," are, on ac-

[1] Presidential address at the tenth annual meeting of the Eugenics Research Association, held at Cold Spring Harbor, Long Island, June 10, 1922.

count of their astonishing and novel revelations, attracting the attention not only of scientific workers in biology and medicine but, and perhaps to too great an extent, also of the laity. Important as a knowledge of these incretions is for an understanding of bodily and mental states, there is some danger, I think, of over-emphasis and of disproportionate prominence. Popular articles and treatises on endocrine subjects too often assume what is mere conjecture, or wild speculation, to be established as fact and reveal a tendency to exploitation that must sooner or later be followed by disappointment and disillusionment. There is, I fear, some danger that even scientific endocrinology may, temporarily at least, be brought into undeserved discredit. It would seem especially desirable, therefore, that those who write or speak upon the subject should discriminate carefully between fact and fancy. Every effort should be made rigidly to control hypotheses by accurate observation and careful experiment, for only thus can an orderly advance in knowledge be assured.

Though an incretory function has been ascribed to many organs of the body, the principal incretory organs, those whose function is best understood, are seven in number: (1) the thyroid gland, (2) the parathyroid glands, (3) the hypophysis cerebri, or pituitary gland, (4) the epiphysis cerebri, or pineal gland, (5) the suprarenals (consisting of two parts of entirely different functions, (*a*) the medulla or chromaffine portion and (*b*) the cortex or interrenal portion), (6) the islands of Langerhans of the pancreas, and (7) the interstitial tissue of the gonads (ovaries and testicles) or so-called "puberty gland."

There is evidence that each of these organs yields an internal secretion that, distributed through the blood, exerts important chemical influences upon other, more or less distant, organs and tissues. Some of these influences have been definitely determined, but it will doubtless be a long time before all of them will be well understood. The knowledge that has been gained concerning the thyroid, the pituitary, and the suprarenals gives promise, however, that steady research will gradually enlarge our information regarding the influences exerted by each of the incretory glands.

The chemical substances contained in the incretions have been called "hormones" and the determination of the precise chemical constitution of these hormones sets fascinating tasks for the biochemist. That the chemical constitution of some endocrine products may be closely approached, if not definitely established, has been shown by researches upon epinephrin (from the medulla of the suprarenal gland) and upon iodothyrin and thyroxin (from the thyroid gland). Studies of concentrated functionally potent extracts from other glands may before long reveal the chemical nature of other hormones; I have in mind, especially, studies of so-called "pituitrin" (hypophyseal extract) and of so-called insulin (extract of the islands of Langerhans of the pancreas). Clues as to the chemical nature of the hormones of the parathyroids, the pineal body, the interrenals and the gonads will probably be more difficult to obtain. Biochemical researches to establish the precise nature of the single hormones are extraordinarily important and should be vigorously prosecuted in order that experimental studies of hormone influences may be more systematically, exactly and intelligently pursued.

THE BETTER-KNOWN ENDOCRINOPATHIES

Our knowledge of endocrine functions has been variously derived, partly through keen clinical-pathological observations, partly through experimental work upon animals (surgical removal of single organs; organ transplantations; injections of organ extracts or of isolated hormones). Before discussing the relations of the endocrine organs to heredity and development, it may be helpful briefly to refer to a few of the classical clinical syndromes that are now justifiably believed to be endocrinopathic in origin. Time will not permit me to refer to more than a few of these, but those chosen will serve as illustrative paradigms.

I may cite first two characteristic clinical syndromes met with in association with disease of the thyroid gland, namely, exophthalmic goitre and myxœdema.

In the former, known also as Graves' disease or Basedow's disease, we observe, in typical instances, a markedly enlarged pulsating thyroid gland (goitre) in the neck, a persistently accelerated pulse rate (say 150 or more to the minute instead of the normal rate of 72), marked nervous symptoms including fine tremor of the fingers, outspoken protrusion of the eyeballs (exophthalmos), a tendency to profuse sweats and to watery diarrhœa, sensitiveness to heat, a peculiar psychic over-alertness and apprehensiveness, and a tendency to rapid emaciation (despite an abundant food intake) associated with demonstrable acceleration of the rate of the basal metabolism. Since similar symptoms can be produced by feeding thyroid gland extract, it is believed that there is a hyperfunction of the thyroid gland (hyperthyroidism) in exophthalmic goitre.

In the idiopathic form of myxœdema (or Gull's disease) the clinical conditions are diametrically opposite to those in exophthalmic goitre. The thyroid gland is small, the pulse-rate is usually slow, the eyes look sunken (enophthalmos), the lid-slits are narrow, the bodily movements are slow and clumsy, the patient is mentally dull, forgetful and apathetic, there is sensitiveness to cold and a tendency to constipation, the hairs fall out, the skin is dry, thick and wrinkled and there is a tendency to obesity (despite a restricted food intake) associated with demonstrable retardation of the rate of the basal metabolism. Since patients with idiopathic myxœdema rapidly improve if they are fed the thyroid gland of the sheep, and since a condition precisely similar to it occurs if the thyroid gland be surgically removed (cachexia thyreopriva), it is believed that myxœdema is due to a hypofunction of the thyroid gland (hypothyroidism).

Two similarly contrasting clinical syndromes due to disorders of the hypophysis cerebri or pituitary gland may next be mentioned, namely, (1) gigantism and acromegaly, due to overfunction, and (2) Froehlich's syndrome of obesity with genital dystrophy, due to underfunction.

When there is overfunction of the pituitary gland in early life before the epiphyses of the long bones have united with the shafts of those bones there is over-stimulation of bony growth and the patient becomes excessively tall (gigantism). When the overfunction of the pituitary gland occurs in later life (after epiphyseal union), bony overgrowth is still stimulated but manifests itself in enlargement of certain parts of the skull and of the hands and feet (acromegaly). There is also enlargement of the tongue and of the internal organs (splanchnomegaly). The victim presents a very characteristic appearance. The face is hexagonal, the nose is broad, the chin is prominent and curved so as to bend sharply upward, the cheek bones are outstanding and the arches above the eyes are prominent. Looked at from the side, the face resembles that of Punch (nut-cracker profile). The hands are spade-like, the fingers are sausage-shaped, and the feet are huge.

On the other hand, when there is underfunction of the pituitary gland during development a condition (Froehlich's syndrome) in marked contrast to gigantism and acromegaly results. The skeletal development is defective, the growth of bone being less than normal. The patient is short in stature, the face remains child-like and the hands and feet are small (acromikria). The subcutaneous fat is markedly increased (obesity), and is distributed in an uneven way over the body, being most abundant on the abdomen, over the buttocks, and in the proximal portions of the extremities. The secondary sex characters either fail to develop or develop in a faulty way. The pubic and axillary hairs do not appear or are scanty. The external genitals remain in an infantile state. In young men the voice is high pitched and there is a lack of normal virility. In young women, the menstrual flow is scanty or absent.

Next, let us contrast two clinical pictures believed to depend upon disorders of the suprarenal capsules, (1) Addison's disease, met with in destruction of the suprarenals (hyposuprarenalism), and (2) pseudo-hermaphrodism, premature puberty, and hirsutism, met with in association with hyperplasias of the suprarenals (hypersuprarenalism).

In Addison's disease there is great weakness and prostration, associated with low blood pressure, diarrhœa and other digestive disturbances, chronic anæmia and often a peculiar bronzing of the skin (melanoderma).

On the other hand, in cases in which there is believed to be overfunction of the suprarenals, the clinical picture is markedly different though it varies somewhat with the time of onset of the assumed hyperfunction. Should this occur during fœtal life, a pseudo-hermaphrodite appears, the person presenting the external genital appearances of one sex while possessing the internal sex organs of the other sex. When the overactivity exists soon after birth rather than before birth, puberty appears prematurely, a little girl of three or four menstruating regularly and exhibiting the bodily and mental attributes (sexually) of an adolescent, or a boy of seven presenting the external genitals and the secondary sex characters of an adult. Should the overactivity of the suprarenals not occur until adult life, it may reveal itself in a woman of middle age by the rapid development of hairiness over the body (hirsutism) and by the exhibition of masculine characteristics (virilism).

Other examples of clinical pictures might be mentioned but these few will suffice to illustrate the extraordinary mental and physical changes that may become manifest when there are disturbances of function of the endocrine organs.

CONSTITUTION AND THE ENDOCRINE ORGANS

Biologically considered, a developed human being, like all developed higher organisms, must be looked upon as the resultant of a long series of reactions between the zygote (fertilized ovum) and its environment. The germinal type or genotype, reacting with the surroundings, becomes the developed type or phenotype, in the case of human beings, the "realized person." The germ plasm provides the determining factors, the environment the realizing factors. Everything in the phenotype attributable to inheritance may be spoken of as "constitution," everything attributable to environment as "condition." Medical men as well as biologists must, then, when studying a person or a single organism, be interested in differentiating, when they can, what is "constitutional" from what is "conditional" in origin. In experiments upon animals and plants such a differentiation may be relatively easy; in studies of human beings it is always extremely difficult and, as regards many features, as yet wholly impossible.

The importance of constitution will need no emphasis among biologists who are predominantly students of heredity. Among medical men, too, throughout the centuries, especially among practitioners, there have always been those who have been fully aware of the significance of constitution and of its relation to disease-disposition. During the past fifty years, however, under the spell of bacterial and protozoan etiology, medical men have been so absorbed by studies of influences arising in the environment that they have, too often, forgotten to continue their investigation of influences of endogenous origin. For a time, it was almost taboo to speak of "constitution," or of "disposition," owing to a justifiable reaction, perhaps, against the earlier prevalent tendency to use these words as a mask for ignorance. Recently, however, there has been a welcome revival of studies of constitution. Now that facts that supply a scientific basis for a general pathology of constitution have been accumulated, we may look forward to a greatly increased interest among physicians in the part played by inheritance in disease. Indeed, during the past five years, several treatises upon this and allied subjects have been published; and we may expect, I think, during the period just ahead of us, many attempts to present, more systematically than hitherto, the rôle played by constitutional disposition in the pathogenesis of a whole series of diseases.

The chemical consideration of endocrine disorders, has in my opinion, given a strong impetus to this movement toward a revival of studies of the physiology and the pathology of constitution. For though the endocrine organs are, in some instances, accessible to trauma and to poisons and parasites that reach them through the blood-stream, diseases of these organs, especially those "idiopathic" chronic diseases that develop insidiously and give rise to the classical endocrine syndromes, appear to be, usually, of endogenous rather than of exogenous origin, that is to say, they develop as the results of special anomalies of constitution. This accounts for the fact that endocrinopathies tend to run in families, and the interrelationships that exist among the different endocrine organs may explain why a disease of the thyroid (exophthalmic goitre) may appear in one member of a family, a disease of the pancreas (diabetes mellitus) in another, a disease of the hypophysis (dystrophia adiposogenitalis) in a third, or a pluriglandular disorder in a fourth member of the same family. The experienced clinician can now often recognize phenotypes in which there are anomalies of constitution that predispose to endocrine disorders; and as a result of this recognition he may, sometimes, be able to institute a rational prophylaxis. The thyreotoxic constitution, the hypothyreotic constitution, the hypoparathyreotic constitution, the hyperpituitary constitution, the hypopituitary constitution, the hypergenital constitution and the hypogenital constitution are instances in point. Unfortunately we have not learned as yet how effectually to intervene in a prophylactic way in all of these anomalies of constitution, but rewarding experiences with the hypothyreotic and with the hypoparathyreotic constitution give us hope that, with widening knowledge, suitable preventive measures will be discovered.

Studies of the symptoms of endocrine disorders and studies of partial anomalies of constitution affecting the endocrine organs are thus throwing much light not only upon (1) the mode of action of the incretions, but also upon (2) inheritance as a determining cause of endocrinopathic phenotypes. The incretions may affect distant parts directly, being carried to them by the blood; or they may affect those parts indirectly through the intermediation of the autonomic nervous system, which they sensitize. When they act directly, they may influence the substances and processes in the localities that they reach (chemical correlation; regulation of metabolism) or they may supply materials for incorporation by the cells (nutritive and formative influences). When they act indirectly through the vegetative nervous system they may exert profound effects through the secretory activity of glands, through the contraction of smooth muscle, or through modifications of those neural mechanisms that have to do with the emotions and the will. During the developmental period, it is clear that the incretions are in part responsible for the dimensions and proportions of the skeletal apparatus and the soft parts. A normal functioning of the incretory organs is essential for the shaping of parts and for the maturing of functions in the right place and at the right time. Through correlative differentiation (due in part at least to the action of the incretions), the developing organism gradually comes to exhibit the characteristics of its species, its age and its sex. Even the anthropologists now maintain that the solution of the problem of how mankind has been demarcated into types so diverse as the Negro, the Mongol and the Caucasian will involve the study of hormonic mechanisms!

CAN HORMONES MODIFY UNFERTILIZED GERM-CELLS SO AS TO INFLUENCE INHERITANCE

Thus far in our discussion of the relation of the endocrine glands to heredity and development we have confined our attention to (1) the genotypic determination of endocrine functions in developing organisms, (2) the rôle played by the incretions in normal and pathological ontogeny, and (3) the fact that there exist heredo-familial anomalies of body make-up that predispose to endocrine disorders. But we must, for a few moments at least, consider the possibility that hormones, reaching unfertilized germ-cells, may modify the germ plasm in such a way as to give rise to new inheritance factors that will be transmitted from generation to generation.

Experiments upon the influence of incretory substances upon the development of cold-blooded animals have yielded such striking results upon cells of the soma that many have wondered whether incretions circulating in the blood might not also permanently alter the germ-cells so as to account in animals for the origin of mutations and new biotypes. You will recall the experiments to which I refer (1) the acceleration of tadpole metamorphosis by feeding thyroid substance and (2) the retardation of the same process by feeding thymus substance.

In endocrine diseases of either endogenous or exogenous origin, the cells of the soma are also markedly altered; and the question has naturally been asked, May not the germ-cells be simultaneously profoundly changed?

Since 1895, a number of investigators have suggested that the influence of specific internal secretions might easily be used for the explanation of the inheritance of acquired characters. Last year, an English evolutionist published a volume on "Hormones and Heredity" and suggested that environmental influences influencing an organ, or part, of the mother may set free chemical substances (hormones) that, carried through the blood to the ovaries, may affect the ova in such a way as to lead to similar changes in the same organ, or part, of the offspring. By such a mechanism he would attempt to account for a progressive evolution in the animal series. His theory would seem practically to be a modification of the pangenesis theory of Darwin with the substitution of "hormones" for Darwin's "gemmules."

Many physicians, too, have leaned toward Lamarckian or neo-Lamarckian theories that assume the inheritance of acquired characters and some of these have suggested that in such inheritance the incretions must be concerned. Those who have been trained in the methods of modern biology, however, usually reject Lamarckism, and attempt to explain the apparent inheritance of "acquired characters" for a generation or two by assuming either a "germinal injury" (in the sense of Forel's "blastophthoria") or a "parallel induction."

The consensus of biological opinion in this country is strongly opposed to the inheritance of acquired characters. Mendelian studies lend no support to the view that conditional influences can affect inheritance factors. Mendelism is, however, difficult if not impossible to apply to man. As some one has put it, "the propagation of man consists of a continual crossing of polyhybrid heterozygote bastards," not susceptible to analysis by Mendelian methods such as can be applied to the study of the propagation of plants and experimental animals. But if inheritance of acquired characters really occurred, why should there not be, as Conklin emphasizes, an abundance of positive evidence to prove it? When one plant or animal is grafted on another, there is no evidence that the influence of the stock changes the constitution of the graft. When an ovary is transplanted, the foster mother does not affect the hereditary potencies of the ova. Until more proof has been brought than has hitherto been advanced, we shall not be justified, so far as I can see, in accepting the theory that conditional influences change hereditary factors. There are, moreover, aside from the problem of the inheritance of acquired characters, enough relationships of the endocrine organs to heredity and development to long keep us rewardingly occupied.

CONCLUSION

Let me summarize in a few words the situation as I see it. The endocrine organs are of the greatest importance in normal development, their incretions exerting profound formative and correlative influences. In pathological development, the abnormal plenotypes that appear often point decisively to partial anomalies of constitution involving especially the ductless glands and their functions. Whether or not under normal or pathological conditions, hormones arising in the soma can so change the germ plasm of ova or sperm-cells as to account for certain mutations or for germ-cell injury is a question that deserves consideration and merits experimental test. Finally, the conjecture that conditional influences upon the soma can through hormonal production and transportation to parental gametes so modify the germ-plasm as to result in the inheritance of the conditioned modification seems, as yet, to have but little, if any, evidence to support it.

Lewellys F. Barker

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AN ANALYSIS OF STUDENT GRADES AT WASHINGTON UNIVERSITY SCHOOL OF MEDICINE

This work was undertaken with the idea of obtaining some definite data upon which to base opinions of students' grades during their medical course. As the data obtained were of great interest to the staff of this school it was thought advisable to publish them in order that they might be used for comparison with those of other schools.

The records of those students in the classes of 1914, '15, '17, '19, '20 and '21 who spent all four years of their course in Washington University Medical School were studied. The class records before 1914 were not complete enough to average with the later records. The class of 1916 had only two members who spent all four years in this school, these records not being complete, and the class of 1918 finished its course in France, so these two classes were not considered in the analysis. In the six classes studied there were available the records of 89 students. From these records were copied the average for each year, the graduation age, degree at matriculation, and the school in which premedical training was taken.

In considering the graduation age of the students it was found that there was little variation from one year to another. The average graduation ages for the classes studied beginning with that of 1914 were 25, 26, 25½, 26, 26, and 24 years, respectively. Thus the average graduation age of the 89 students was approximately 25½ years. The variation between individuals was so slight that no relation between age and grade was worked out.

The number of students possessing bachelor's degrees upon matriculation was 14, or 15.73 per cent. of those studied. Eleven were A.B. degrees and three B.S. degrees. One might have expected a larger percentage of bachelor of science degrees from students interested primarily in the sciences. The average graduation age of these students was 26.64 years, or 1.35 years older than that of those without degrees. The average grade of the group with degrees was 82.21 per cent. as contrasted with 80.89 per cent. for that without degrees. Thus we see that the average man with a degree upon matriculation was 1.35 years older than the man without one, but that his grade was 1.32 per cent. higher than that of the undergraduate student. Is an increase of grade of 1.32 per cent. worth a time loss of 1.35 years in a medical student's career?

The grade averages by years for each class are given in Table I. Here we see that there is not much variation between the classes of the years studied. This fact would indicate that a uniform system of grading had been used for all classes, providing the class of stu-

TABLE I

Class	Av. Year I	Av. Year II	Av. Year III	Av. Year IV
1914	77.87%	80.31%	79.95%	82.11%
1915	79.21%	79.76%	84.51%	83.60%
1917	78.28%	78.81%	81.75%	84.02%
1919	76.67%	79.84%	81.45%	85.52%
1920	77.62%	81.48%	82.18%	83.68%
1921	79.80%	81.33%	81.96%	84.73%
Total Av.	78.24%	80.26%	81.97%	83.93%

General average for all classes for four years = 81.10%.

TABLE II

Amount of Variation	Per Cent. of Students							
	Year I-II		Year II-III		Year III-IV		Year I-IV	
	+	—	+	—	+	—	+	—
0-1%	3.41	12.50	6.82	5.68	8.99	5.62	7.78	4.50
1-2%	10.02	6.82	10.02	6.82	16.85	6.74	3.37	2.25
2-3%	3.41	5.68	9.09	11.36	10.11	3.37	5.62	2.25
3-4%	5.68	11.36	9.09	6.82	8.99	6.74	5.62	1.12
4-5%	6.82	....	7.95	2.27	8.99	....	7.78	4.50
5-6%	9.09	2.27	7.95	1.14	10.11	1.12	3.37	....
6-7%	4.55	1.14	3.41	....	4.50	1.12	8.99	....
7-8%	2.27	....	3.41	1.14	4.50	....	4.50	....
8-9%	4.55	....	2.27	1.14	1.12	....	10.11	1.12
9-10%	4.55	....	1.14	....	....	....	4.50	....
10-11%	1.14	....	1.14	....	1.12	....	4.50	....
11-12%	3.41	....	1.14	....	....	....	1.12	....
12-13%	1.14	....	....	....	....	....	6.74	....
13-14%	....	....	....	....	....	....	2.25	....
14-15%	....	....	....	....	....	....	2.25	....
15-16%	....	....	....	....	....	....	....	....
16-17%	....	....	....	....	....	....	1.12	....
17-18%	....	....	....	....	....	....	1.12	....
18-19%	....	....	....	....	....	....	2.25	....
19-20%	....	....	....	....	....	....	1.12	....

dent remained the same for each year. There is a gradual increase in the general average from the first to the fourth year of 4.69 per cent. As the same students are present throughout all four years, this either shows an improvement in the student's ability or, more likely, severe grading during the first years or lax grading during the last years of the course. The general average of the entire group for all four years is 81.10 per cent., which is a low B grade in our letter system. This gives us a numerical figure for our average students in the future.

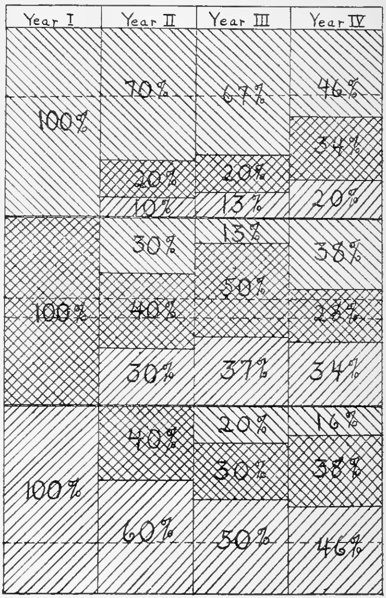
There was a great tendency toward variation in the grades of an individual from one year to the next. This is well shown in Table II in which the per cent. of students varying a given percentage in grade, either up or down, between the different years of the course is shown. There is always a larger proportion of the class showing an increase in grade as would be expected from the increase in general average. To show how inconstant the grades are from year to year we note that more than 36 per cent. of the students have a difference of over 8 per cent. between first and fourth year averages, and indeed, 3.62 per cent. show a difference of over 18 per cent.

In Table III the rank of the student in his class is considered. The men of each class were arranged according to rank, based on their first year averages, and the class then split into thirds, an upper, middle, and lower third. Each third was now considered 100 per cent. and the upper represented by left diagonal lining, the middle by cross hatching, and the lower by right diagonal lining. The proportion of the men of the upper third during the first year who fell into the middle third the second year is represented by the area of left diagonal lining in the middle division under year II. Similar changes in other groups may be followed in the same manner. It is obvious that a man might go from group 1 to group 2, then back to group 1 the third year, so that the left diagonal lining in group 1 for the third and fourth years does not represent the percentage of men who remained there constantly for four years, but that portion of the men who started in group 1 the first year who are there in the year observed. Therefore the interrupted line was inserted in order to indicate the percentage of men in each division who remained there constantly for every one of the four years.

This table shows that the upper and lower thirds of the class are the most constant in their rank, for 36 per cent. remained in the upper third constantly and 27 per cent. in the lower, while only 10 per cent. of the middle third remained there for four years. Those students who drop from the upper to lower third in the third year may be the ones primarily interested in the fundamental sciences, and not in clinical work. There are usually one or two such individuals in each class. We do get a surprising revelation of the inconstancy of a large proportion of the class.

Only 24.7 per cent. of the group studied remained constantly in one division for four years, 57.3 per cent. went up or down one division, and 18 per cent. up or down two

TABLE III



divisions during the course. This shows that no class could have been even approximately grouped for the entire course on the basis of the first year's averages.

Finally those men in the group who had first year averages of less than 72 per cent. were picked out. It was thought that these were the borderline men, students who might have been dismissed from school had their grades been only one or two per cent. lower. The object was to observe the further progress of this group with regard to the other students. There were 15, or 16.8 per cent., of the students with a first year average under 72 per cent. Forty per cent. of them had their premedical training at Washington University, 40 per cent. at the smaller colleges, and 20 per cent. at state universities.

At the end of the fourth year 40 per cent. of these men had grades above the average for the senior year, 20 per cent. ranked in the upper third of the senior class, 27 per cent. in the middle third, and only 53 per cent. in the lower third. Of the 20 per cent. in the upper third of the senior class, one third had premedical training at Washington University, one third at a small college, and one third at a state university. The middle and lower thirds were equally divided between the small colleges and the universities. So it would seem that if poor preliminary training were the cause for the low first year average of these students we must blame the universities equally with the smaller colleges, for the percentage of advance in grade was equally divided between students from Washington University and such colleges as Central, Missouri Valley, Southwestern, and Christian Brothers'.

As almost 50 per cent. of these men who might easily have been dismissed from school on their first year's record made mediocre and even excellent students during their senior year, the question arises as to how many of the men with first year grades just below 70 per cent. who are now dismissed from school might reach the upper third of their class were they allowed to remain. Can we say it would be less than 20 per cent.? Yes, because many questions are considered in giving a student a grade just under or just over 70 per cent., amongst them being just this possibility of improvement. However, these figures should make us in the future think even more carefully before declaring a student unfit for the study of medicine on the basis of his first year's record.

M. F. Weymann

Washington University
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CHARLES BASKERVILLE

The death of Charles Baskerville, last January, was a great calamity to the chemical profession. His end was premature—he was nearing 52 years of age—and it brought a poignant sense of bereavement to his numerous friends. He did not live to see his life's work done, but he departed from a world which will evermore be the richer for having once had him.

Deeply and peculiarly American, an aristocrat by birth, Charles Baskerville was nevertheless broad and cosmopolitan in all his educational work, and honored by his students, pedagogic associates and professional colleagues. A man of high quality whose poise and personality early established leadership, his cheerfulness, sympathetic helpfulness and constant productivity brought the admiration and respect of all who had the privilege of being near him.

For thirty years Charles Baskerville occupied a prominently successful position in chemical education (University of North Carolina, his *alma mater*, 1891-1904; College of the City of New York since 1904); but, in addition, he found time for the conduct of original researches of value (first on the rare earths and later on the chemistry of anesthetics), while his inventions in the refining and hydrogenation of vegetable oils, plastic compositions and reinforced metals are of recognized industrial importance.

In addition to 190 educational, scientific and technologic papers, Charles Baskerville was the author of the following books: "School Chemistry," 1898; "Key to School Chemistry," 1898; "Radium and Its Applications in Medicine," 1906; "General Inorganic Chemistry," 1909; "Laboratory Exercises" (with R. W. Curtis), 1909; "Progressive Problems in Chemistry" (with W. L. Estabrooke), 1910; "Qualitative Analysis" (with L. J. Curtman), 1910; "Municipal Chemistry" (with other experts), 1911; and "Anesthesia" (with J. T. Gwathmey), 1914.

Charles Baskerville became a member of the American Chemical Society in 1894 and later, as councilor and chairman of important committees, rendered much valuable service. His activities on the society's committee on occupational diseases in the chemical industries were especially prominent. He was one of the most constant attendants upon the annual meetings, effectively laboring for the best interests of the society. He was also a fellow of the London Chemical Society, a member of the Society of Chemical Industry, of the American Institute of Chemical Engineers, of the American Electrochemical Society, of the Washington and New York Academies of Science, of the Franklin Institute, and of the American Association for the Advancement of Science.

Charles Baskerville's great forte was in making practical suggestions for the better conduct of affairs. At North Carolina and later at the College of the City of New York, he was respected as an able teacher who kept in close and sympathetic touch with his students; but he did not confine himself to the teaching side of education. Upon the completion of the chemical laboratory of the College of the City of New York, which he designed, he took rank among the foremost laboratory directors of the United States. He was indeed an organizer and administrator of the highest order. Indomitably energetic in his executive duties, and aided by an active staff of carefully selected chemical specialists, he succeeded in establishing and operating a strong department, and in consequence his influence extended throughout the institution. Constantly alert to help and keenly interested in bettering conditions, his accomplishments for his associates were numerous. His most attractive personal characteristics led to friendships of weight, which, in turn, benefited his colleagues and students.

An intellect more powerful from its happy union of scientific ability with broad culture has probably not been seen in the American chemical profession. He was inferior to none in extent of literary acquirement, in penetrating and fertile executive ingenuity, and in general equipoise of mind. And withal he tried to be his "own man," generous, kindly and sympathetic. The spirit of goodness is ever the same; but the modes of its manifestation are numberless, and every sterling man is original. The vigor and sincerity of this sterling man made his friendship a treasure.

W. A. Hamor

SCIENTIFIC EVENTS

THE PENSION AND INSURANCE PLAN OF PRINCETON UNIVERSITY

A pension and insurance plan for the Princeton University teaching staff was adopted on June 19 by the board of trustees at their annual meeting, held in connection with the university's one hundred and seventy-fifth commencement exercises. It provides for the raising of a special fund of $1,000,000 not later than 1925, to provide the money that will be required under the trustees' action.

The plan, which was placed before the trustees by a special pension committee of which John O. H. Pittney is chairman, supplements the provisions of the Carnegie Foundation, of which about 90 per cent. of the faculty are at present beneficiaries.

Any member of the university teaching staff may, under the plan approved, retire at the age of 65, and every member must retire at 68, provided, however, that in special cases by a vote of the board of trustees an individual may be continued in active service beyond the retiring age period not exceeding three years.

The general provisions of the plan are as follows:

Every member so retiring shall be entitled to receive during the remainder of his life an annual retiring allowance equal to one half of his annual salary as teacher at retirement:

Provided that the obligation of the university shall be reduced by the amount of any Carnegie or similar allowance to which any such member may be entitled. Any member so retiring, not immediately entitled to a Carnegie allowance, shall receive from the university his half salary as before defined (with such additions thereto as may be necessary to qualify him for the maximum Carnegie allowance) until he is entitled to maximum allowance under the Carnegie rules. Any member of the teaching staff who is entitled to a Carnegie retiring allowance and who forfeits such retiring allowance because of any voluntary act by which the same is forfeited under the Carnegie rules, may be deprived of his retiring allowance from the university.

The university will provide life insurance that shall assure to each member of the teaching staff the payment of $5,000 on his death before his retirement, payable to his wife if he leaves one, otherwise to his children, or, if he leaves none, then to such person as he may, with the approval of the president, designate.

"An alternative" plan" submitted by the committee on pensions and also approved covers the cases of members of the faculty who hold deferred annuity policies issued by the Teachers' Insurance and Annuity Association of America or other companies approved by the university finance committee. The university will, on the request of a member of the faculty and his relinquishment of all benefits under the insurance and pension plan, contribute toward the payment of the premiums on such annuity policies a sum not exceeding five per cent. of his annual salary, nor a maximum of $300.

GIFTS TO THE AMERICAN MUSEUM OF NATURAL HISTORY

GIFTS of $1,000,000 by Mr. John D. Rockefeller, Jr., and $250,000 by Mr. George F. Baker to the American Museum of Natural History were announced by President Henry Fairfield Osborn at a meeting of the executive committee of the board of trustees last week, when the following resolutions were passed:

Resolved, That the trustees accept with grateful thanks the splendid gift of $1,000,000 presented to the museum by Mr. John D. Rockefeller, Jr., for its corporate purposes and hereby take pleasure in applying it to the permanent endowment fund, the principal to be kept invested and the income only to be expended for the work of the institution.

This munificent gift, valued at more than a million dollars, is the more appreciated because it is received at a time when the increase of the permanent endowment by at least $2,000,000 stands as the paramount need of the museum, in order that its scientific exploration and research may not be curtailed and in order that it may continue to render to public education, especially through the school system of the city and country, a service which is increasing in importance and is receiving universal approval of educators.

Mr. Rockefeller's attitude in his generous terms of gift and in his liberal-mindedness with respect to the use of this fund is a further source of deep satisfaction and encouragement to the trustees because it indicates his hearty endorsement of the aims and purposes of the museum and of the trustees' policy in its development and expresses his belief in the present and future service which it can render to science and education for all the people.

In recognition of Mr. Rockefeller's interest in the museum, the trustees take pleasure in hereby electing him a benefactor.

Resolved, That the trustees desire to record their deep sense of gratitude to Mr. Baker for his generous gift of $250,000, which constitutes the initial contribution to the much needed enlarged endowment for the growth and development of the museum. The trustees deeply appreciate not only the intrinsic value of the gift, but especially the generous attitude of the donor in permitting the unrestricted use of the income of this fund—an action which is indicative of his confidence in the administration of the museum and the aims and purposes of the institution. In recognition of Mr. Baker's earlier contributions, the trustees had previously elected him a benefactor, and can therefore merely express their gratitude to him by extending their heartfelt thanks and best wishes for continued good health and happiness.

THE INTERNATIONAL ASTRONOMICAL UNION AT ROME

AT the meeting of the International Astronomical Union at Rome from May 2 to 10, according to a report in *The Observatory,* the adherent countries represented were Australia, Belgium, Brazil, Canada, Czecho-Slovakia, Denmark, France, Great Britain, Holland, Italy, Japan, Mexico, Norway, Poland and the United States. Greece and South Africa, though adhering to the union, were not represented, while Roumania and Spain were represented, although the formalities connected with adhesion to the union had not been completed.

The list of committees for the coming three years drawn up by the executive committee was adopted. They were as follows, the name of the chairman being given in each case:

Relativity, Levi-Civita (Italy); Notations, Stroobant (Belgium); Ephemerides, Eichelberger (U. S. A.); Bibliography, B. Baillaud (France); Telegrams, Strömgren (Denmark); Dynamical Astronomy, Andoyer (France); Instruments, Hamy (France); Solar Physics, Hale(U. S. A.); Wave-lengths, St. John (U. S. A.); Solar Rotation, Newall (Great Britain); Physical Observations of Planets, Comets and Satellites, Phillips (Great Britain); Lunar Nomenclature, Turner (Great Britain); Wireless Determination of Longitude, Ferrié (France); Variation of Latitude, Kimura (Japan); Positions of Planets, Comets and Satellites, Leuschner (U. S. A.); Shooting Stars, Denning (Great Britain); Carte du Ciel, Turner (Great Britain); Stellar Parallaxes, Schlesinger (U. S. A.); Photometry, Seares (U. S. A.); Double Stars, Aitken (U. S. A.); Variable Stars, Shapley (U. S. A.); Nebulæ and Clusters, V. M. Slipher (U. S. A.); Spectral Classification, Adams (U. S. A.); Radial Velocities, Campbell (U. S. A.); Time, Sampson (Great Britain).

Sir Frank Dyson gave, on behalf of the delegates of Great Britain and, more particularly, on behalf of Professor Newall, an invitation to the union to meet in Cambridge in 1925, and also to be present at the celebration of the two hundred and fiftieth anniversary of the foundation of the Royal Observatory, Greenwich. This invitation was seconded by Mr. Stratton, and was accepted after invitations from Poland and eastern center in the United States had been noted for 1928. The following were elected to act as officers and executive of the union for the coming three years:

President: Professor W. W. Campbell (U. S. A.).

Vice-presidents: Professor Cerulli (Italy), M. Deslandres (France), Professor Hirayama (Japan), Mr. Hough (Great Britain), Professor de Sitter (Holland).

Secretary: Professor Fowler (Great Britain).

HONORARY DEGREES CONFERRED BY YALE UNIVERSITY ON SCIENTIFIC MEN

At the commencement exercises of Yale University on June 21, President James Rowland Angell conferred the honorary doctorate of science upon Dr. John C. Merriam and Mr. J. J. Carty and the doctorate of laws on Dr. Russell H. Chittenden. In presenting the candidates for the degrees Professor William Lyon Phelps spoke as follows:

John Campbell Merriam: President of the Carnegie Institution, paleontologist and educator. Born in Iowa, where he took his first degree at Lenox College in 1887. Doctor of philosophy of the University of Munich. He began his professional career as an instructor in paleontology and historical geology at the University of California in 1894, and since that date he has become a leading authority in fossil reptiles and fossil mammals of western North America, and of general historical geology of the Pacific coast region. He is a member of many learned societies and his publications are numerous and important. He was for years professor of geology and dean of the faculties at the University of California. He was largely instrumental in establishing the Pacific exploration project which has taken on large dimensions, involved wide ranges of science and large numbers of scientists. During the late stages of the war, he acted as chairman of the National Research Council. He is a member of the National Academy of Sciences and widely regarded by scientific men as one of the half dozen conspicuous representatives of American science. He combines to an extraordinary degree ability as an investigator with ability as a teacher.

John Joseph Carty: Vice-president of the American Telephone and Telegraph Company, A pioneer in the development of telephone science since 1879. He designed and constructed the first metallic circuit multiple telephone switchboard. A high authority states that his original researches published in 1889 demonstrate the preponderating effect of electrostaic induction in producing cross-talk on adjacent telephone circuits. Cross-talk is presumably used only in a technical sense. He invented the method of common battery work now in general use throughout the world. The bridging telephone was designed by him; this forms the basis of all farmers' party-lines, thus adding social knowledge and delight to the existence of farmers' wives. He is a leader in the movement to encourage research in pure science at the universities. During the war he was chairman of the executive board of the National Research Council. He rendered invaluable service in preventing the interruption by the enemy of our trans-Atlantic cable communications. He designed the telephone and telegraph system for the American Army in France. He served as colonel in the United States Army as a staff officer, and is now brigadier-general of the Officers' Reserve Corps. For his services in establishing the telephone system in Japan, he received there the Order of the Rising Sun and of the Sacred Treasure. For his war services, he was given the formal thanks of the French Army, the cross of Officer of the Legion of Honor and the Distinguished Service Medal from the United States government.

RUSSELL HENRY CHITTENDEN: Dr. Chittenden was born in New Haven, and his active career has been identified with the Sheffield Scientific School, a fortunate thing for that institution. He took his bachelor of philosophy degree there in 1875. After taking his doctorate in the Graduate School, he studied at Heidelberg, and has received honorary degrees from the University of Toronto, University of Pennsylvania, Washington University, and the University of Birmingham in England. His researches and publications in the field of physiological chemistry have made him one of the world's foremost authorities; and during the war he represented America on the Inter-Allied Scientific Food Commission, which held sessions in London, Paris and Rome. In 1898 he was appointed director of the Sheffield Scientific School, where he immediately showed executive ability as remarkable as his powers of research. Under his leadership the Sheffield Scientific School became a liberal college, one of the best in America, where the study of the humanities had no stronger friend than the great scientist who directed the institution. Its growth in numbers and in buildings and in resources was phenomenal; leading authorities were numerous on the faculty, Dr. Chittenden's devotion to the avocation of fishing enabling him to be a good fisher of men. He retires from office this year in the plenitude of his powers, with the respect of the best scholars in Europe and America, with the admiration of his colleagues, and with the devoted affection of thousands of students who have been graduated under his administration.

SCIENTIFIC NOTES AND NEWS

PROFESSOR T. H. MORGAN, of Columbia University, was on June 1 formally received into the Royal Society and delivered the Croonian lecture. On the following day he and Dr. Sturtevant addressed the Genetical Society at its annual meeting, held at the John Innes Horticultural Institution. On June 8, Professor Morgan lectured at the University of Edinburgh and its degree of doctor of laws was presented to him.

DR. GEORGE ELLERY HALE, director of the Mount Wilson Observatory and honorary chairman of the National Research Council, has been elected the American representative on the international committee which, under the auspices of the League of Nations, is to study and suggest methods of intellectual cooperation throughout the world.

AT the commencement exercises of Princeton University, the doctorate of science was conferred on Dr. Arthur Gordon Webster, professor of physics at Clark University; Dr. Henry Crew, professor of physics at Northwestern University, and Dr. John Campbell Merriam, of the Carnegie Institution of Washington. The doctorate of laws was conferred on Dr. Livingston Farrand, president of Cornell University.

DR. VERNON KELLOGG, of the National Research Council, was given the honorary degree of doctor of science by Oberlin College on June 21.

THE honorary degree of doctor of laws was conferred on the secretary of agriculture, Henry C. Wallace, by the Iowa State College of Agriculture and Mechanics Arts at the commencement this month. Secretary Wallace is an alumnus of the institution and gave the commencement address.

DR. HAROLD L. AMOSS, associate member of the Rockefeller Institute for Medical Research, New York, on June 7 received the degree of doctor of science from George Washington University, Washington, D. C. The scientific staff of the Rockefeller Institute on June 12 gave a dinner in honor of Dr. Amoss, who has accepted the appointment of associate professor of medicine at the Johns Hopkins Medical School, Baltimore.

AMONG those knighted on the occasion of King George's birthday were Professor William Maddock Bayliss, professor of general physiology in University College, London; Professor Frederick William Keeble, Sherardian professor of botany at Oxford University, and Dr. Edward John Russell, director of the Rothamsted Experiment Station.

A COMPLIMENTARY dinner was given to Dr.

Henry Head, F.R.S., on May 26 in recognition of his eminent services to neurology as editor of *Brain* for seventeen years. Sir Charles Sherrington, president of the Royal Society, was in the chair and addresses were made by Sir David Ferrier and Dr. Head. Dr. Gordon Holmes has been made editor of the journal.

Dr. Leon C. Havens, associate in immunology in the Johns Hopkins School of Hygiene and Public Health, has been appointed director of laboratories of the State Board of Health at Montgomery, Alabama.

H. A. Noyes has severed his connection with the Mellon Institute of Industrial Research of the University of Pittsburgh to accept the position of research chemist for the Michigan Department of Agriculture.

J. A. McClintock, plant physiologist at the Georgia Experiment Station, has resigned, effective July 1, to accept the position of associate plant pathologist at the University of Tennessee Agricultural Experiment Station.

Dr. Charles D. Walcott, secretary of the Smithsonian Institution, has left for the Canadian Rockies to continue geological explorations.

Professor J. G. Needham, head of the department of biology and entomology in Cornell University, is to exchange for the college year 1922-3 with Dr. William A. Hilton, of the department of zoology, Pomona College, Claremont, California.

Dr. G. Canby Robinson, acting professor of medicine at the Johns Hopkins University during the current year, will spend the summer in study at the University of Copenhagen before assuming his duties as professor of medicine at Vanderbilt University.

Dr. John Rice Miner, associate in the department of biometry and vital statistics of the School of Hygiene, the Johns Hopkins University, has been granted leave of absence for the next academic year and will spend the time in study and travel abroad. During Dr. Miner's absence, his position in the department will be filled by Dr. Flora D. Sutton, who has the degree of doctor of philosophy in mathematics from Johns Hopkins University, and has for some time been connected with the department of biometry and vital statistics.

Dr. J. W. Turrentine, formerly director of the Experimental Kelp-Potash Plant of the U. S. Department of Agriculture at Summerland, California, has obtained furlough from the department for a period of six months to act as consulting chemist for the U. S. Kelp Products Corporation, the newly organized concern which has purchased the government's plant and is now proceeding with the manufacture of kelp products.

Professor Frank Thilly, professor of philosophy at Cornell University left on June 8 for Houston, Texas, to give the commencement address at the Rice Institute. From Houston he plans to go to Los Angeles to give a course of lectures before the Summer School of the Southern Division of the University of California.

On June 6, at the Denver Public Library, Dr. C. P. Gillette, director of the Colorado Agricultural Experiment Station, delivered a lecture on "Heredity and the improvement of man," under the auspices of the Genetic Foundation of Colorado.

Professor Eugene C. Bingham gave an illustrated lecture in Philadelphia on the evening of June 15 before the Philadelphia Section of the American Chemical Society on the subject of "Fluidity and plasticity."

A Mendel festival was organized at Vienna by the Zoologic-Botanical Society to commemorate the hundredth anniversary of the birth of Gregor Johan Mendel on June 7.

Dr. William Carruthers, from 1859 to 1895 assistant and keeper of botany in the British Museum, known for his work in paleobotany, died on June 2, at the age of ninety-two years.

Professor William Gowland, emeritus professor of metallurgy in the Royal School of Mines, London, has died at the age of seventy-nine years.

The deaths are also announced of Professor C. V. Zanetti, director of the Institute of Pharmacological Chemistry of the University of

Parma, and of Professor Jenö Holzwarth, who held the chair of radiology in the University of Budapesth.

A cablegram from Prague announces that Professor Edmund Weil has died from typhus contracted by infection in his laboratory at Lemberg, where he was working at the invitation of the Polish government.

Preparations for the fourth Boston meeting of the American Association for the Advencement of Science, to be held from December 26 to 30, by invitation of the Massachusetts Institute of Techonology and Harvard University, are progressing in a very satisfactory way. The privilege of reduced railway rates for those attending the meeting has already been granted by the New England Passenger Association, the Trunk Line Association, the Central Passenger Association, the Southeastern Passenger Association, and the Eastern Canadian Passenger Association. This privilege is based on the certificate plan, and the cost of the round trip to Boston will be one and one half times the regular one-way tariff. The region thus far included extends about to the Mississippi River.

Sigma Delta Epsilon, graduate women's scientific fraternity, founded at Cornell University, May, 1921, recently became incorporated and installed Beta Chapter at the University of Wisconsin on April 25. The national officers, who serve until the convention in Boston in December at the time of the meetings of the American Association for the Advancement of Science are: Christianna Smith, Cornell, *president;* Elizabeth Smith, Wisconsin, *first vice-president;* Helen M. Johanns, Wisconsin, *second vice-president;* Evelyn Fernald, Cornell, secretary; Helen Brewster Owens, Cornell, *treasurer.*

Dr. Vernon Kellogg writes: "The industry and commerce committee of the Polish parliament has drafted a bill providing for the adoption of the metric system of weights and measures for the whole of reunited Poland. The bill provides that beginning January 1, 1923, all retail trade in Poland will be conducted on this basis, and that on and after January 1, 1924, all trade, whether retail or wholesale. At present the metric system is in use in the parts of Poland which were formerly under German and Austrian rule, but the Russian system, with its versts and poods, is still being used in former Russian Poland.

Following an unconditional gift of its large collection of books and documents on public health, medical and related subjects to the Surgeon General's Library of Washington, the Prudential Life Insurance Company of America has made a similar, though less extensive, presentation of its books and documents on forestry and agriculture to the library of Yale University.

Professor Arnold Pick, the well-known neurologist at Prague, is about to retire from teaching and wants to sell his library. It contains some 3,000 works on psychiatry, neurology and psychology, besides 7,000 reprints and theses.

The *British Medical Journal* states that strong protests have been made by the medical profession in France, and especially by the Syndicat général des médecins français électro-radiologistes, against the appointment by the prefect of the department of the Seine of a radiographer who is not a qualified medical practitioner to be director of the radiological laboratory of the Salpêtrière Hospital in succession to the late Dr. Charles Infroit.

Mr. F. H. Riddle, president of the American Ceramic Society, writes: "Allow me to submit a correction to the item relating to the annual meeting of the American Ceramic Society which appeared in Science on June 2. As it stands, it is made to appear that in the investigation on special porcelains adapted for spark plugs, etc., conducted by the Bureau of Standards, the work of Mr. A. V. Bleininger was of a secondary and minor character. Permit me to say that his contribution was vital and important and that the final conclusions reached were the result of close cooperation."

A reflecting telescope with a 61-inch mirror is to be made for Ohio Wesleyan University. It will be housed in the Perkins Observatory, of which Professor Clifford Crump is director. There are only two reflecting telescopes in the world which will exceed this new instrument in size, according to officials of the Warner and Swasey Company, which has contracted to make the installation. These are the 100-

inch reflector at the Mount Wilson Observatory in California and the 72-inch one at Victoria, British Columbia. The $250,000 for its construction was given by Professor M. H. Perkins, for twenty-five years an instructor in mathematics at Ohio Wesleyan, who has made many other contributions for the upkeep and maintenance of the observatory. A feature of the telescope is that it will be devoted primarily for the use of the students in the university and only secondarily for research. This is the first of the large instruments to be so used. Three years will be required to complete the installation.

A BETA CHAPTER of Sigma Delta Epsilon, a women's honorary scientific society, was recently installed at the University of Wisconsin. The society has a membership of 33 women who are doing advanced work in science in the University of Wisconsin, the federal government and the state scientific institutions in Madison. The officers are Dr. Eloise Gerry, U. S. Forest Products Laboratory, *president;* Miss Marion E. Phelps, department of physics, *vice-president and chairman of the membership committee;* Miss Helen Johann, cereal investigations U. S. Department of Agriculture, *secretary;* Dr. Elizabeth A. Smith, department of zoology, *treasurer;* and Miss Nevada Evans, department of plant pathology, *chairman of the program committee.* The meetings are held twice a month and give opportunities for presentation and informal discussion of the results of research as well as social intercourse. The society is non-secret. Its name means united in friendship through science. The officers-elect for the coming year are Professor Elizabeth A. Smith, zoology, *president;* Professor Helen Parsons, food chemistry, *vice-president;* Miss Helen Johann, cereal investigations, *secretary;* Miss Ruth Chase, zoology, *treasurer;* and Miss Emma Fiske, botany, *chairman of the program committee.*

THE Biological Station of the University of North Dakota at Devil's Lake is planning to continue this season the work which it has been conducting for a number of years past, which includes experiments on the influence of solutions of different salts of varying concentrations upon fishes, in the attempt to ascertain the cause of death of fish in such solutions. It is also continuing the biological survey of the state, upon which considerable progress has already been made. The work this year will be centered, chiefly on the fishes, reptiles and Amphibia. Reports have already been published, or are in press, dealing with a number of groups, including the birds, mollusks, Protozoa, locusts, and bugs (Hemiptera). This latter work is in charge of Miss Crystal Thompson, of the Amherst College Museum, and is in cooperation with the Museum of Zoology at Ann Arbor. The environment of Devil's Lake, with numerous ponds differing markedly in their physical and chemical characteristics, marshes, woodland, and cultivated land, contains a rich fauna for ecological studies, especially on aquatic life.

WE learn from *Nature* that the Strangers' Hall, Norwich, an old city merchant's house, with groined undercroft, fifteenth century banqueting hall, and other paneled rooms of later date, has been offered by its owner, Mr. Leonard G. Bolingbroke, to the corporation of Norwich for the purpose of an English Folk and Historical Museum, in conjunction with the Norwich Castle Museum. Mr. Bolingbroke has also offered his collection of old domestic appliances and other "bygones" illustrative of the various phases of a middle-class Englishman's home during the last four or five centuries, which will find a fitting environment in the various rooms of the house. While the aim of the museum will be historical rather than scientific, there will be found many exhibits of interest to students of early history and development of such subjects as the production of light and fire, domestic cookery, and other kindred objects.

THE *Royal Geographical Journal* reports that an expedition lately left Copenhagen for the Dutch East Indies with the object of taking preliminary steps towards the establishment of a Tropical Station for Biological Research in that region. It is headed by Dr. T. Mortensen, of the Copenhagen Zoological Museum, and the botanist is Hjalmar Jensen. The project was set on foot some years ago and has been brought to a head through the labors of a Scandinavian Society formed for the purpose. The present expedition has been rendered possible by a grant from the "Raskorsted Fund." The probable site of the station will be in the Ké islands, previous research having shown that there is an unusual abundance of animal life in the waters to the west of the group. What is really a deep-water fauna is here found at comparatively small depths—200-300 meters—making it easy to collect rare deep-water species. It is possible that Dutch cooperation may be secured, and in any case the intention is to give an international character to the station.

UNIVERSITY AND EDUCATIONAL NOTES

MRS. DOROTHY WHITNEY STRAIGHT will give to Cornell University a million-dollar building to be used as a center for the social and recreational life of the students.

AT the commencement of Princeton University a gift of $100,000 was announced from James H. Lockhart, of Pittsburgh, for the endowment of scholarships in memory of his father, Charles Lockhart.

HEARST HALL and Hearst Hall Annex were destroyed and the Pathology Building of the University of California was damaged on June 21 in a fire with estimated loss of $100,000. Hearst Hall, a large frame structure, was the gift to the university women of Mrs. Phoebe Apperson Hearst. Mr. William Randolph Hearst has undertaken to rebuild Hearst Hall and its accessory buildings in fireproof material.

DR. HAVEN EMERSON has been appointed professor of public health and administration in the College of Physicians and Surgeons, Columbia University, and given the task of working out a plan for the organization of the Institute of Public Health established by the bequest of the late Joseph A. DeLamar.

MR. SIGFRED HAUGE and Mr. Robert Evans have been appointed instructors in the division of agricultural biochemistry of the University of Minnesota. Dr. Paul F. Sharp, instructor in the division, has been appointed assistant chemist of the Montana Agricultural Experiment Station.

PROFESSOR S. I. KORNHAUSER, of Denison University, has been appointed head of the department of anatomy of the School of Medicine of the University of Louisville, in the place left vacant by Dr. Chas. Brookover. During the summer Dr. Kornhauser will be biological assistant to Colonel William G. Atwood, director for the committee on marine piling investigations of the National Research Council.

DR. ALFRED POVAH, formerly associate professor of plant pathology and associate plant pathologist at Alabama Polytechnic Institute, has been appointed assistant professor of botany at Northwestern University.

DR. A. O. WEESE, professor of biology at the University of New Mexico for the past ten years, has accepted the professorship of biology at James Millikin University, Decatur, Illinois, recently made vacant by the death of Dr. A. A. Tyler. Professor Weese has spent the past year at the University of Illinois.

DISCUSSION AND CORRESPONDENCE

THE NEW CATASTROPHISM AND ITS DEFENDER

REFERENCE was made in my contribution to SCIENCE for February 17 to Professor Price, alleged geologist, upon whose scientific vagaries a reactionary theology relies much in its recent attack on evolution—the result of a recrudescence of the old conflict which such a theology has ever waged against the progress of science.

George McCready Price, who since 1906 has held positions as professor of geology, College of Medical Evangelists, Loma Linda, California, professor of English literature, Fernando Academy, California, and professor of chemistry and physics, Lodi Academy, California, is evidently in the religious denomination (Seventh Day Adventist) to which he belongs held to be a man of considerable versatility.

The writings by which he is best known are two books, "Fundamentals of Geology" (1913), and "Q. E. D., or New Lights on the Doctrine of Creation" (1917), and numerous articles in the religious press—chiefly the Philadelphia *Sunday School Times*.

The distinctive ideas for which he stands in geology (the only ones to be reviewed in this article) are:

First: What he terms the "New Catastrophism," which turns out to be nothing more than the Old Catastrophism embodied in the Noachian Deluge.

Second: A literal creation of material things (the sidereal universe with its parts apparently in different stages of development—its nebulæ, hydrogen stars, metallic stars, carbon stars and dark stars); and all animate things (trilobites, nummulites, graptolites, ammonites, sigillaria, the fishes of the Old Red Sandstone, the large reptiles of the Mesozoic, the mammoth and the mastodon, the one-toed horse and the three-toed horse, and man) all at one and the same time just as set forth in the first chapter of Genesis.

While not committing himself to any estimate of the time back of the present when all this took place, it is evident that he leans to a "short chronology"; for in Chapter IX of his Fundamentals of Geology he argues for a catastrophic instead of a uniformitarian rate for the deposition of strata. In Chapter I of his "Q. E. D." he refers to the study of the phenomena of radioactivity as having "thrown a good deal of doubt upon the older estimates of the age of the earth," but he fails to inform his reader that such study has revealed the necessity of postulating a long succession of atomic transformations, and has enormously extended the length of geologic time.

Realizing that if there has been a geological succession of life on the earth

"then some form of genetic connection between these successive types is the intuitive conclusion of every thinking mind, even though the recovery of these connecting links may prove impossible,"

and his Genesis account, which he is out to defend at all hazards, goes by the board, he flatly denies that there has been any geological succession, and sets himself to the task of endeavoring to prove the astounding thesis "that all fossils are of the same age and none of them older than man." In doing this he shows wide familiarity with geological literature, quoting largely from the most eminent authorities in this country and in Europe. Any one reading these writings of Price, which possess a certain charm of literary style, and indicate on the part of the author a gift of popular presentation which makes one regret that it had not been devoted to more laudable purpose, must constantly marvel at the character of mind of the man who can so go into the literature of the subject and still continue to hold such preposterous opinions.

The position of superiority he arrogates to himself is amazing: With his solicitude for harmonizing his views with those of the Bible so palpable, one of his eyes, at least, being always "kept on Genesis," he still has the face to accuse all "other geologists" of being biased, charging that they hold to a belief in geological succession "solely on the strength of the infallibility of a theory" (elsewhere referred to as the onion-coat theory of Werner) "invented a hundred years ago in a little corner of western Europe."

So much under the spell of this old Wernerian hypothesis are geologists still (excepting himself), that, according to Price they "invent" unconformities and faults to explain breaks and repetitions in the life succession.

Price especially endeavors to find "mare's nests" in the "alleged" great thrust faults of the earth, impugning the competency or integrity, or both, of the distinguished geologists who vouch for their existence: as that of Heim and Rothpletz for the great Glarus overthrust in the Alps, that of Geikie for the great overthrust in Scotland, that of McConnell, Campbell and Willis for the great overthrust along the eastern front of the Rockies in Canada and northwestern United States, and finally that of Hayes for the numerous overthrusts in the southern Appalachians.

Professor Price also thinks he has found another geological "mare's nest," one that ought to confound these believers in a geological succession, in the fact:

"That the rivers of the world in cutting across the country, completely ignore the varying ages of the rocks in the different parts of their courses, and act precisely as if they began sawing at them all at the same time."

Evidently the conception of a superimposed river, disclosing old buried structures as it deepens its channel, so easily understood by any high school student of physiography, is beyond the mental grasp of the author of "Fundamentals of Geology."

This then is the man who, while a member of no scientific body and absolutely unknown in scientific circles, has in at least one of his contributions to the religious press (the one in which he tried to make much of the so-called anti-evolution admissions of Bateson) had the effrontery to style himself "geologist," in the expression he there used "we geologists"; and this is the man who in his support of a literal Genesis is hailed by the "Fundamentalists" as their great champion—one who has "demonstrated the absurdity of the evolutionist's geological theories" and has brought into prominence the "heretofore mute evidence of a mighty upheaval and a flood."

Arthur M. Miller
University of Kentucky

KEYS IN SYSTEMATIC WORK

To the Editor of Science: It seems more mechanical uniformity is possible in the keys which systematists find of so much value in descriptive work. The number of forms used now is limited apparently only by the number of authors publishing such keys, and among this large number of forms are many which are wasteful of space and many which are confusing to the student.

Some of the mechanical requirements of a good key may be briefly summarized:

1. The key should occupy a minimum amount of space, and should present the minimum difficulty to the printer.
2. The key should be capable of indefinite expansion, that is, provide for any number of groups, and no headings of groups or sections should be duplicated.
3. Any desired space under each heading should be available.
4. Coordinate groups in the key should be recognizable as such at a glance and such coordinate groups should be in juxtaposition.
5. The key should be as readily "run backward" as "run forward."

Ample reasons for all these requirements could be given but need not be detailed here. The following skeleton key shows a form which I believe meets all these requirements, and it is presented for criticism in the hope that after discussion some form of key may be found which will meet with general approval. Sections 3 and 3′ show length of printed lines when several lines are required for a section.

Key to Species *a-h* of the Genus X

1.	Tarsi spurred....................	2.
1′.	Tarsi not spurred....................	5.
2 (1).	....	*a.*
2′.	....	3.
3 (2′).	....	4.
3′.	....	*b.*
4 (3).	....	*c.*
4′.	....	*d.*
5 (1′).	....	*e.*
5′.	....	6.
6 (5′).	....	*f.*
6′.	....	*g.*
6″.	....	*h.*

E. B. Williamson
Bluffton, Indiana

THE Y-CHROMOSOME TYPE OF SEX-LINKED INHERITANCE IN MAN

In a short article which appeared in the *Journal of Heredity* for November, 1921, Richard Schofield describes a case of human inheritance which has very great theoretical interest. It involves the transmission through four generations of a condition called webbed toes. The condition is found only in male members of the family and is transmitted from father to son, never to a daughter nor through a daughter to her sons.

It thus has the distribution in heredity of a Y-chromosome, a structure found only in the male-determining spermatozoa of certain animals and never in their eggs. The Y-chromosome accordingly is a structure possessed by male individuals only and thus forms an appropriate vehicle for the transmission of characters from father to son, quite independently of the female line of descent. All this was pointed out by Schmidt in a contribution from the Carlsberg Laboratory, which I reviewed in Science for April 8, 1921, under the title "A New Type of Inheritance." Schmidt described in a fish the first known case of inheritance of this type. This has since been confirmed in the case of another species of fish by a Japanese observer, so that it may now be regarded as well established. Schofield's article furnishes evidence that the Y-chromosome type of inheritance occurs in man as well as in fishes.

W. E. CASTLE

BUSSEY INSTITUTION,
JUNE 3, 1922

THE VOCABULARY OF METABOLISM

I wish to suggest in the columns of SCIENCE the following new terms in the vocabulary of metabolism: (1) *Eubolism,* a condition of normal bodily metabolism; (2) *Pathobolism,* a condition of perverted metabolism of a diseased nature, as, for example, diabetes; (3) *Dysbolism,* a condition of disturbed metabolism not necessarily of a diseased nature, as, for example, alkaptonuria. I believe that these terms will supply a want in the terminology of metabolism.

MAX KAHN

BETH ISRAEL HOSPITAL,
NEW YORK

SALARIES OF PROFESSORS IN POLAND

I TAKE the following item from the weekly news release of June 7 of the Polish Bureau of Information:

Because of the importance attached to their rôle in the life of the nation, the university professors of Poland have been granted salaries greater than those to which their official rank would entitle them. [The official rank of full professors in Polish universities is considered equivalent to that of major generals.]

If they have been in service fifteen years and are supporting families, they are to receive monthly salaries of 139,000 marks. This approximates the salaries of cabinet ministers, who receive about 160,000 marks monthly, and is slightly in excess of those of vice-ministers, who receive, including representation funds, about 137,000 marks.

These salaries for professors have been made possible by a special provision in the state budget, appropriating 357,906,966 marks for professors' salaries and 87,625,761 marks for the salaries of assistants, a total of nearly half a billion marks. [For the value of a Polish mark in American money to-day, consult the morning newspaper.]

VERNON KELLOGG

WASHINGTON, D. C.

SPECIAL ARTICLES

THE SPIRAL TREND OF INTESTINAL MUSCLE FIBERS

IN the *Anatomical Record* for May, 1921 (Vol. 21, pp. 189-215), Professor Carey published his "Studies on the Structure and Function of the Small Intestine." These were reprinted, in part, with the title, "Studies on the Anatomy and Muscular Action of the Small Intestine," as the opening article of volume 1 of the *Journal of Gastro-Enterology* (July, 1921). The first conclusion, and the only one on which comment is here to be made, is this:

The inner muscle coat of the small intestine is not composed of circular or annular rings contiguously placed, but is a continuous muscular sheet wound into a close helix. One complete turn is made in every 0.5 to 1 mm. or less (*Anat. Rec.*, p. 193; *Journ. Gastro-Ent.*, p. 9).

Professor Carey characterizes the conception that the inner muscular coat is composed of discrete muscular rings with a certain degree of connection, as "a faulty anatomical heirloom"—an "erroneous idea which arose with the inception of the microscope and has since been accepted unchallenged." There is, however, a neglected anatomical heirloom, with which perhaps the author was unfamiliar, in the form of "A Discourse concerning the Spiral, instead of the supposed Annular, structure of the Fibres of the Intestins; discover'd and shewn by the Learn'd and Inquisitive Dr. William Cole to the Royal Society" (*Phil. Trans.*, 1676, Vol. xi, pp. 603-609). This discourse, not now readily accessible, is so admirably confirmed by Professor Carey's repetition of the work as to repay examination.

At the time of Dr. Cole's studies, Willis, in his *Pharmaceutice rationalis,* published two years previously, had described the interior fibers of the muscular coat as "annular, everywhere girdling in close-set ranks the cavity of the intestines, and inserted into the edge of the mesentery as in a tendon." Overlying these, and "crossing them at right angles," he found straight or longitudinal fibers, and believed that the sinewy outer layer wrapped around them served them in place of tendons. (Earnest efforts were made by the early anatomists to find tendons for smooth muscle!) From the mesentery and from the fibers of the outer coat, the circular and longitudinal muscles, respectively, received the animal spirits or nervous energy whereby they were at first inflated and distended, thereafter becoming shorter and more contracted. As to the action of the two sets of muscle fibers, he wrote:

Indeed the circular fibers, having contracted successively and seriatim, constrict the diameter of the intestine; and at the same time the longitudinals, inflated and distended, narrow it still more and produce a downward movement, so that the contents of the intestines, thus compressed from behind, must constantly be driven forward.

With such a description current, Dr. Cole begins his paper as follows:

Discoursing (near two years since) with a very ingenious Person, concerning the Mechanical reason of the Peristaltick motion of the Intestines, which is by Anatomists deduced principally from *Annular* fibres, constituting, according to the received doctrine (with the right fibres immediately investing them, though, by the by, I take these to make a distinct coat) one of the coats of them; his sence was (which he told me was that likewise of some others of his acquaintance) that they might be rather numerous, though small, Sphincter-muscles, than single fibres, to which that motion is to be attributed.

For four theoretical considerations Dr. Cole dissented, namely (1) that on the supposition of circular sphincters there would be no continuous lengthwise channel for the propagation of motion, and (2) lateral transmission seems not to be agreeable to nature's methods. Moreover, (3) lateral exits would tend to prevent distension of the fibers by the influent matter; and (4) circular muscles lack two tendons by the approximation of which all muscular work is accomplished. He therefore offered the following solution:

Viz. That those fibres which have been esteemed *annular*, might perhaps be *spiral*, and so be continued down in one tract to the lowest extremity of the intestines; . . . their declination being not easily discernible. . . But . . . I consider'd 'twas too unphilosophical to acquiesce in bare speculation, when *autopsy* might be consulted; and therefore I set upon the experiment, first in the upper intestines of an Ox, afterwards in those of Sheep and Calves. . . .

To effect a due disjunction of the membranes and fibres (which I found 'twas hard, if not impossible, for me to make while 'twas raw), I was fain to cause the intestine of Oxen to be boiled 5 or 6 hours, of Sheep 4; whereby the compages of the parts was so loosned, that the two outward coats were easily separated from that to which my search was destined, and left those reputed annular fibres naked.

The results of attempting to follow, through separation, the course of the bundles of these muscle fibers—single fibers being found too small to isolate—Dr. Cole records in numbered paragraphs, from first through "eighthly." The following are selected statements, abbreviated (as were previous citations):

When, beginning at the top, I attempted the separation of one of these clusters of fibres towards my right hand (on that side of the intestine, I mean, which was turned towards me) a whole ring would come off together . . .; but endeavouring it towards my left, I found, for the most part, I could easily enough unravel that cluster to a considerable length, *viz.*, that of sometimes more than two or three spans, before ruption, which yet at last 'twould be subject to.

If I began at the lower part of the intestine, and try'd to unravel *upwards*, there was not much more difficulty in so doing . . . [But] the operation, I observ'd would not succeed, unless I attempted it on the contrary order, *viz.*, towards my right hand.

When before boiling I caused the inside of the intestines to be turned outward, as I did in two tryals, . . . and endeavoured to unravel the fibres, I found they would come off in the contrary order . . . the intestine being inverted, the order of separation must be so too.

Other observations are that the obliquity of the spiral may vary; that the spiral is less well-defined in the cæcum; and that everywhere some fibers deviate from the main trend, being in the opposite order, or forming intercommunications between the turns of the spiral. But the general conclusion reached is that the fibers altogether form "one concave helical muscle."

Where the tendons of it are fixed is not evident; but if I may have the liberty of conjecture, I should think the upper of them to be radicated at the pylorus (if not as high as the sphincter gulæ); and the other at the anus.

Whether the supposed annual fibres of the veins and arteries may not have the same fabrick as those of the Intestines . . . I propose to be considered and examined by persons of more acute hands and judgment; as I do all what I have here delivered, nor daring too much to trust even the informations of my own hands and eyes, till I find them confirmed by those of others, more judicious as well as more dextrous in making experiments.

After two centuries Professor Carey has supplied the needed confirmation *except in one particular;* he finds that the spiral winds in the opposite direction! Carey describes a "left-handed helix,"—a spiral which reverses the direction of the rotation of the embryonic stomach and goes counter to the twisting of the œsophagus. But Dr. Cole recorded the type familiar in dextral gastropod shells, which accords with the rotation of the stomach. Although it often happens in nature, as noted by Thompson, that two opposite systems of geodetic spirals exist together, and interfere with one another, forming a criss-cross pattern[1] (and indeed such a condition has been recorded for the œsophageal muscles of ruminants[2]), it can not be invoked to reconcile the conflicting statements regarding the direction of the intestinal spiral, since both Cole and Carey agree that there is but one well-defined cleavage. Under these circumstances, the question has been referred to Professor Sykes, who, during the past season, while studying in the Harvard Laboratory, has frequently unwound the circular muscle of the intestine. Although his results are to be published elsewhere, I am permitted to report that he has verified the early work of Dr. Cole in regard to the direction assumed by the spiral; it is dextral. If this is so, Dr. Carey's explanation of that primary torsion of the embryonic intestine which determines the disposition of small and large bowels in the adult, though very ingenious, must be considered illusory, for it depends on sinistral coiling and tension.[3]

The origin of the spiral trend of the muscles is ascribed by Dr. Carey to "the rotating spiral growth of the epithelial cells,"[4] but this is a phase of the problem which invites further study.

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[1] *Growth and Form*, 1917, p. 489.

[2] Owen: *Comp. Anat. of Vert.*, 1868, Vol. 3, p. 470.

[3] *Journ. Gen. Physiol.*, 1920, Vol. 3, p. 76 *et seq.*

[4] *Anat. Rec.*, 1920, Vol. 19, p. 220.

NEARCTIC PROTURANS

THE Protura—the most primitive of all the insects, if indeed they are insects—were first reported from the Nearctic Region in 1909. In that year the eminent Italian zoologist and entomologist, F. Silvestri, collected and described under the name of *Eosentomon wheeleri*, a single species from New York. For the next twelve years no record was added from the vast area of the Nearctic.

The second record from this region was obtained in 1921 from the vicinity of Washington, D. C., the first specimen being found by H. S. Barber, who accidentally came across it in some leaf mold in which he was rearing beetle larvæ. Other specimens of the same species, which proved to be new, were soon taken, and the species described by the writer as *Acerentulus barberi.*[1]

Following the initial discovery at Washington the writer has been fortunate enough to encounter Proturans in large numbers and in considerable diversity at Takoma Park, Maryland. Here during the spring of 1921 no less than twelve species, representing six genera, were found, ten of them proving to be new. These have been described in a paper presented at a meeting of the Entomological Society of Washington.[2]

To these records obtained in the vicinity of Washington are now added several more from widely separated localities, and in some instances from different life zones of the Nearctic Region. These localities are as follows: Chesapeake Beach, Md.; top of Blue Ridge Mountains, near Bluemont, Va. (elevation 1,200 feet); near Prospect Hill, Va.;

[1] "A Second Nearctic Species of Protura, *Acerentulus barberi*, new species." *Ent. News*, Vol. XXXII, pp. 239-241.

[2] "New Genera and Species of Protura," *Proc. Ent. Soc. Wash.*, Vol. XXIII, No. 9, pp. 193-202, Pl. XVI.

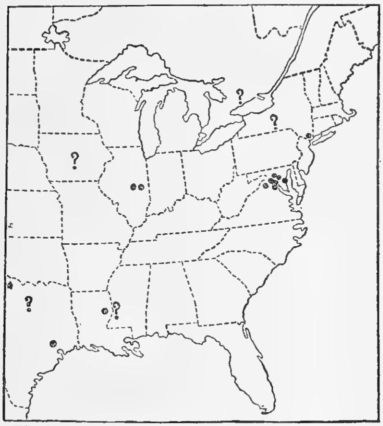
Great Falls, Va.; Tallulah, La.; Houston, Tex.; Chesterville, Ill.; near Decatur, Ill.

Proturans have been searched for but not found in the following localities: Vicksburg, Miss.; Dallas, Tex.; Ames, Ia.; Toronto, Can. In addition, also, Professor Silvestri has looked for them at Ithaca, N. Y., without finding any.

The known distribution up to date of Proturans in the Nearctic is shown by the accompanying figure, each positive record being indicated by a large dot and each negative record by a question mark.

It would be premature at this time to attempt any generalizations in regard to the Nearctic distribution of these most primitive hexapods, yet by way of summary it may be noted that up to the present Proturans have been found in 9 localities in the Upper Austral Life Zone, these records coming from 4 different states; from 2 localities in the Lower Austral Life Zone, the records being from different states; from 1 locality in the Transition Life Zone. Of the negative records, 1 is from the Upper Austral, 2 from the Lower Austral and 2 from the Transition.

The only life zone in which these hexapods have been found in either abundance or diversity is the Upper Austral. In the Lower Austral only two minute under-bark species were taken—two specimens of *Eosentomon pallidum* Ewing from Tallulah, La., and two specimens of *Eosentomon minimum* Ewing from Houston, Tex. In the Transition, three specimens of *Eosentomon wheeleri* Silvestri and one specimen of *Eosentomon pallidum* Ewing were taken from decaying leaves and twigs near Bluemont, Va., at the top of the Blue Ridge Mountains (elevation 1,200 feet).



The known distribution of Nearctic Proturans.

H. E. Ewing

U. S. National Museum

STEM END ROT OF APPLES

During the late spring of 1921 a large number of apples were found which developed a decay at and around the base of the stems. These apples were in a lot that had been removed from a cold storage temperature of 32° and held for a few days at 45° Fahr. When placed in moist chambers such apples very soon decayed without wrinkling, becoming soft and watery. The decay was of a sharply defined nature, such that the affected parts could be easily removed. Normally these decayed apples were soon covered with green mold. On examining the stems of apples in storage it was found that many stems were green with spores. Cultures of this mold were made by the poured plate method. The fungus was believed to be *Penicillium expansum* Link., and was later identified as such by Mr. Charles Thom of the U. S. D. A., Bureau of Chemistry.

A search of the literature on apple decay was made, but no mention of the entrance of a decay-producing organism through the stem was noted. The decay of apples ordinarily caused by *P. expansum* is invariably mentioned in connection with abrasions of the skin, such as insect punctures, wounds or injuries of a mechanical nature. Some writers mentioned the infection as entering through the calyx or blossom end but no one noted stem end infection.

The matter was taken up with Mr. E. A. Siegler, assistant pathologist of the U. S. D. A., Bureau of Plant Industry; Mr. Charles Brooks, pathologist, and Dr. Charles Thom, mycologist, U. S. D. A., Bureau of Chemistry, none of whom had noted such a decay gaining access to the apple by way of the stem. In fact they doubted the possibility of any fungus traversing the dry stem of an apple. It is well proven that stem end rots occur in other fruits, for example, the stem-end rot of citrus caused by *Phomopsis* sp. and the stem-end rot of both citrus and watermelon caused by two species of *Diplodia*.

In the fall of 1921, large, mature Yellow Bellefleur apples were secured from trees in a Berkeley garden. These apples were picked with the fruit spurs attached, carefully washed in wood alcohol, mercuric chloride solution 1-1000 and distilled water consecutively. The leaves were clipped from the spurs to facilitate the work but the spurs were not removed. Moist chambers were sterilized, lined with filter paper, washed out with mercuric chloride solution, rinsed with distilled water, glass covers were prepared in the same manner. The spurs were then removed from each apple in turn and spores of *P. expansum* from sub-cultures made from the original isolation were planted on the freshly exposed surface at the ends of the apple stems, and the apples placed in the moist chambers. Control apples similarly treated but not inoculated were placed in jars prepared in the same manner and all were kept under the same conditions in the laboratory. Of the six apples treated in this manner, four developed the characteristic stem end rot and were soon completely decayed. The check apples kept in good condition for three months.

Yellow Newtown apples were picked in the same manner at Watsonville, California, and brought to Berkeley. On October 17, 1921, three of the ripest of these apples were treated and inoculated in the same manner as the Bellefleurs. On November 18 the decay of all three apples was identical with the decay observed on the fruits naturally infected. Six Yellow Newtown apples were treated in the same manner and inoculated with the same organism several days later than the previous group and they all developed the typical decay. In all cases the checks remained in good condition. At the end of six weeks, all the apples so inoculated were entirely decayed and covered with green spores.

Cultures of the spores appearing on the surface of the inoculated apples were made and appeared identical in every way with the original culture. Stab inoculations were made with these re-isolated cultures on apples also carefully sterilized. At the same time other apples were inoculated with the original culture. The results were identical, the typical Penicillium decay of apples resulting at every puncture. A penicillium isolated during the fall of 1921 from decaying prunes was found to cause typical decay of apples when inoculated into the flesh. This prune penicillium was planted on three Yellow Newtown apple stems and within three weeks it caused typical stem end decay of all three apples. This organism was later found to be identical in all of its reactions with the original penicillium isolated from apples.

Washings made from the attached leaves on some of the apples used in the experiments were plated and typical colonies of *P. expansum* appeared on all the plates so made. About 15 per cent. of the colonies which grew were identified as some species of Penicillium, a considerable number of which caused typical *P. expansum* decay when inoculated into mature apples. This would indicate the prevalence of the organism in the trees at the time of harvest.

These results prove that stem end infection of apples is a possibility. Observations by the writer indicate that this mode of infection is quite common among the apples of this state, especially in Yellow Newtowns. Though retarded in cold storage, the rot makes some progress at a temperature of 45° Fahr. and at room temperature the decay is rapid.

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AMERICAN PHYSIOLOGICAL SOCIETY

THIRTY-FOURTH ANNUAL MEETING

The thirty-fourth annual meeting of the American Physiological Society was held during the Christmas holidays under the patronage of Yale University, New Haven, Connecticut. Two scientific sessions daily were held December 28, 29 and 30. The meetings opened at 9:30, December 28, with a joint session of the societies of the Federation of American Societies for

Experimental Biology, under the chairmanship of J. J. R. Macleod of the physiologists. A vigorous program of reports on the scientific subjects announced below was carried out in the six half-day sessions.

The afternoon of December 29 a joint demonstration was held in the halls of the Osborne Zoological Laboratory. The demonstrations of the American Association of Anatomists occurred at the same time. This brought the two great groups of scientists of the pre-medical sciences together in what proved to be a very pleasing and outstanding demonstration of scientific progress for the year.

Three business sessions were carried forward at which the more important steps and decisions made were as follows:

1. The report of the treasurer, Dr. Joseph Erlanger, of Washington University School of Medicine, showed a net balance of $467.07.

2. The annual assessment was placed at one dollar per member.

3. An appropriation of $125 was made in aid of the English journal, *Physiological Abstracts.*

4. The council announced the appointment of J. Hepburn of the University of Toronto to the fellowship established at the last annual meeting under the grant of Dr. W. T. Porter. Dr. Hepburn is pursuing his research in the subject of 'The Reactions of the Respiration Center to Lack of Oxygen." This investigation is being carried out in the Laboratory of Physiology, University of Toronto, under the direction of Professor J. J. R. Macleod.

5. The society voted approval of the principles stated in the Cannon-Henderson resolution, instructing its officers of the executive committee of the federaiton to support the same.

6. The council announced the appointment of Donald R. Hooker of Baltimore as managing editor of the *American Journal of Physiology* for the year 1922.

7. The council recommended and the society voted the following changes in the rules governing the publication of *Physiological Reviews.* These changes affect the general management of the journal by reserving to the council the appointment of the chairman of the editorial board, and by transferring the appointment of the managing editor to the editorial board.

8. The report of the managing editor of the *American Journal of Physiology* to the council which was transmitted to the society showed a progressive recovery from the war time deficit in the issue of the successive volumes of the journal. At the present time the cost of publication per volume is only slightly greater than the income for the same. The net balance in the journal fund is $9,659.62.

The council announced that in order to overcome the delay in publication a free volume of the journal would be issued immediately, and beginning with the next current volume the size of the journal would be restored to the standard of 600 pages.

9. The first issue of the first volume of *Physiological Reviews* was announced together with the encouraging report that subscriptions had so far exceeded anticipation that reprinting of the first number had already been accomplished.

The following board of editors for *Physiological Reviews* for the year 1922 was reported by the council:

William H. Howell, Baltimore, *chairman;* J. J. R. Macleod, Toronto; D. R. Hooker, Baltimore; Reid Hunt, Boston; Frederic S. Lee, New York; L. B. Mendel, New Haven; H. Gideon Wells, Chicago.

10. The following officers of the society were elected at the business meeting on December 29:

J. J. R. Macleod, University of Toronto, *president;* C. W. Greene, University of Missouri, *secretary;* Joseph Erlanger, Washington University, *treasurer;* J. A. E. Eyster, University of Wisconsin, member of the council for the years 1922-25.

11. The following scientists were elected to membership during the session:

Edward Frederick Adolph, A.B., PhD., instructor in general physiology, University of Pittsburgh.

James Percy Baumberger, B.S., M.S., Sc.D., instructor in physiology, Leland Stanford Junior University.

Henry Cuthbert Bazett, M.A., M.D., F.R.C.S. (Eng.), professor of physiology, University of Pennsylvania.

G. E. Burget, B.S., Ph.D., professor of physiology, University of Oregon.

Mary Elizabeth Collett, A.B., A.M., Ph.D., instructor in physiology, University of Buffalo.

Helen Copeland Coombs, A.B., Ph.D., instructor in physiology, Columbia University.

D. J. Edwards, Ph.D., assistant professor of physiology, Cornell Medical College.

Carl Hartley Greene, A.B., Ph.D., M.D., assistant in medicine, Mayo Foundation.

Carl G. Hartman, A.B., A.M., Ph.D., professor of zoology, University of Texas.

Henry F. Helmholz, A.B., M.D., professor of pediatrics, Mayo Foundation.

Paul Dudley Lamson, A.B., M.D., associate professor of pharmacology, Johns Hopkins University.

Carl H. Lenhart, Ph.B., M.D., associate in surgery, Western Reserve University.

Clarence A. Mills, A.B., Ph.D., instructor in bio-chemistry, University of Cincinnati.

Stuart Mudd, B.S., A.M., M.D., fellow in medical research, Harvard Medical School.

Harry Sidney Newcomer, A.B., A.M., M.D., research assistant, Henry Phipps Institute.

Leonard B. Nice, Ph.D., professor of physiology, University of Oklahoma.

Stanley P. Reimann, M.D., assistant in experimental pathology, University of Pennsylvania.

Mrs. Mary Davis Schwartz Rose, A.B., Ph.D., associate professor of nutrition, Teachers College, Columbia University.

Clarence A. Smith, B.S., M.S., Ph.D., associate in physiological chemistry, Jefferson Medical College.

Joseph Treloar Wearn, B.S., M.D., instructor in pharmacology, University of Pennsylvania.

Russell M. Wilder, B.S., Ph.D., M.D., assistant professor of medicine, Mayo Foundation.

At the close of the last general session the appreciation of the society for the material facilities and social arrangements of the local committee was expressed in the following resolution:

The American Physiological Society wishes to express its sincere thanks to the Yale University and to the local committee for the splendid facilities offered for the scientific meetings, and for the cordial hospitality extended to members attending the meetings.

SCIENTIFIC SESSIONS

The scientific sessions of the annual meeting were of high merit throughout. Perhaps the most profitable feature of the meeting was the vigorous discussion which characterized a large majority of the subjects presented. Too many themes were introduced for the time available, thus crowding the program. It was evident that more restriction would have to be used if representative reports of the activities of American physiologists are to be discussed within the limit of a three days session. The entire list of titles reported at the meeting or announced in the printed program is as follows:

The effect of thyroidectomy on heat production following injury to the suprarenal cortex in rabbits: David Marine and Emil J. Baumann.

Metabolism studies with enemata of dextrose and levulose: Thorne M. Carpenter.

Reasons for believing that respiratory X is not Ch: Yandell Henderson.

Does the partial pressure of oxygen in arterial blood during progressive anoxemia support the secretary theory? C. W. Green and Carl H. Greene.

Determination of the acid base balance of the blood: Donald D. VanSlyke.

The acid base equilibrium in the blood after parathyroidectomy: D. Dwight Wilson and C. L. Krantz.

Carbon dioxide as an inhibitent of cell growth: G. H. A. Clowes and Homer W. Smith.

Injury, recovery and death. Lantern: W. J. V. Osterhout.

Elective localization of bacteria following various methods of inoculation and the production of nephritis by devitalization and infection of teeth in dogs: E. C. Rosenow and J. G. Meisser.

A new factor in drug analgesia: H. G. Barbour and D. S. Lewis.

On the physiological cause of evolution: Albert P. Mathews.

Integumentary changes in the sheep following thyroidectomy and administration of thyroxin: Sutherland Simpson.

The blood-flow and oxygen metabolism of the thyroid gland: F. P. Knowlton, M. S. Dooley and A. N. Curtiss.

Results on an enlarged thyroid gland nine years after obstructing the veins: C. C. Guthrie.

The after effects of prolonged fasting on the basal metabolic rate (man, dog): Margaret M. Kunde.

Studies on the relation between nutrition and ovulation: an invariable and characteristic disturbance of the œstrous cycle of the rat as a result *of fat vitamine. A deficiency which may nevertheless give normal growth:* Herbert N. Evans and Katherine Scott Bishop.

The oxygen capacity of bird's blood: Theodore Kruse.

The reflex control of the lower esophagus and cardia: A. J. Carlson, J. F. Pearcy and E. T. Boyd.

A comparison of the respiratory and circulatory effects of anoxemia and carbon dioxide: E. C. Schneider.

Effects of carbon dioxide on protoplasmic viscosity: M. H. Jacobs.

Water intoxication: L. G. Rowntree.

Blood volume changes in dogs following water deprivation: N. M. Keith.

Some factors modifying the ejection and filling curves of the ventricles under different circulatory conditions: C. J. Wiggers and L. N. Katz.

Physiological aspects of experiments on mitral regurgitation: H. Feil and C. J. Wiggers.

The thermocardiogram, and the relation of its waves to the events of muscle contractions: C. D. Snyder.

The specificity of gastrin and secretin: A. B. Luckhardt, S. C. Heine and W. L. Palmer.

The penetration of dyes into living cells: Marian Irwin and W. J. V. Osterhaut.

Electrical conductivity of animal tissues under normal and pathological conditions: George W. Crile, Helen H. Hosmer and Amy F. Rowland.

The relation of the ammonia content of the blood in Eck's-fistula dogs to meat poisoning: S. A. Matthews.

The hepatic factor in choloroform and phosphorus poisoning: C. S. Williamson.

The excretion of water, chlorides and urea by the human kidneys: E. F. Adolph.

The Glomerular circulation in the frog's kidney: A. N. Richards and Carl F. Schmidt.

Observations on the composition of glomerular urine: Joseph T. Wearn.

The inhibition of erection by decerebration: E. G. Martin and M. L. Tainter.

Changes in osmotic pressure in crabs during the molt-cycle: J. M. D. Olmsted and J. P. Baumberger.

The relative stimulating effect of light of different wave-lengths in an equal energy spectrum: Henry Laurens.

An experimental criticism of the pignet formula for physical efficiency: E. G. Martin, H. S. Wells and A. H. Beede.

The relation of the adrenals to fatigue: F. A. Hartman.

The calorigenic action of adrenalin in dogs: W. M. Boothby and I. Sandiford.

Hibernation: John Tait.

The effect of cocaine on growth of lupinus alba: a contribution to comparative pharmacology of animal and plant tissues: David I. Macht and Marguerite Livingston.

The production of CO_2 by the smooth muscle of sea-anemones: G. H. Parker.

The rôle of the sodium ions in the contraction of the isolated duodenal segment of the albino rat by sodium carbonate: F. S. Hammett and J. E. Nowrey, Jr.

The central heat regulating mechanism: H. G. Barbour and E. Tolstoi.

Physical fatigue and susceptibility—an experimental study: Reynold A. Spaeth and Ella Hutzler Oppenheimer.

The effect of some salts on the growth and experimental amœbocyte tissue near the iso-electric point and after addition of acid and alkali: Leo Loeb and K. C. Blanchard.

On the increased weight of spermatazoa in egg-secretion: O. C. Glaser.

The effects of Roentgen rays upon glandular activity. I. The submaxillary gland: A. C. Ivy, B. H. Orndoff and A. Jacoby.

The applicability of the gasometer method for the determination of the heat production in dogs with and without urethane: W. M. Boothby and F. C. Mann.

Relation between number of hours of sleep and muscular efficiency: Lillian M. Moore, Lu Marie Jenkins and J. Lucile Barker.

Variations in muscular efficiency in women: Lillian M. Moore and J. Lucile Barker.

The regulation of respiration: F. H. Scott, C. C. Gault and R. Kennedy.

The effect of pulmonary congestion in lung ventilation: Cecil K. Drinker, Francis W. Peabody and Hermann L. Blumgart.

Voluntary stimulation of the thoracic autonomic nervous system: N. B. Taylor.

Some relations of vagus and spinal afferent nerves in respiratory control: F. H. Pike and Helen C. Coombs.

Observations on cerebellar stimulations: F. R. Miller.

The possibility of the application to physiology of an inertialess method of observing currents of short duration: H. S. Gasser and J. Erlanger.

The electrical resistance and reactance of suspended unicellular organisms: S. C. Brooks.

Pseudo-paradoxical pupil-dilatation following afferent path lesions: Joseph Byrne.

The catalase content of normal and atrophied muscles: A. E. Guenther and S. Morgulis.

The mode of action of physical work, cold weather and cold baths in increasing the oxidative processes: W. E. Burge.

An experimental study on the significance of fertilization in spathidium spathula: L. L. Woodruff and Hope Spencer.

The relative alcohol content of blood and urine: W. R. Miles.

What are viscera? C. Judson Herrick.

A further study of the effect of total removal of the liver: F. C. Mann and T. B. Magath.

The beneficial influence of certain pancreatic extracts on pancreatic diabetes: J. J. R. Macleod, F. C. Banting and C. H. Best.

A comparison of normal cats and cats deprived of the greater part of the adrenals, with special reference to their reactions to morphine (hyperthermia, hyperglcemia) and to muscular exercise: G. N. Stewart and J. M. Rogoff.

The cardio-accelerator agent produced by hepatic stimulation: W. B. Cannon and F. R. Griffith.

Latent period in reciprocal innervation: J. M. D. Olmsted and W. P. Warner.

Physiological entities in inheritance and evolution: Ernest L. Scott.

DEMONSTRATIONS

A radial transmission sphygmograph with rigid support: C. J. Wiggers and W. R. Baker.

A model demonstrating the dynamics of mitral regurgitation: C. J. Wiggers and H. Feil.

The distribution of the vagus nerves to the sino-auricular junction of the mammalian heart, photographs and tracings: G. Bachman.

The glomerular circulation in the frog's kidney: A. N. Richards and Carl F. Schmidt.

NH_3 production in the nerve during passage of the nerve impulse: Shiro Tashiro.

A simple method of demonstrating glomerular and tubule secreting functions: E. G. Martin and G. D. Shafer.

A new type of recording spirometer: R. Burton-Opitz.

Liver, spleen and bone-marrow of rats treated with germanius dioxide: F. S. Hammett and J. E. Nowrey, Jr.

A two-wedge colorimeter for the comparison of solutions containing two colors, as in the colorimetric determination of the hydrion concentration: Victor C. Myers.

Some new apparatus: D. E. Jackson and J. V. Lawrence.

The effects of parathyroidectomy on the incisors of the albino rat: F. S. Hammett.

PAPERS READ BY TITLE

Vascular reaction to epinephrin in perfusates of various Ch. II. The portal systems of the terrapin: C. D. Snyder and Louis E. Martin.

Source of the water of hemodilution evoked by hot environments: H. G. Barbour, W. J. Craig and E. C. Wakeman.

A study of blood platelets: Theo. Kruse.

A study of alimentary glycemia curves in rabbits: Ernest L. Scott and T. H. Ford.

The contour of the pressure variations in the portal vein: D. D. Forward and H. Feil.

A study of fibrinogen following removal of the the liver: C. S. Williamson, F. J. Heck and F. C. Mann.

A comparison of the different methods of ablation of the liver: F. C. Mann and T. B. Magath.

The production of chronic liver insufficiency: F. C. Mann and T. B. Magath.

The effect of total removal of the liver in some lower vertebrates: T. B. Magath and F. C. Mann.

Smooth muscle responses when subjected to alcohols: F. M. Baldwin and B. M. Harrison.

Pulse rate and blood pressure responses of men to passive postural changes. II. Under low oxygen: Max M. Ellis.

The effect of prostatectomy on integration of muscular movements in the white rat: D. I. Macht and J. L. Ulrich.

The relation of parathyroid tetany to the intestinal flora: Lester R. Dragstedt.

The influence of a beri-beri diet upon the metabolic rate of the white rat: Addison Gulick.

The rôle of the vagi on gastric tonus and motility in the necturus: T. L. Patterson.

The hormone of the posterior lobe of the pituitary gland; its probable nature and its great physiological activity as compared with that of B-iminazolylethylamine: John J. Abel, Charles A. Rouiller and J. S. Vander Lingen.

NH_3 production during muscular contraction: Shiro Tashiro and Olive Pearl Lee.

Observations on the relation of endocrine disorder to early embryonic death in birds: Oscar Riddle and E. R. Rose.

The rôle of the change in hydrogen-ion concentration in the motor activities of the small intestine: Frederick S. Hammett.

Photo reaction currents of the optic nerve: W. T. Bovie.

Chas. W. Greene,
Secretary

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