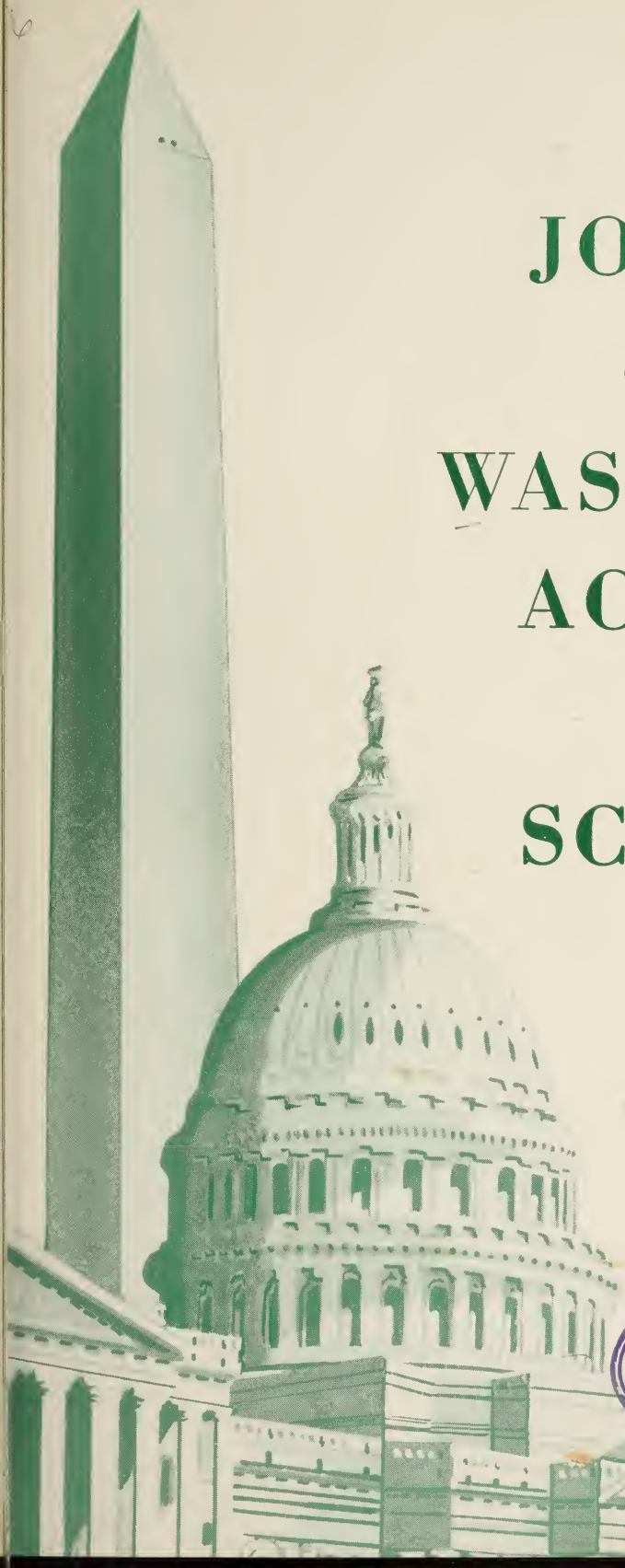

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The Journal for 1960

Frank L. Campbell

All members of the Washington Academy of Sciences would probably agree that its *Journal* should contain whatever the majority wants, within the bounds of financial and human feasibility. If the Board of Managers can be regarded as a fair sample of the membership, it is certain that the majority does not want the kind of *Journal* we have had in recent years, but we still do not know what the majority does want. It is also possible, but improbable, that the Board does not represent the opinions on the *Journal* of the membership as a whole. Because of these uncertainties the Board at its December meeting authorized a referendum on the question of the contents of the *Journal*. We must act now on the probability that changes in content are desired, but if the referendum shows that the majority wishes to support an archival *Journal* such as we have had, we can and will promptly revert to it. If it shows that the majority do not wish to support such a *Journal* but are not sure what they do want, then we should experiment with the contents of the *Journal* guided by comments we hope to receive from interested members. It will be much easier for members to offer suggestions after they have in hand something to criticize.

The new editorial group has only one conviction at this time; namely, that the *Journal* should serve in part as a medium of communication between the officers and members of the Academy, and between the Academy and its affiliated societies. But some members disagree even on this point. They fear that the use of the *Journal* as a medium of local communication may cause it to become essentially a house organ and submerge or extinguish its scholarly aspects. This feeling is prevalent not only among those who favor an archival *Journal* but among those who will not give up hope that the *Journal* could become a medium for the publication of papers reporting original research in both experimental and descriptive science. Experience shows, however, that such a hope is not realistic. Only a *Journal* having lavish financial resources for free and prompt publication could hope to draw all kinds of high-grade research articles away from specialized professional journals. We doubt that such a hope could be realized even under optimum conditions because experimental scientists have a strong desire to publish their most significant results in journals that are seen regularly by their own professional colleagues.

It seems to us that local communications in the *Journal* need not destroy its scholarly character. If the *Journal* can no longer be a factor in the publication of primary research, it should and can publish its share of papers concerned with the later processes in the growth of knowledge—what Paul Weiss calls the digestive and assimilative processes leading to the production of knowledge. Such papers may be called historical articles, critical reviews, critiques, etc., papers that bring together existing information and opinions and integrate them into the body of knowledge. Members of the Academy have ideas and opinions to publish in the *Journal* that will be of interest to scientists everywhere. We think such feature articles will take up much of the space in the *Journal*. They should be articles that every member of the Academy and other scientists can read with interest and with profit. Not all such articles will have permanent value, but they should give to the world examples of the synthetic writing of Washington scientists.

Some members contend seriously that there is no need for a *Journal* that can be read with interest. They argue that we already have more general publications

than we can read and that the Academy can make its best contribution to science by publishing an archival *Journal*. There is much to be said for this point of view. It is true that we all have too much to read. We guess that few scientists could state that they read every issue of *Science* from cover to cover, and yet we think most scientists like to feel they are paying for a periodical that may contain something they want very much to read, and when something extraordinary comes along, the word travels rapidly on the grapevine; for example, "Have you read in *Science* Warren Weaver's proposal on special committees?"

If the referendum indicates that our members want a *Journal* they can read if they wish, then we can go ahead toward producing a *Journal* that more and more of them will want to read. This first issue from the new editorial group is the best that could be done under present difficult circumstances. Subsequent issues should become progressively more comprehensive and interesting as the volunteer organization needed to produce such a *Journal* becomes experienced and effective. Please remember, however, that dues were not increased for 1960 and that we can spend this year, for the production of the *Journal*, only $4000, less than half as much as we did in 1959. Therefore, the *Journal* will be smaller than it was last year and the possibilitities for improvement will be restricted until greater support can be provided. We hope that you will be patient and tolerant as we move toward a *Journal* in which the Academy can take new pride.

Virchow's "Cellular Pathology" in the Framework of Biology and Medicine*

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This title is chosen because the centenary has brought the words "Cellular Pathology" to the attention of many. The topic at hand, however, is cellular physiology and cellular histology as well; it is cellular biology. The terms theory and doctrine also are used without intending to establish a standpoint a priori. Virchow himself liked the neutral term cellular principle.

When his lectures were published in the Fall of 1858 with the title "Die Cellularpathologie in ihrer Begruendung auf physiologische und pathologische Gewebelehre" the words "cellular" and "cell" had been used for more than a century. One is tempted to marvel at the prophetic vision of the poet when one reads Voltaire's question, written about 1755.[1] "In what corner of cellular tissue lies the genius of Homer and Virgil?" But, cellular tissue was in the 18th century what since 1834 has been called connective tissue, and it was supposed to contain the vital force. Blumenbach, the father of anthropology, saw in it the seat of the "nisus formativus", the tendency to create; for Caspar Friedrich Wolff, the pioneer of embryology, it harbored the "vis essentialis" the real life force. An analogous misunderstanding has made Lamarck a precursor of the cellular principle. The old meaning survives in the term "cellulitis" used for an inflammation in subcutaneous connective tissue.

* This article is based on a lecture given at the Armed Forces Institute of Pathology, on November 12, 1958, as part of the Institute's Virchow Centennial Program.

An 800 page American pathology book of 1845,[2] speaks about "cellular transformation", meaning transformation of another tissue into loose connective tissue, which the author calls "cellular tissue". The word "cell", as far as I can see, is mentioned only casually in the book.

When things seen under the microscope in sections of cork were called "cells" for the first time (Hooke, 1665) the name was given on account of the thick rectangular walls. It is a far cry from there to the still valid definition of a cell as "a lump of protoplasm with a nucleus".[3] We reckon the cellular era from the year 1839 when Theodor Schwann in Berlin published his "Microscopic Investigations on the Accordance in the Histological Structure and Growth of Plants and Animals". The thesis, implied in the title, that not only plants but animals also are composed of cells had been voiced before by several people more or less clearly but had failed to make an impression on the scientific world. Dutrochet in 1824 had declared the cell "the fundamental part" of the animal organism.[4] It is difficult to know how far his "cells" and those of other observers in the late 18th and early 19th century really were cells and not starch granules, droplets of some substance, or artifacts caused by the chromatic aberration of the lenses and the lack of condensers. The often used term "globules" makes one doubtful, and it might be wise not to accept "cells" as such unless they are unambiguously described or illustrated.

Johannes Mueller, the teacher and spiritual father of a whole group of men whose names are connected with the development of cellular ideas in Germany (Schleiden, Schwann, Virchow, Remak, Henle) recognized the cellular composition of tumors in 1838. Purkinje in Breslau, who was ahead of his time in several respects, had perhaps the clearest ideas about cells before Schwann. The good observations of Goodsir in Edinburgh were recognized by Virchow himself. (The second edition of the Lectures on Cellular Pathology is dedicated to Goodsir.) Virchow's publications begin to show his preoccupation with cells in 1847, in the first volume of his "Archiv", but at this time he still believed with Schwann and others that cells were formed in an amorphous substance, the "blastema". Later he shared Remak's [5] view that cell division is the only source of cell formation. Much about cells had been written by others, and much he had said himself in his lectures and written about them during his professorship in Wuerzburg (1849-1856). One can understand therefore that he was astonished about the success of the book, saying that it did not contain much that was new. He wanted to ascribe the effect to its easy style. As it appears today it was more the exhaustive, convincing presentation and the offer of a promising method.

The change caused by the "Cellular Pathology" was perhaps even greater in France than in Germany. Cruveilhier was professor of pathology in Paris until 1866. his atlas of gross pathology is unsurpassed in beauty but he did not use a microscope. One of his pupils [6] went to Berlin and studied under Virchow together with four Scandinavians. He transplanted modern pathology into France. As he said many years later, Virchow's teaching had been a revelation. pathological anatomy became alive, it became connected with physiology. The difference between medical teaching before the "Cellular Pathology" and afterwards was perhaps greatest in Russia. The influence on pathology in England was characterized as replacement "by orderly arranged and objective facts of what was before a tangled wilderness of old superstitions and modern disconnected observations". Similar opinions were voiced at the celebration of Virchow's 80th birthday "from Archangelsk to Cadiz", not to forget Japan, and the United States.

William Osler, with his historically trained mind, realized that such a revolution in medicine could not be ascribed to one man, that the "Zeitgeist" worked like a leaven. "But", he continued, "no physician of our time has done more to promote the change, or by his individual efforts to win his generation to accept it

than Virchow". The cellular theory stimulated people to make use of the improved microscope. As long as a man believed that alterations of body fluids or disturbances in innervation were the essential factors in disease he could not expect to learn much about disease by looking into the microscope. But when he expected to find meaningful alterations of cells then he had reason enough for using this lately improved gadget.

The English translation of the cellular pathology [7] appeared in 1860, and within a few years, seven American editions were sold out, in spite of the fact that pathological anatomy always has been a stepchild in the United States. Before 1865, that means in the years when Virchow's interests were essentially in pathology, American students went to England and France rather than to Germany, thus Virchow had no important direct American pupil. Welch, the nestor of American pathology, worked under Virchow's pupil Cohnheim, whose experiments had laid the foundation for modern concepts of inflammation. In Welch's laboratory at Johns Hopkins Hospital, Virchow's postulate of combining morphology and experimental pathology was fulfilled to a degree but it is tempting to speculate how American pathology might have developed if Welch had worked in Virchow's institute. The unprecedented impact of Virchow's publication—Welch said it was the greatest advance ever made by scientific medicine—must have had several causes. One of them might have been that it offered a striking fact of which people were not, or not sufficiently aware, namely the cellular composition of the body, and at the same time a unifying principle. People suddenly were made to realize that the human body was composed of cells like any other organism, and that human diseases were disturbances in the life processes of these cells. In the middle of the nineteenth century, the human being was to most people something apart from the rest of creation, and diseases were entities apart from the body. The new teaching thus catered to man's desire for unified concepts.

Important progress in medicine is generally attributed to technical inventions, and impulses given by changes in theoretical concepts are overlooked. The transition of tumor surgery from knife shyness to optimistic activity in the later decades of the nineteenth century was undoubtedly caused by the emergence of anesthesia, antisepsis and asepsis. But about at the same time, cancer became a local disease in the minds of physicians while it had been a constitutional one before. And what is the use of performing a local operation for a constitutional ailment?

The much discussed topic of the precursors to Virchow and the cellular doctrine may be dealt with by quoting what Sir Gavin de Beer recently has written about Darwin: "For various reasons, including imperfect formulation of the problem and insufficiency of evidence, none of these precursors was able to compel attention, let alone adherence, to these views; and it is because of the completeness of his demonstration . . . that the world owes its debt to Darwin".[8] Claude Bernard and internal secretion furnish another parallel. The idea of internal secretion existed in the mind of Albrecht von Haller, almost a century before Bernard's publications; several people voiced similar opinions, and in 1849 A. Berthold reported a successful substitution experiment by implantation of testicle into a castrated rooster.[9] None of these workers gave internal secretion to the scientific world, but Claude Bernard did. There are more points of comparison, in spite of the fact that the "Cellular Pathology" did not shake mankind as the "Origin of Species" did. Both represent the synopsis of painstakingly accumulated observations, many of which were made after the general idea had been conceived. Both ran counter to feelings that had been dear to man since time immemorial: Darwin offended the idea of man's exalted position in nature. Virchow hurt the human individual's proud feeling of being a truly indivisible entity. As Virchow

said, all plant physiology was based on the cellular principle, and the reluctance of people to introduce the concept into animal physiology was based only on esthetic and moral objections. Darwin as well as Virchow may have had a deep-seated personal feeling for their theories. Darwin [8] in his notebook from the Galapagos Islands (1835) calls animals "our fellow brethren in pain, disease, death, suffering and famine, our slaves in the most laborious works, our companions in our amusements," and he continues "they may partake of our origin in one common ancestor—we may be all melted together." His just conceived theory obviously agreed with his love of animals. And through Virchow's whole life, there goes the idea of true democracy in which every individual feels as a participant in a harmonious whole, namely the state. He often talked about the "Zellenstaat", he called the body "a free state of single beings with equal rights," and continued, "they keep together because the single parts are dependent upon each other." A few years later, he used the term federation to designate the relation of the cells to the body as a whole. His antimonarchial, democratic heart made him overdo such comparisons; he loved them. When we read what he said in parliament (1867) about decentralizing the administration of the state . . . "the administration to be based on the freedom of the communities . . . the constitutional life built from below . . ." [10] then we almost expect to find something about cells in the next line.

When we draw etiological conclusions from histological pictures, we remember that the patterns in which a tissue can react may be few, and that diverse causative factors may result in one and the same picture. This is well exemplified in dermatology. But one should not forget that the number of ideas a rational human being is prone to conceive about a group of phenomena is restricted also, and that identical or closely related ideas spring up independently in different minds. Most of us enjoy having the good idea and let it go at that, genius, however, puts it to work. This historical reasoning applies to some of Virchow's ideas which can be found in various writings of the German Romantic period, and I hesitate to assume from this a philosophical underpinning of Virchow's theories. We know that he liked to read Aristotle but it would be difficult to prove that his idea of the cell state stems from Aristotle's concept of the body as a well-governed commonwealth, neither do I know whether he ever read Kant's "Critique of Judgment" in which a similar comparison is made.

The history of cellular doctrine through the century of its existence is in no small measure a comedy of errors or misunderstandings. Virchow insisted that he had based everything on observation, and that criticism could come from observations only. Others maintain that his work had its basis in philosophical ideas of the Romantic school. Virchow saw the main merit of his work in abolishing systems and speculation, but Ricker called the cellular pathology anthropomorphistic nature philosophy.[11]

An impressive almost incomprehensible foreshadowing of cellular theory may be seen in the words of Goethe,[12] who was a biologist in his own sublime way. "Every living thing is not a single thing but is a plurality. Even when it appears to us as an individual it still remains an assembly of independent living beings, that are equal according to the idea, to the anlage, while in fact they may appear equal or similar, unequal or dissimilar . . . The more imperfect a being is, the more equal or similar are these parts and the more they resemble the whole. The more perfect the being becomes, the more dissimilar will the parts be. The subordination of the parts indicates a perfect being." And he was conscious of both the analytic and synthetic standpoint when he wrote to Alexander von Humboldt: "Your observations start from the element, mine from the gestalt."

Virchow was proud that his doctrine was purely scientific, not burdened with a system of therapeutics as the old "schools"

were. But Klebs, Virchow's brilliant, rebellious pupil said that cellular pathology could not amount to much since it had not even created new therapeutics. Virchow insisted from the beginning that it is not so much the morphology but the life of the cell that counts: nevertheless cellular pathology, even today, evokes in some people the idea of one-sided, "dead" morphology.

The history of cellular doctrine in the framework of biology can be studied by considering the standpoint of those who oppose it for scientific reasons or otherwise. Virchow's pupil Cohnheim, who by his famous experiment proved that leucocytes migrate through the capillary walls, has been considered an opponent of cellular theory by the medical historian Baas and by others. In reality Cohnheim only refuted Virchow's erroneous ideas that the blood vascular system is entirely closed and that all pus cells are formed in loco, but he was not opposed to cellular theory. In his lectures on general pathology, he calls the cells "living beings with a metabolism . . . which certainly is a very active one in many of them." Thus I rather agree with Cameron that Cohnheim's experiment gave a new impetus to cellular pathology. It showed cells, namely the leucocytes, in action, while they are not in contact with other tissues.

The most vigorous attack upon cellular pathology was made by Gustav Ricker in 1924. He wanted to replace it by "relation pathology." He denied that the cell has any life by itself in health or disease, he did not believe that the cell has a choice in taking substances out of the surrounding blood. Virchow's idea that the cell has the faculties of function, nutrition and proliferation appeared metaphysical to him and an obstacle to clear, scientific causal thinking. The cell, he said, cannot be looked at in any way as separate from its relation to the central nervous system and to the blood. He denied even the anatomical concept of the cell, pointing to syncytial formations like the myocardium, the fetal part of the placenta or the skin epithelium with its intercellular fibres. The functions and diseases of the body, Ricker concluded, after decades of purposeful animal experimentation, are located in the central nervous system. It governs everything by means of the nerves that accompany all blood vessels, even the smallest ones, and that form delicate networks around and in the cells. The cell does nothing, according to Ricker, things are done to it. A statement made by Virchow in 1855 represents a powerful argument against Ricker's theory. He wrote that an entirely general innervation of the parts is not sufficient for explaining "the many special happenings in the course of nutrition and formation." The restriction of special happenings to structures as small as cells could be explained only by isolated and qualitatively different effects exerted by the same nerve. And this, Virchow continues, "is contrary to all available experiences." [13] Unless I am mistaken the second part of this argument still holds while the first one has been superseded by the discovery of nerve endings in many cells. What happens in the organs, rest and function, anabolism and catabolism follows, according to Ricker, a definite law, his "Stufengesetz." Constriction and dilatation of vessels, which are regulated by the central nervous system through the vasomotor nerves, are the essential factors. Morphological findings and localization in the sense of Morgagni, Rokitansky and Virchow are not of primary importance, according to Ricker they are only one item in diagnosis. The whole body is the seat of disease. In Ricker's opinion, Virchow's anatomical thinking has been proved infertile by the history of medicine. Form is to Ricker no scientific reality but a concept of reflexion that can induce only philosophical thoughts without heuristic value. (To avoid misunderstandings, it might be inserted here that Ricker considered Virchow's merits immortal). Similar thoughts have been brought forward in 1934 by Speransky,[14] a pupil of Pavlov. He believed that he could produce most known pathological lesions by local freezing of cerebral cortex, by withdrawing and

Rudolf Virchow in the late 1850's

reinjecting spinal fluid repeatedly, or by squeezing the hypothalamus into a glass ring. He acknowledged the achievements of cellular pathology in systematizing pathological processes morphologically but he doubted its value for constructing a dynamic theory. Not only Virchow's ideas but also the medicine of Pasteur and Ehrlich was approaching exhaustion in Speransky's opinion, and could not cope with the contradictions that have arisen. Speransky's book makes fascinating reading and has influenced some people, notably in Germany, to a degree designated as "Speransky psychosis" by others. Attempts at repeating his experiments however, were successful only when the dogs were infected with leptospira.[15] Ricker had, and still has, followers, but more and more people declare themselves unable to confirm his "Stufengesetz" which is supposed to regulate the bloodstream after an irritation has taken place. And it has been shown long ago that nerveless tissue of vertebrates can react to a stimulus.[16] I agree with those who think that Ricker's work is mainly of historical interest today, and few people, I trust, will share the opinion of Claudius Mayer that Ricker's ideas will become as important for the future development of medical research as was Virchow's cellular theory for the second half of the 19th century.[17]

Theories and doctrines are essentially a matter of emphasis. Ricker, the most important enemy of cellular pathology, knew everything that was to be known about cells but he stressed the dominating influence of vascular innervation. In the same way, Virchow knew that the organs are subject to changes in blood supply, and are innervated, though the finest nerve endings were not known in his time but he minimized that because he was so enraptured by the cells. Nobody denies that Virchow sometimes exaggerated in this respect, but one could quote numbers of his utterances that show appreciation of the body as a whole. And Ricker's theory neglects the many life phenomena of organs and cells that are separated from their nerves and from their normal blood supply. Even the complex Goldblatt phenomenon, the rise in blood pressure after reduction of arterial flow to one kidney, can be produced when the kidney first is transplanted to the neck, which entails a drastic disturbance of perivascular nerves. In all such discussions, we forget too easily that plants function as organic units without having a nervous system. Opponents of cellular theory who stress the nerve conditioned totality of the metazoan body often refer to Pavlov. A survey of Pavlov's writings, however, does not indicate that he was opposed to cellular theory. He used expressions like "the struggle for existence among the cellular elements," he calls the cell "a whole organism, if a small one;" he talks about disturbance in cerebral cells as cause of the behavior of an animal; he lets cells have "capacity for work," mentions "relaxation of nerve cells" and "weakened irritability of gastric cells."[18] Speransky's ideas had been accepted in Russia for a while but have been repudiated lately.

The teaching of pathology, histology and embryology at medical schools has not

been significantly influenced by the objections raised against cellular doctrine. Numbers of recent textbooks, English, French or German, teach according to cellular doctrine, mentioning the theory or simply taking it for granted. E. R. Long in his history of pathology wrote in 1928: "We are all cellular pathologists today, taking our post Virchowian cellular sense for granted." [19] A recent French textbook of zoology and a German text on botany also stress cellular structure, almost unreservedly as did the botanist Kuester in a historical survey of the problem in 1938.[20] Such an attitude must be expected because histology and pathology can neither be practised nor taught from the holistic standpoint, no matter how much one might be enamoured of it philosophically or esthetically. Horst Oertel, in his General Pathology (1921) emphasized the interrelations of cells whose disturbance by a local process might be of more consequence than the local process itself, and that means disease of the whole organism.[21] The holistic totality aspect and the atomistic (cellular) one are the two horns of a dilemma out of which there is no escape for the pathologist or any other biologist. The poet-biologist Goethe has worded it succinctly, in 1832, a few weeks before his death: [22] "Thus one is driven from the whole to the detail and from the detail to the whole whether one wants to or not." If we stress the heuristic standpoint, we can say that to consider the whole body as the main object of investigation means replacing one riddle by another one; but the man who is essentially interested in the patterns of nature will strive again and again to comprehend the totality of the organism without getting lost in too much detail. An author who with a subtle logical distinction, expresses doubt whether pathology of the cell really means "cellular pathology" declares in the same paper that the cellular doctrine is, today more than ever, one of our secure possessions.[23] He even thinks that Virchow's much attacked cellular ideas about inflammation have more of a future than the accepted vascular concept of inflammation as established by Cohnheim. A philosophically minded pathologist, wrote in 1928 that pathology is not pure cellular pathology anymore, which does not mean that it is wrong, but that pathology has unending variations and thus cannot be deduced from one single principle. Roessle, the third successor in Virchow's chair, characterized Virchow's concept of the body as "a state of autonomous, widely independent cells," and formulated his own as "non autonomous single cells cooperating with each other and with blood and the nervous system." I feel that Roessle in this exaggerated Virchow's emphasis of the independence of the cell, but what with the multitude and variety of Virchow's statements, this remains a matter of personal taste. Many authors have an ambivalent attitude towards the cell concept because on the one hand they see the cells, their role in physiology and pathology, and work with them all the time; but on the other hand they see the body as a whole and are unwilling to give up its individuality. An example for this is furnised in a modern English textbook of pathology.[24] It regards the cell as the ultimate unit of structure and function however complex the tissue or organ may be. But, it continues, "it is more profitable to regard the organism as the individual, . . . and the cells not as units of which it is built up, but rather as parts into which it is divided in order to provide for the necessary division of labor. (Adami [25] expressed the same standpoint in 1910). The conception of the cell thus remains, but no longer requires or is capable of the strict definition that was needed when the word was supposed to represent a fundamental biological entity." One should note the words "in order to provide," in the second half of the statement. This is teleology and shows the danger inherent in the biological totality concept. When the authors say "it is more profitable to regard the organism as the individual," I agree with them from the psychological standpoint but I have doubts from the standpoint of biological methodology. Hueck, whose studies of the

mesenchyme have played an important role in the discussions about the cellular doctrine, considers the totality concept as absolutely necessary but, he too adds that we can study only the parts.[26] The titles of publications are revealing. The first volume of the handbook of microscopic anatomy (Moellendorf) which appeared in 1929 bears the title: "Living Matter", thus referring collectively to the substance of the organism and ignoring the cell, while the corresponding volume of the handbook of general pathology in 1955 is titled: "The Cytoplasm," which means the stuff cells are made of.

Our tendency toward accepting one opinion and condemning the opposed one smacks of man's primitive fighting instinct, and he who objects to a theory is prone to exaggerate it because that makes it vulnerable. Opponents of the cellular doctrine have invested it with a primitively additive character neither Virchow nor his followers had seriously in mind. Thus we read in a modern textbook of histology: "Every cell of the human body, according to Virchow, is a kind of homunculus, and the combined efforts of these well specialized microhumans shall result in the preposterous cell state that represents the organism." [27]

This book leaves out the word "cell" in its definition of tissue; it uses the words "elementary parts" and "masses." The author tells us that "function can be conceived only dependent upon the undefinable totality of the organism." Since this gives us no hope of understanding this totality why not stick to less hopeless problems, reserving the totality concept for fields in which we can use it, or for a remote future? At the other end of the line we have the statement made by a zoologist in 1957: "The living part of nature is an atomized system; its atoms are the cells." [28]

The period of rising bacteriology and immunology brought many attacks on cellular pathology which were mainly based on lack of knowledge in both fields. A French author wrote in 1885: "Cellular pathology has lived. Down with the cells." The ideas of sera, of circulating antibodies brought a resurgence of some kind of "humoral pathology." Deeper insight, furthered by Paul Ehrlich's work, showed how such substances are manufactured by cells, and today we see no contradiction between immunology and the cellular doctrine.

Internal secretion, in health and disease, has been considered as an expression of the total organism and as contradicting the cellular concept. But since we know that giantism, acromegaly, and other endocrine disorders are caused by alterations of hormones, and since the hormones are produced by cells, sometimes by relatively few cells, the phenomena of internal secretion might be marshalled as well in favor of cellular doctrine as against it.

While cellular doctrine was under heavy attack the science of the cell was started and grew. The term cytology seems to have been used first in England about 1885; a magazine "La Cellule" was founded in Belgium in 1884; Verworn [29] wrote his much maligned book on general physiology in 1895. Today we have an imposing monograph, Cameron's "The Pathology of the Cell" (which in spite of its title contains much criticism of cellular doctrine), in the same year Caspersson [30] published his "Cell Growth and Cell Function." And what would Virchow say if he could see the title "The Mammalian Cell as an Independent Organism?" [21]

The way tissues are formed by cells suggests that the cells are morphological and functional units. The existence of syncytia, continuous masses of protoplasm with many nuclei, seemed to contradict the universal applicability of this statement. Opponents of cellular theory have written much about these structures,[32] but without agreeing among themselves, and in the opinion of some, including myself, not with convincing power. Structures with two or more nuclei had been seen in 1802 long before the true cellular era [33] and purley syncytical organisms, mycetozoa, were described in 1860 (see Baker). But, to my knowledge, no highly complex plant or animal is entirely or even essentially composed of syncytia. A crustacean

(Peroderma) has been mentioned as having no cellular structure, but this is a parasitic animal, and its lack of cellular organization is a secondary adaptation to parasitic life. Related species consist of cells, as other crustaceans do, and we can reasonably assume that the free living ancestors of Peroderma were cellular, not syncytial.

The absence of visible cell boundaries apart from the fact that our optical methods may be at fault does not necessarily indicate absence of functional boundaries. The botanist Sachs, in 1893, postulated smaller functional units in syncytia, each dominated by a nucleus, he called them "energids." This concept, which has not gained much recognition, appears plausible when nuclei are evenly distributed; it is convincingly demonstrated when two flagella are found near each nucleus. The idea that syncytial structure prevails in the metazoan body has led to describing the body as "a lump of living matter." [32] Others stress especially the syncytial nature of the mesenchyme (Hueck). The continuous character of connective tissue had impressed Virchow himself. He wrote in 1862: "The body appears composed of a more or less continuous mass of connective tissue like parts, as Reichert has pointed out." [34] The decision whether to call something a group of cells or a syncytium is sometimes an arbitrary one because cells which have distinct outlines are often connected by bridges or fibrils. Every medical student learns about the intercellular bridges of the skin epithelium. But it is more than doubtful if these fibers are biochemical pathways at all and actually make a syncytium out of the skin epithelium. Our daily experience as pathologists speaks against it since we see severely altered single epidermal cells surrounded by normal ones or near normal ones. Schultze, who in 1861 defined the cell as a lump of protoplasm with a nucleus, denied that even broader connections interfered with the individuality of cell life.[8, 33] The fibrils which seem to connect the epithelial cells of the skin may well have a mechanical function. It is noteworthy that these so-called intercellular bridges do not seem to interfere with the isolating of cells by microdissection. The concept of the cell certainly is not abolished by the existence of connections,[35] and syncytial structures are the exception in the essentially cellular metazoan organism. But anticellular considerations based on the textbook concept of syncytial structures begin to be only of historical interest. Electron microscopy has shown cell boundaries in most so-called syncytia, first in the neurons, the very embodiment of continuity, then in neuroglia, and lately also in heart muscle, skeletal muscle, nervous endplates, myoepithelium of glands, and squamous epithelium. This marks, "the beginning twilight for syncytial theories in which the lode star of cellular doctrine shines more brilliantly than ever." [36] Oskar Hertwig has called the cell "one step in the organization." With the progressive disappearance of syncytia, this step gains in importance.

The supposed active and decisive role of noncellular mesenchymal ground substance in the genesis of collagen diseases did not agree with cellular theory. But the factor that characterizes the classical collagen disease Lupus erythematosus disseminatus (the L. E. factor) seems to counteract an enzyme which normally inhibits depolymerization of nucleoproteins. This enzyme (desoxyribose nuclease inactivator) is found in cells, and provided these relatively recent findings will stand the test of time, the cellular doctrine will be vindicated once more. A similar situation exists concerning the formation of collagen fibrils. They can be formed in a solution of collagen molecules without the help of cells. But the collagen molecules in turn have been secreted by cells.[37] This knowledge, arrived at by our most modern techniques, was theoretically anticipated long ago. Adami wrote in 1910 "we can well admit, with Virchow, that the cells discharge living molecules of the order of enzymes which act upon and modify the surrounding matrix." At least two other supposedly cell free structures have been believed to be "living:"

The vitreous of the eye forms hyaluronic acid but as has been shown recently cells are numerous in its outer layers.[38] The second example is more striking. In fishes and in other animals, a long filament, which appears structureless on ordinary microscopic examination, extends from the brain deep down into the central canal of the spinal cord; it is called Reissner's fibre, its function is unknown. Older literature stated that the distal portion of this fibre could regenerate itself after transverse cutting, and this distal portion is not in contact with cells while the proximal is. Recent work however does not confirm this; the peripheral portion disappears after transection, and secreted material accumulates cephalad to the cut.[39] No metabolism that is independent of cells has been demonstrated to my knowledge. Johannes Mueller wrote in 1838 about the cellular composition of tumors, a year before Schwann's studies appeared, and since that time the tumor cell has been the center of onocology. The aggressive cancer cell evokes the image of an animal more vividly than the normal tissue cell does. Uncounted work hours have been spent in anatomical, physiological, and chemical laboratories with attempts at determining its characteristics. The practical diagnosis of malignancy in the hospital laboratory, however, has been based not so much on the characteristics of the single tumor cell as on the structures formed by tumor cells and their behavior toward the adjoining normal tissue. in short, it is more structural than cellular. Only in the last decades, following the work of Papanicolaou, has cytological tumor diagnosis gained momentum, and exfoliative cytology has become a recognized branch of clinical pathology. Combined with the hoped for progress in histochemistry this may develop into an important diagnostic method based on the characteristics of single cells. The failure of all the ingenious methods devised for a humoral diagnosis of cancer might be referred to in this connection. Developing in a time when cellular pathology was vigorously attacked, exfoliative cytology has, wittingly or not, furnished a prop for it.

Theoretical cytology is expanding rapidly, urged on by modern methods, and even the time hallowed, often belittled routine procedure of studying the paraffin section has added something to the biological importance of the cell, namely the sex chromatin. The single cell that bears the hallmark of as decisive a general body character as sex is, may claim a higher dignity than that of a brick in the building.

The cell is the only component of the metazoan body that also exists as an independent, motile organism, namely the protozoon. Neither organs nor tissues, nor any postulated units have a free living animal as counterpart, and the few existing syncytial organisms are poorly differentiated ones like the myxomycetes. This may be the strongest claim the cell has for being called "elementary organism," a title conveyed upon it not by an anatomist, but by the physiologist Bruecke in 1861. Another physiologist, Max Verworn, declared it inadmissible in 1895 to call a structure an elementary unit unless we knew about an analogous free living organism.[29, 8] The unicellular character of many protozoa is evident beyond doubt, and while complicated organelles and skeletal structures give others an organismic habitus they still remain a mass of protoplasm with a nucleus, and thus a cell. The cellular nature of bacteria has been proved, and viruses as well as bacteriophages, which are not cellular, are not free living organisms either.

The converse question namely how far the cells of the metazoan body have the nature of living organisms is much more difficult because their variety is so great and because "life" and "living organism" are ill defined concepts. Something halfway between the two problems may be seen in the behaviour of the cells of certain sponges, primitive sessile metazoa. When separated by squeezing the sponge through a porous cloth, they swim around with ameboid motion and sometimes reunite to form another sponge. This remarkable

sponge experiment did not create much of a stir perhaps because sponges are such lowly creatures. But, as has been shown recently, even mammalian embryonic kidney cells, when carefully separated, can reassemble and be organized into typical kidney structures.[57] This almost exemplifies what Oken wrote in 1805, "Organisms are a synthesis of infusoria." A generation later, Schwann went to the core of the problem when he wrote that each metazoan cell could lead an independent life if the relations it bore to its new surroundings were but similar to those in which it stands in the organism.[40]

In dealing with this problem, namely the autonomy of the cell, we must differentiate between the potential autonomy and the actual one. The former can be proved by single cell culture, e.g., but the latter is beyond accurate proof. I cannot imagine a method for proving autonomous behaviour of a cell while it is in its normal place within the metazoan organism. This is a kind of Heisenberg situation. Virchow, while repeatedly referring to the importance of neural and vascular influences, stressed the individual reaction of the cell very much, sometimes in an exaggerated way. Ricker, who believed that all reactions in the body are regulated by vasomotor nerves, denied any reactivity of single cells. Many opinions between these extremes have been voiced, and no general answer can be expected when we compare the dependent status of a ganglion cell with the relative freedom a leucocyte. During phagocytosis the leucocyte must breach its cell membrane and reestablish it after having engulfed the foreign particle, and it accomplishes this tricky physicochemical feat without being in contact with other tissue not to mention a nerve.

The power of locomotion is one of the criteria of life, but it stands to reason that metazoan cells, caught as they are in the tissues, cannot move around much. Leucocytes move; the term "wandering cells" speaks for itself; each type of myeloid cell has is own characteristic style of ameboid motion, and so has the lymphocyte. Motility of tumor cells has been observed long ago, and migration of nontumorous mammalian cells occurs in the pituitary gland of man, where basophile cells of the intermediate zone are seen singly invading the posterior lobe. I have little doubt that these cells are actually migrating.

As said before, one must differentiate between the actual and the potential motility of the cell. The latter must be widespread since all cell types in tissue cultures exhibit ameboid motion.[41]

The double nature of metazoan cells manifests itself in the tissue culture. Mammalian cells, isolated by trypsination, can be grown in serum free media.[42] They move around, more or less in the fashion of amoebae, single cells can be observed in the motion picture eating their way through the medium. Even ganglion cells move. Single cells break off their contact with the others, especially before dividing, and they rejoin the others. Cells do not only adhere to each other by stickiness, but form protoplasmatic connections through which material, pigment, e.g. has been seen carried from one cell to the other. Stimuli also are transmitted from cell to cell since waves of ciliary movement run along a row of cells and can be interrupted by injuring one cell. [41] The growth curve of a single cell in tissue culture turned out to be a counterpart of that of a bacterium. Mutant strains of such cells "have been identified, isolated and established as standard stocks." Some mutant characteristics have remained stable after more than 200 generations, corresponding to stable mutations of microorganisms. These astounding similarities between the metazoan cell and the free living unicellular organism justify the designation of the body cell as a unit of life. Virchow and the men who shared his opinions could hardly know how right they were in many respects.

The dominance of morphological studies under the influence of Virchow and his school has misled people into identifying

the cellular doctrine with a one sided morphological attitude that neglects functional, physiological aspects. Virchow's numerous statements to the contrary have been quoted so often that I am reluctant to repeat them. May I just point to his one dictum that "pathological physiology is the main fortress of medicine while the pathological anatomy and the clinic are outlying bastions".[43] He postulated in his early years, and in 1900, that pathology should be pathological physiology. Young Virchow's first great scientific accomplishment was experimental, namely the demonstration of embolism (he coined the term).

But the fact remains that he and his pupils worked mainly in tissue pathology. People who complain about this and lay it at the door of cellular theory do not realize that this morphological work created the basis for later physiological studies. Furthermore, no methods were available at the time for cellular physiology, and physiology did not furnish ideas for cellular study. The anatomist Fleming,[44] who did classical work on cells and cell division, stated in 1882 that cell problems mostly belonged to the field of physiology, especially physiological chemistry. "But," he continued, "both seem hesitant to direct their action into a truly microscopic area." And as late as 1900 Eugen Albrecht, who was a man of vision, was pessimistic about a future cellular physiology. Modern techniques have made it possible.

The terms cytochemistry and biochemical cytology refute the idea that the cellular concept is necessarily a morphological one. These disciplines remedy the antiquated situation in which biochemistry did not apply the localization principle, be it Morgagni type according to organs or Virchow type according to cells, and they bring the cellular aspect once more into the foreground of medical science. Clinical blood chemistry, notwithstanding its practical usefulness, is like touring a state in a low flying airplane and counting the number of freight cars that are loaded with coal. That will not tell us how much coal is burning in furnaces, lying in covered sheds or still underground, and this may be more important than the amount in transit. Pflueger's proof that metabolism takes place in the tissues and not in the blood was the real death blow for humoral pathology. A recent paper, "The cellular principle in today's biochemistry,"[45] describes the chemical accomplishments of the cell in detail, how it transports glucose and aminoacids even against the concentration gradient, how it keeps sodium out of the cell, and how the membranes which surround the nucleus and the mitochondria function in similar ways. It concludes that modern biochemical knowledge shows the correctness of the cellular principle.

The functional completeness of the single cell decreases with evolution, it is best preserved in the sex cell. But many mammalian cells do have a specific metabolism which represents a functional separateness perhaps inherited from a chemical mutation in a single cell, and how shall one interpret the different phases of secretion in neighbouring glandular cells if not by individual differences in reactivity?

The division of matter from energy having disappeared, it has become meaningless to separate form from function. If we elaborate Karl Ernst von Baer's delightful idea of having our life extremely compressed in time or extremely stretched, and imagine an exaggerated slow motion picture of a living cell at a magnification that shows the molecules, then substance and function will be one, and histology will be identical with cytochemistry. A hundred years ago, Virchow said that the basis for the normal and pathological life of the cell was to be found for the time being in histology, in the finest anatomy. Morphology to him was the way to physiology, and pathology as well as biology have travelled this road a good distance in the last century. Thus it does not sound too paradoxical any more when we say that biochemistry is micro-micro-anatomy, that in the ever flowing stream of a living system, a histological aspect and a functional phase are identical, or that "the anatomy of an organism is the greatly magnified expression of its chemistry.[46]

Life processes, like everything else, take place in a space-time configuration.

It is an ever returning wish to make biology or one of its branches like pathology into an exact science. This was Virchow's dream, and he went a long way in the right direction. Almost 70 years after the publication of the "Lectures on Cellular Pathology," Ricker, this sharp opponent of Virchow, gave his book the title "Pathology as Natural Science," [11] and in 1950, V. Bertalanffy closed his paper on "Open Systems in Physics and Biology" by expressing the hope that this will "pave the way for biology to become an exact science." [47] Finally in 1955, the anatomist Zeiger wrote that it does not appear impossible anymore to resolve cytology into physics and chemistry.[35] The cellular doctrine opened the way to this desired goal.

Science often has been thwarted by ecclesiastical or political interference, and the cellular doctrine has not been spared. An Austrian book from the National-Socialist era lets the "crazy idea" of cellular pathology originate in the brain of a French Jacobine (meaning Raspail), and Virchow, it says, succeeded by a coup overnight in introducing it, because Germany, at the time, was infected with liberalistic, materialistic ideas.[48] Conversely we learn from a paper, which appeared in Warsaw in 1950, that cellular theory is built on idealism and reactionary metaphysics, and that its vestiges must be eradicated.[49] In the same year, a new "dialectic-materialistic" cell theory by Lepeshinskaya gained official recognition in Russia and was given a Stalin prize. This theory revived Schwann's belief that cells are formed in a fluid, a blastema, which belief, ironically, had represented idealism to the Nazi, in opposition to Virchow's materialism. Fortunately Lepeshinskaya has been disavowed lately,[50] and the "omnis cellula e cellula" is recognized again in Russia. Such things appear to us extreme, almost unpardonable; but how will future historians judge our generation's attitudes toward the Malthus problem or to the genetic danger of radioactive fallout?

Today's situation of medicine is not unlike that of 100 years ago in some respects: The improved microscope of 1830 yielded a multitude of not always easily digestible new facts, and the electron microscope does the same today. One-sided theories had to be and are to be dealt with: humoral and solid pathology then, systems like those of Ricker and Speransky in our time. And the danger of metaphysics encroaching upon medical science which was so great in the "Romantic" era should not be underrated today either. We still live in the era of cellular pathology and therefore are unable to judge it historically. Its beginnings, three generations back, are sufficiently removed, and we can say that the cellular doctrine has freed biology and medicine from metaphysical chaos and thus gained lasting fame. Future history of science will have to decide about the merits of anticellular theories because they keep us from a one-sided attitude and about their demerits because they raise anew the spectre of metaphysics. Philosophical minds have often dealt with analogies between world and man, considering both as entities, and the extremely holistic anticellular attitude evokes the saying of a 16th century humanist: "The world is one: not the sum total of atoms that are subject to chance, devoid of reason and incapable of building up an orderly cosmos." [51]

Our ego feeling, the consciousness of the human being as an indivisible unit, may be the real basis of the biological totality concept. But none of the theories which accuse the cellular doctrine of neglecting the organism as a whole has helped us in grasping the genesis of our ego consciousness.

As long as we have no method for attacking the problem how the totality of the metazoan organism is realized, it will remain preferable to study the parts that make this totality, the cells, the tissues, the organs. I am no judge of how far the concept of the whole organism as an open system in stream equilibrium (Bertalanffy) has heuristic value, with the mathematical

possibilities which are claimed for it. But it seems that the single cell with its individual metabolism also represents such a system.

People will react in different ways to a dictum like "every branch of science has its roots in metaphysics." [17] It may be easier to accept Goethe's formulation: "My way of looking at things is my thinking, and my way of thinking determines the way I am seeing." This shifts from metaphysics to psychology, and it catches the pivotal word "theory" in its original meaning of "to see." Even the sober Darwin once said that there is no good observation without a theory. The struggle between cellular doctrine and the totality aspect of living organisms is based to a large extent on differences of personality. The totality aspect is tempting esthetically; the whole, the all embracing, has more appeal than the details, one can feel like Faust compared with his unimaginative famulus. The philosophically trained Virchow knew how to deal with such feelings. After describing how the analytical method leaves us with the parts in our hands instead of the whole, he continues "is not this whole destructive (zersetzende) natural science a dead end street, and is it not truly high time that we turn back to other pathways? If only there were any: But we have no choice." [12, 51] The holistic aspect does not only satisfy philosophical urges, it has inestimable value in practical medicine. No good therapeutics are thinkable without it. the total person should always be treated not the localized disease. But psychotherapy also must have a means of entry, which may be represented by influencing a cerebral field of energy about whose function we have not even a nebulous idea. All this is beside the point when we look at theories as tools of science, as means of finding out more and more about the world around us and in us. The whole, from the empirical standpoint, always remains something we add by thinking to the parts we perceive, (ein Hinzugedachtes). Fr. Kraus,[52] who was the protagonist of constitutional medicine, saw no discrepancy between it and cellular doctrine. He believed that cells retain a certain autonomy within the organism they form. The question thus becomes quantitative. Do we think more of a federation (Staat) of rather independent cells as Virchow was inclined to do? Or do we think of mutually dependent cells which act together somehow through the blood and the nervous system. This "somehow" is the crux, the great question mark, of biology and natural philosophy. Schwann had recognized it clearly, twenty years before the Lectures on Cellular Pathology appeared. Virchow accepted the concept of the unity of the organism in the realm of psychology. His slogan for the practising physician: "to console, to alleviate, to cure" shows that the analytic cellular theory need not interfere with a healthy holistic attitude toward man, in medicine or otherwise. Few will deny that the body consists essentially of cells and their products since this is an observation not an interpretation. Neither Virchow nor his pupils have, to my knowledge, ever maintained that the cells lead an entitrely independent life, they only underestimated the importance of interrelations.

The importance of the cell as the smallest unit of life has been denied not only by those who prefer larger units, but also by those who in atomistic fashion look for ever smaller ones.

The many colorful names given to imaginary units have disappeared from the literature, and so have Haeckel's anuclear protists and the "naked" nuclei. Locke, in "ignorabimus" fashion, declared that man, even with instruments, could never hope to see the smallest units of biological function. R. Altmann in 1890 wrote a much discussed monograph with the title "The elementary organisms and their relationship to the cells." He described granules, "bioblasts", as the ultimate units of living matter. The cell appeared too complex for him for being the unit of life. I would rather say that life is extremely complex, and a simple unit therefore is unthinkable.

The idea even has been proposed that the cell can disintegrate into minute particles each of which will give rise to a new cell in analogy to sporulation. Electron micro-

scopy has brought many details of cellular structure to light, but not one of them so far resembles a free living organism. Nor do we see the postulated symbiotic conglomeration of virus sized living particles. Granting that a gene and a virus may sometimes be identical, and that viruses are organisms in a way, the fact remains that viruses do not lead an independent life but need the host cell. In this respect, the much compartmentalized cell still is the smallest unit of complete independent life, and there seems to be consensus about this. When people doubt the role of the cell as a fundamental unit because a denucleated fragment of an amoeba retains properties of living matter for some time, then the conclusion does not appear cogent. The anuclear fragment cannot divide and thus survive, it can ingest particles but cannot digest them, it can use glucose as a source of food but cannot synthesize nitrogenous compounds from glucose and urea. A denucleated plant cell does not form a new cellulose wall unless it is in contact with a complete cell.

Similarly, a denucleated egg cell can sometimes undergo cleavage, but development does not go further than the blastula, and the anuclear cells of such a blastula do not react to induction stimuli. The addition of a nucleus to the previously denucleated egg cell is followed by normal development in many instances. We do not know how far the evolution of life out of ordinary molecular structures took place slowly in minute steps or what role sudden, mutation like, changes have played. No matter how this has been there must have been precursors to the cell. But nothing compels us to assume that any existing forms resemble the postulated precursors. To take viruses as the precursors of cells is as unfounded as calling the chimpanzee the ancestor of man. We may discover smaller entities that possess some, but not all, characteritics of life, but we will have to be wary about assigning to them ancestorship to the world of cellular life. Maybe we should declare a moratorium on theories about the microstructure of living matter until a larger body of electron microscopic data and corresponding microchemical data is available. But I seriously doubt that we ever shall find a "unit of life" at the Angstrom level.

The concept of the atom as the smallest particle of matter existed for two millennia before methods were devised to prove its reality; that means: theory preceded observation. It was the converse with the cell since cellular theory came about 150 years after cells had been seen. Virchow, in 1855, considered it easier to build the basic ideas of biology upon the cellular elements than to build physics upon molecules and atoms since "cells are within the boundaries of sensual perception while the units of the physicists, the molecules and atoms, are only conclusions from sensual perceptions and are philosophically so little satisfactory that we can look at their assumption only as a temporary termination of research." [13] The inner structure of cells as well as atoms appears more and more complex with improving methods of investigation. Both were originally considered static structures but appear now as dynamic systems.

A historical comparison between physics and biology as far as small units are concerned may not be out of place. How real is the connection between the atomic ideas of Democritus and the modern concept of atoms, and what about the relationship between cellular theory and Leibniz's monads? Dalton's publications on atoms, which began in 1803, were in part responsible for the interest in small units of living matter. But the urge to know about the atoms of life had been strong for generations in the best minds: Leibniz, Locke, Buffon, to mention only a few. The divisibility of matter, living or not, appears as a logical postulate, a thought that arises independent of observation. Thus when Virchow applied the recently proved cellular composition of the animal body to the often voiced idea of everything consisting of small units he fulfilled a strong logical desire of his generation, and similar ideas had been voiced in the decades before him by people who had not made original observations. The large number of new

anatomical observations that had accumulated since 1830 made a theory into which new facts could be fitted doubly welcome. The comparison between physics and biology may have entered a new phase in our days with the concept of feedback. How far do we think of the computer as a whole, a totality, and how far do we think of the single tubes or transistors. One might call that a "seeming problem" (Scheinproblem) not a true problem but could one not say the same of the totality aspect and the cellular aspect in biology?

The cells serve two masters, one rules from inside the cell by Virchowian law, the other resides in the organism of which the cells are a part, but where and how he rules is unknown. In the fertilized egg, the cell and the organism are the same. When Spemann, using a fine hair, carefully separated the two blastomeres which had resulted from the first division of an amphibian egg, each cell developed into a complete larva, in spite of the fact that it was not under the influence of the total organism. When Roux, the founder of experimental embryology, had attempted in 1888, the same experiment by destroying the one cell with a hot needle, the result had been different: only half an embryo was formed. The remaining cell was prevented from following its inherent power of forming a complete larva by the remnants of the destroyed cell which so to say reminded it of its dependent status in relation to the total organism. Removal of certain cells from a young embryo generally leads to malformation of the larva because the total organism has been disturbed. But careful removal (Ubisch) has, in certain animals, resulted in defects of only that part of the body that corresponded to the removed cell.[54] That means: the totality influence was nil, only the removed cell counted. This ambivalence is demonstrated in grotesque fashion by the chimaera experiment. A fragment of a young frog embryo is taken from the area that is destined to become central nervous system, and is transplanted into that part of a salamander embryo that will form the mouth. The fragment will develop into a mouth, in spite of the fact that it was meant to become nervous tissue: thus it obeys the law of the total organism to which it now belongs. But this mouth will be a frog's mouth in a salamander body because the transplanted cells also obey their inherent nature.

Thus, there is no yes-or-no-answer to the question of independence or dependence of the cell. Simple answers hardly ever do justice to the complexity of life processes.[55] Even the staunch enemy of cellular doctrine, M. Heidenhain,[56] considered the antithesis between cellular dominance and organismic dominance as erroneous since "all and everything in the living body is based on interrelation between the whole and the part." But who, may I ask, no matter how philosophy minded he may be, can refrain from searching for the source and seat of this mysterious force which the whole exerts over the parts? We come back to the above quoted word of the 80 year old Goethe: "Thus one is driven from the whole to the detail and from the detail to the whole whether one wants to or not." We can expect the cell to remain, for some time to come, if not our unit of life so certainly our main unit of investigation, and the cellular doctrine will remain a most valuable guide in the progress of biology and that part of it which we call medical science.

REFERENCES

[1] de Voltaire, J. F. A., "La Pucelle", chant 21.

[2] Gross, S. D., 1845, Elements of Pathological Anatomy, 2 ed., Barrington and Haswell, Philadelphia.

[3] Schultze, M., 1861, Arch. f. Anat. u. Physiol. u. wissenschaftl. Med. *9*, 24.

[4] Rich, A. R., 1926, Johns Hopkins Hosp. Bull. *39*, 330.

[5] Remak, R., 1951, quoted by G. R. Cameron, The Pathology of the Cell, C. C. Thomas, Springfield, Ill. p. 24.

[6] Cornil, V., 1901, Berl. Klin. Wchnschr., Oct. 14, 1936.

[7] Virchow, R., 1860, Cellular Pathology as Based upon Physiological and Pathological Histology. Twenty lectures delivered at the Pathological Institute of Berlin during the months of February, March and April 1858, R. M. DeWitt, New York.

[8] de Beer, Sir Gavin, 1958, in C. Darwin and A. R. Wallace, Evolution by Natural Selection, Cambridge Univ. Press, pp. 1-22.

[9] Berthold, A., 1849, Arch. f. Anat. u. Physiol. u. wissenschaftl. Med.

[10] Klein-Hattingen, O., 1871, Geschichte des Liberalismus in Deutschland, Berlin-Schoeneberg, Buchverlag der Hilfe, *1*, 377.

[11] Ricker, G., 1924, Pathologie als Naturwissenschaft, Berlin.

[12] Goethe, quoted by R. Virchow, 1862, "Atome und Individuen" in Vier Reden ueber Leben und Kranksein, Georg Reimer, Berlin, p. 58.

[13] Virchow, R., 1855, Arch. path. Anat., *8*, 33.

[14] Speransky, A. D., 1935, A basis for the Theory of Medicine, transl. and ed. by C. P. Dutt in collab. with A. A. Sobkov, Internat. Publ., New York.

[15] Randerath, E., 1956, Deutsches med. J. *7*, 49.

[16] Lange, F., W. Ehrich and A. E. Cohn, 1930, J. Exp. Med. *52*, 65.

[17] Mayer, C. F., 1952, Bull. Hist. Med., *25*, 71.

[18] Pavlov, J. P., 1953-54, Saemtliche Werke, Akademie Verlag, Berlin.

[19] Long, E. R., 1928, A History of Pathology, William and Wilkins, Baltimore.

[20] Kuester, E., 1938, "Die Entwicklung der Lehre von der Pflanzenzelle" in Hundert Jahre Zellforschung, vol. 17, of Protoplasma-Monographien Deuticke, Berlin.

[21] Oertel, H., 1921, General Pathology, P. B. Hoeber, New York.

[22] Goethe, in letter to Sulpiz Boisseree, Feb. 25, 1832, Ausgabe letzter Hand, 1833, 55, 96, Cotta Verlag, Stuttgart u. Tuebingen.

[23] Doerr, W., 1958, Deutsche Med. Wchnschr. *83*, 370.

[24] Beattie, J. M., and W. C. Dickson, 1948, A Textbook of Pathology, Gruene and Stratton, New York.

[25] Adami, G. J., 1910, The Principles of Pathology, 2 ed., Lea and Febiger, Philadelphia, vol. 1, p. 40.

[26] Hueck, W. 1920, Beitr. z. Pathol. Anat., *66*, 330.

[27] Stoehr, P., Jr., 1951, Lehrbuch der Histologie und der mikroskopischen Anatomie des Menschen, Springer Verlag, Berlin.

[28] Mazia, D., 1957, "The Life History of the Cell", in Science in Progress, ser. 10, G. E. Baitsell, Ed. (Yale Univ. Press, New Haven, Conn.).

[29] Verworn, M., 1895, Allgemeine Physiologie, Ein Grundriss der Lehre vom Leben, Fischer-Jena.

[30] Casperson, T. O., 1950, Cell Growth and Cell Function. A Cytochemical Study, Norton and Co., New York.

[31] Puck, T. T., 1957, The Mammalian Cell as an Independent Organism. Spec. Publ. of the New York Acad. Sc. 5, 291.

[32] Studnicka, F. K., 1929, Die Organisation der lebendigen Masse, in Handbuch der mikroskopischen Anatomie des Menschen, W. v. Moellendorf Ed. (Springer Verlag, Berlin) 1/1/1, 421.

[33] Bauer, 1952, quoted by J. Baker, The Cell Theory: A Restatement, History and Critique, Part 3, "The Cell as a Morphological Unit," Quart. J. Microsc. Sc. *93*, 157.

[34] Virchow, R., 1862, Die Cellularpathologie in ihrer Begruendung auf physiologische und pathologische Gewebelehre, 3 Aufl, August Hirschwald, Berlin.

[35] Zeiger, K., 1955, Zur Geseschichte der Zellforschung und ihrer Begriffe, in Handbuch der allgem. Pathologie, Buechner, Letterer, Roulet ed., Springer Verlag, Berlin, Goettingen, Heidelberg, 2 part 1.

[36] Bargmann, W., 1958, Deutsche Med. Wchnschr., *83*, 361.

[37] Gross, J., 1958, Bull. New York Acad. Med., *43*, 701.

[38] Szirmai, J. A., and E. A. Balazs, 1958. Arch. Opthalm. *59*, 34.

[39] Olssen, R., 1957, Z. Zellforschung *46*, 12.

[40] Wightmann, W. P. D., 1951, The Growth of Scientific Ideas, Yale Univ. Press, New Haven, Conn. p. 388, 390.

[41] Fischer, A., 1946, Biology of Tissue Cells, Cambridge Univ. Press, p. 53, 58.

[42] Pumper, R. W., 1958, Science, *128*, 363.

[43] Virchow, R., 1847, Arch. pathol. Anat. *1*, *19*.

[44] Fleming, W., 1882, Zellsubstanz, Kern und Zellteilung, Vogel Verlag, Leipzig.

[45] Netter, H., 1958, Deutsche Med. Wchnschr. *83*, 364.

[46] Wald, G., 1958, Science, *128*, 1481.

[47] Bertalanffy, L. V., 1950, Science, *111*, 23.

[48] Lartschneider, J., 1940, Hippokrates oder Virchow, Franz Deuticke, Vienna.

[49] Krupinsky, J., 1950, Polski Tygodnik Lekarski, *5*, 1137.

[50] Zhinkin, L. N., and V. P. Mikhailov, 1958, Science, *128*, 182.

[51] Reuchlin, J., quoted by W. Pagel, 1958, Paracelsus, S. Karger Verlag, Basel and New York, p. 292.

[52] Kraus, F., 1919, Die allgemeine und spezielle Pathologie der Person, Allgemeiner Teil, Leipzig, Georg Thieme Verlag, p. 51.

[53] Altmann, R., 1890, Die Elementarorganismen und ihre Beziehungen zu den Zellen, Veit und Co., Leipzig.

[54] von Ubisch, 1957, quoted by W. Bargmann, Vom Bau und Werden der Organismen, Rowohlt Verlag, Hamburg, p. 46.

[55] Plaut, A., 1924, Beitr. z. Path. Anat. u. Allg. Path., *72*, 654.

[56] Heidenhain, M., 1937, Synthetische Morphologie der Niere des Menschen, E. J. Brill Publ., Leiden.

[57] Moscona, A. A., 1959, Scientific Amer. *200*, 132.

For further references see:

G. R. Cameron, 1951, Pathology of the Cell, C. G. Thomas, Springfield, Ill.

The Insecticide Society of Washington

C. M. Smith

In January 1959 there was affiliated with the Washington Academy of Sciences an organization known as the Insecticide Society of Washington. It is believed that members of the Academy will be interested in an account of the founding and nature of this organization, and this seems an appropriate time to so acquaint them because the Society was started by Dr. F. L. Campbell, the 1959 President of the Academy, and October of that year marked the 25th anniversary of its founding.

The U. S. Department of Agriculture has long been interested in avoiding or controlling the damage caused by insects attacking crops, farm animals, and even man himself. As the interest in controlling these pests grew it was natural that chemical compounds were tried and recommended for the purpose. The manufacture and sale of such chemical insecticides assumed such dimensions that there arose a need for some form of control over their purity and for keeping a check-rein upon the validity of the claims made for their efficacy. In 1910 the U. S. Congress passed the so-called Insecticide Act. The Insecticide and Fungicide Board, composed of representatives from the U. S. Bureaus of Entomology, Plant Industry, Animal Industry, and Chemistry, was appointed to administer the act. There also was established in the Bureau of Chemistry an Insecticide Division for the analysis of chemical insecticides. Naturally, need arose for a considerable amount of research work to develop the knowledge necessary properly to enforce the act. The regulatory and research activities were finally separated, with each group building up laboratories staffed by scientists of various kinds.

In October 1934, Dr. F. L. Campbell, an entomologist in the Division of Control Investigations of the Bureau of Entomology, recognized the need for closer personal association of the scientists in the Washington area who were working in the field of insecticides, particularly to provide for informal exchange of ideas and discussion of technical and scientific problems. In a letter dated October 4, he reported to the Chief of his Division the results of a meeting held at his house the previous evening. This meeting was attended by all members of his own laboratory and by Dr. R. C. Roark and Mr. C. M. Smith of the Insecticide Division, Mr. W. S. Abbott of the Insecticide Testing Laboratory at Beltsville, and Dr. C. A. Weigel from the Truck Crop and Garden Insects Division. This group decided to hold an organizing meeting on October 17 and this action was then called to the attention of all those men in the nearby laboratories of the Department of Agriculture and the University of Maryland at College Park, who conceivably might be interested. This meeting was held as planned in Dr. Campbell's laboratory at 7710 Blair Road, Takoma Park.

The response was very gratifying, 55 persons attended. A temporary committee composed of Mr. W. S. Abbott, Chairman, and Drs. L. A. Hawkins, R. C. Roark, E. H. Siegler, and C. A. Weigel, was appointed to suggest an outline for the nature of the organization and the rules and regulations to govern the conduct of future meetings. This committee met in the Takoma Park laboratory on October 24, 1934 and drafted such a set of recommendations. They then set the date for the next meeting November 14, at which time temporary chairman, Mr. W. S. Abbott brought the recommendations before the membership and the following rules were adopted in lieu of a formal constitution and by laws:

1. The name of the organization shall be "The Insecticide Society of Washington".

2. The membership shall be limited to federal and state men who are interested in insecticides.
3. A nominating committee shall be appointed to suggest candidates for the following offices: Chairman, Vice-Chairman, Secretary, Treasurer, and a "Steering Committee" to be composed of the first two officers and three other members.
4. The Steering Committee shall be authorized to perform all the functions that are usually assigned to several committees in larger organizations; i.e., executive, program, membership, arrangements for meetings, and refreshment. This committee shall endeavor to secure speakers best qualified to talk on the topic chosen. Non-members, including employees of commercial firms may be invited to speak.
5. Meetings shall be held preferably on the third Wednesday of each month from September to June, inclusive.
6. Dues shall be $1.00 per year per member.

The nominating committee suggested individuals for the four offices and the members confirmed Dr. F. L. Campbell as Chairman, Mr. C. M. Smith as Vice-Chairman, Mr. J. W. Bulger as Secretary, and Mr. S. C. Billings as Treasurer. Drs. E. L. Griffin, C. A. Weigel, and E. H. Siegler were chosen to be the steering committee. Following a *lapsus linguae* by the secretary, this committee came to be called for quite some time, the "steerage committee".

Some of these regulations were changed as time passed. The two offices of secretary and treasurer were merged into one and the election date changed to May, the officers then serving from July to June. At the suggestion of the Entomological Society of Washington, the Insecticide Society soon devoted the June meeting to participating in the annual picnic of that other affiliate of the Washington Academy. The most significant change, however, was to broaden the membership to include interested scientists and technical people from industry.

Since the membership of the Insecticide Society consisted mainly of entomologists and chemists, it immediately became the practice to elect a Chairman from among the former one year, and from the latter the next year. In most cases this convention has been followed to the present day.

The Society has used a number of meeting places over the years, as necessity and expediency demanded. The first ten meetings were held at Dr. Campbell's laboratory in Takoma Park. Meetings numbered 11 to 52, inclusive, were held at the nearby Jesup-Blair House on Georgia Avenue, just outside the District of Columbia. With the coming of World War II, this building was taken over by the county draft board and the next three meetings had to be held in other county buildings in Silver Spring. One of these was in a room over the police station and the other two over the liquor dispensary. The record does not make clear whether the latter two were better attended or more lively than those held elsewhere! Meetings numbered 56 to 62 were held at the Bethesda Recreation Center Building at 4700 Norwood Place, Bethesda. Finally, Dr. E. N. Cory, then Professor of Entomology at the University of Maryland in College Park, and State Entomologist of Maryland, kindly made arrangements for the Society to meet in his quarters in Morrill Hall at the University. This proved to be quite satisfactory and the Society met here until October 1954. That year the Entomology Department moved to new quarters in Symons Hall and the Society went along, meeting in lecture rooms and later in the auditorium.

One unique feature of the Society that deserves comment is that the dues of one dollar per year, established in 1934, have never been increased. Where else will a dollar buy as much today as 25 years ago?

In the course of 25 years over 300 papers have been presented at the meetings. The first two were given by Mr. J. S. Yip, a specialist in the cultivation of the insecticidal plant, pyrethrum, and Dr. F. B. Laforge, a chemist long identified as an authority on the chemistry of the insecticidal

dally active constituents of this plant. It seems quite appropriate that the Society began its existence by consideration of this, one of the most important and interesting of plant insecticide materials.

Through the years the topics discussed have ranged over the entire broad field of pesticides and their use. There also have been excellent papers on such diverse subjects as plant growth regulators, photoperiodism in plants and insects, insect physiology and even scientific travelogues. The list of speakers includes bureau and division chiefs from various civil agencies, professors, representatives of the Armed Services, prominent authorities from industry and members of Congress. We also have had prominent guests from other countries from time to time. Among the early speakers were Mr. R. H. LePelley, a government entomologist from Kenya Colony, British East Africa, and Dr. F. Tattersfield, Head of the Department of Insecticides and Fungicides at the Rothamstead Experiment Station in England. The Society honored the latter at a dinner meeting at the Cosmos Club on May 31, 1935.

Now for a few words concerning the attendance at the meetings of the Society through the years. Naturally the number soon dropped below the 55 who attended the organizational meeting, but an average of 45 was maintained through the eight meetings of the first year. In April 1939, Dr. L. P. Ditman, then Secretary-Treasurer, presented a report on the attendance figures. He stated "Many individuals seemed rather surprised that the Society has existed for so long a period. Many are still rather uncertain as to the future of the Society" and concluded his memorandum with his own comment, "As far as the future of the Society is concerned, the Secretary feels that it will exist as long as a minimum of 20 good souls will continue to brave such nights as were experienced during January, February, and March of 1939". His faith in the Society was well founded, for although the attendance figure once dropped to 13, the Society has now lasted an additional 20 years. It also speaks well for the insight of Dr. Campbell and the other founders of the Society, that the purpose of the organization is still the same—a place where these "20 or more good souls" can meet in an informal atmosphere to enhance their knowledge of insecticides and like matters; to listen, to discuss, even to argue at times; and, not the least, to enjoy the company of our colleagues. It also is gratifying that the Society has the stature to be honored as an affiliate of the Washington Academy of Sciences.

Science in Washington

SCIENTISTS IN THE NEWS

This column will present brief items concerning the activities of members of the Academy. Such items may include notices of talks given, important conferences or visits, promotions, awards, election to membership or office in scientific and technical societies, appointment to technical committees, civic activities, and marriages, births, and other family news. Formal contributors are being assigned for the systematic collection of news at institutions employing considerable numbers of Academy members (see list on masthead). However, for the bulk of the membership, we must rely on individuals to send us news concerning themselves and their friends. Contributions may be addressed to **S. B. Detwiler, Jr.**, Associate Editor, 2605 S. 8th St., Arlington, Va.

Applied Physics Laboratory

Alfred J. Zmuda has been appointed a consultant to the Geophysics Panel of the Air Force Scientific Advisory Board.

Coast & Geodetic Survey

Dean S. Carder was appointed chief seismologist of C&GS in October, 1959. During December he was elected a member of the Scientific Council of the Geological Society of Washington; also, he participated as observer and analyst in Phase I of the Louisiana "Cowboy Shots." Dr. Carder is serving as president of Rapidan Camps, Inc., a cooperative camping group in the Blue Ridge.

Charles A. Whitten, chief of the Triangulation Branch, presented a paper on the computation and adjustment of geodetic networks as part of an international symposium held at Cracow, Poland, September 9-13, 1959. The presentation was made by invitation of the Polish Academy of Sciences.

Aaron L. Shalowitz has been elected a fellow of the American Geographical Society. Dr. Schalowitz represented C&GS at the recent Third Annual Meeting of the Florida Shore and Beach Preservation Association.

David G. Knapp recently visited Peru, Chile, Argentina, Brazil, and Puerto Rico, to confer with geophysical scientists; he was accompanied by Mrs. Knapp. Dr. Knapp participated in the Symposio Antartico de Buenos Aires, held November 17-25 under the sponsorship of the Instituto Antartico Argentino.

Thomas J. Hickley was recently made chief of the Instrument Davision.

Geological Survey

At the annual meeting of the Mineralogical Society of America in early November, **George Switzer** was elected secretary, and **Marjorie Hooker** the treasurer of the organization. **George T. Faust** was appointed to the Nomenclature Committee for 1960-62, while **Edwin W. Roedder** was appointed to the Board of Associate Editors for 1960-62, and to the Awards Committee.

At the annual meeting of the Geochemical Society last November, **George T. Faust** was re-elected treasurer and reappointed to the Advisory Board on the International Critical Tables.

Francis R. Fosberg attended AAAS Council meeting in Chicago, December 26-30. While in Chicago he presented a paper, "Problems of Tropical Herbaria," before the Society of Plant Taxonomists on December 28. On December 10, Dr. Fosberg sat with the NAS Committee on Science in UNESCO, as U. S. member on the Advisory Committee on Science Research in the Humid Tropics.

While on a vacation trip in November and December, **Margaret D. Foster** visited points of interest in Morocco, Spain, Majorca, Sicily, Italy, and southern France.

National Bureau of Standards

On January 4, Director **Allen V. Astin** resumed his duties on a part-time basis following recuperation from a heart attack.

Three NBS staff members presented invited papers at a symposium on weights and measures at the Chicago AAAS meetings, December 28-29. **Lewis V. Judson** spoke on "Our Units of Weights and Measures"; **Irvine C. Gardner** discussed "Adoption of a New System of Weights and Measures"; and **Wilmer Souder** presented "Metric Usage—Report of Special AAAS Committee." At the same meeting, **George C. Paffenbarger** spoke on "Dental Materials from 1939 to 1959." Dr. Paffenbarger is a research associate of the American Dental Association, stationed at NBS.

Two staff members have been appointed to editoral boards of the American Chemical Society for the three-year term 1960-63. **Roger G. Bates,** assistant chief of the Chemistry Division, was appointed to the Advisory Board of *Chemical and Engineering News,* and **Bourdon F. Scribner,** chief of the Spectrochemistry Section, will serve on the Advisory Board of *Analytical Chemistry.*

Kurt E. Shuler spoke on "Energy Transfer and Relaxation Processes in Gas Phase Collisions" at the Harvard MIT Physical Chemistry Colloqium held at Cambridge on January 7.

Walter J. Hamer, chief of the Electrochemistry Section, on December 15 was elected vice president of the Electrochemical Society for the three-year term 1960-63. He will assume office on May 1, at the Society's national meeting in Chicago. On completion of his term as vice president, Dr. Hamer will become president of the Society for the 1963-64 term.

On January 5, **William J. Youden** presented a paper on "Experiments Involving Several Variables" at the Air Reduction Corporation, Murray Hill, N. J., and a paper on "Statistical Ideas Useful in Experimentation" at a meeting of the Society for Applied Spectroscopy in New York City.

William F. Meggers, former chief of the Spectroscopy Section and now retired, left Washington January 15 on a trip around the world, accompanied by Mrs. Meggers. The couple plans to visit Near- and Far-Eastern countries during a 60-day tour.

Alan D. Franklin was appointed acting chief of the Mineral Products Division in November; he replaces **Irl C. Schoonover,** who will devote full time to his duties as associate director for planning. Dr. Franklin, who received the Ph.D. degree from Princeton in 1950, served as chief of the Franklin Institute's Magnetics Section from 1945 to 1955, when he came to NBS. Since joining the Mineral Products Division he has conducted research on the fundamental properties of ferroelectric materials.

Karl G. Kessler was appointed chief of the Spectroscopy Section last August. In this capacity Dr. Kessler will direct work in interferometry, analysis of spectra, and the study of hyperfine structure and isotope shift in spectra: additionally, he will continue to head the Bureau project to develop a new wavelength standard of length, using atomic beams as a light source.

National Institutes of Health

Erich Mosettig of the Laboratory of Chemistry, National Institute of Arthritis and Metabolic Diseases, returned to Bethesda December 23 after an unusual international lecture tour of extensive proportions. The trip, sponsored jointly by NIAMD and the Cancer Chemotherapy National Service Center, involved over 25 formal lectures and informal talks before scientific groups in Honolulu, Japan, Hong Kong, Thailand, India, Pakistan, Lebanon, Turkey, and Austria. These lectures covered various aspects of the NIH research program, including the biochemistry of steroidal compounds, modern analgesics, endogenous carcinogenesis, and cancer chemotherapy.

State Department

Wallace R. Brode, science adviser to the Secretary of State, has won the American Chemical Society's 1960 Priestley Medal, according to recent announcement by retiring ACS President John C. Bailar.

Jr. The gold medal—highest honor in American chemistry—was awarded to Dr. Brode for "distinguished services to chemistry"; it will be presented at the 137th national meeting of ACS in Cleveland next April. Immediate past president of AAAS, Dr. Brode is on leave from the National Bureau of Standards, where he has been associate director for the past 12 years; he was for 20 years professor of chemistry at Ohio State University.

Deaths

Rees F. Tener, assistant chief of the Testing and Specifications Section, National Bureau of Standards, died suddenly on December 25. A native of Sinking Springs, Ohio, Mr. Tener received the M.S. degree from GWU in 1926. After Army service during World War I and science teaching experience, he joined the NBS staff in 1924, serving in the Rubber Section until 1930 and thereafter in the Testing and Specifications Section. Mr. Tener, a recipient of the Commerce Department's Meritorious Service Award, was an authority in various fields of rubber chemistry and on the development of specifications and test methods for organic and fibrous products. He was particularly active in committee work for ASTM and the American Standards Association.

Walter J. Murphy, editorial director of the American Chemical Society's applied journals, died of cancer on November 26. Dr. Murphy's death came at the height of a notable career devoted to bettering the chemical profession and industry. Under his leadership over a 17-year period, the ACS applied publications became the largest scientific publication program in the world, with a total circulation of over 165,000. He was also director of the Society's News Service, the public relations organization serving the chemical profession.

Following a successful start in the chemical process industries, Dr. Murphy entered the technical publication field in 1930, when he was named managing editor, and later editor and general manager, of *Chemical Industries*. Subsequently he was named editor of *Chemical and Engineering News* and *Industrial and Engineering Chemistry*. In 1953 he initiated the *Journal of Agricultural and Food Chemistry*, and in 1959 the *Journal of Chemical and Engineering Data*. In 1947 he had received the honorary D.Sc. degree from Centre College of Kentucky.

AFFILIATED SOCIETIES

As time goes on, we hope to establish in this section of the Journal periodic reports of the activities of the some twenty-six scientific bodies affiliated with the Washington Academy of Sciences, reports which will be of interest and service to members of the Academy. Experience will indicate, as we go along, just what sorts of material are both obtainable and worthwhile, but at this stage we have in mind such items as: meeting places, dates, and topics, special projects, summaries of society proceedings, educational and promotional programs, public relations efforts, and so on. Machinery is gradually being set up whereby one individual in each affiliate will keep us informed of what goes on in his particular organization. In addition, we will include, as data become available to us, names of incumbent president and secretary of each society listed, with indications of changes as they occur.

We solicit information from individual members of the Academy as a most welcome supplement to the established channels.—**Russell B. Stevens,** Associate Editor, George Washington University.

American Meteorological Society, District of Columbia Branch

Oct. 21, panel discussion on the "Use of Artificial Satellites in Meteorology," with Sigmund Fritz, David Wark, Charles Bristor, Jay Winston, Lester Hubert, and David Johnson, all of the U. S. Weather Bureau, participating.

Nov. 18, address by A. H. Mikesell, U. S. Naval Observatory, on "Finding the Jet Stream by Star Twinkling."

Dec. 16, panel discussion on "Oceanographic Forecasting," with John Schule, Richard James, Howard French, and Walter Wittman, all of U. S. Navy Hydrographic Office as participants.

Jan. 20, meeting in Lecture Room, NAS-NRC, 2101 Constitution Ave., N.W., 8:00 P.M., with a talk by Albert P. Crary, Geophysical Research Directorate, on "Antarctic Meteorology."

Feb. 10, meeting scheduled as above, to hear Joseph Smagorinsky, U. S. Weather Bureau, discuss "Digital Simulation of the General Circulation."

American Society for Metals, Washington Chapter

President: William L. Holshouser (NBS). *Secretary:* Glenn W. Geil (NBS)

Nov. 16, meeting and address by Robert F. Thompson, General Motors Corporation, on "Automotive Gas Turbines."

Dec. 21, joint meeting with AWS and lecture by Alexander Lesnewich, Air Reduction Company, on "Electron Beam Welding."

Jan. 18, Meeting and talk by Morris Tanenbaum, Bell Telephone Laboratories, on "Metallurgy in Electronics."

Feb. 8, Burgess Memorial Lecture, Arlington Towers, by R. H. Aborn, U. S. Steel Corporation.

March 21, John E. Hilliard, General Electric Company, "Pressure - Induced Transformation in Metals."

April 18, Walter L. Finlay, Crucible Steel Company, "Titanium and Competitive Stainless Steels."

May 16, National Officers Night, featuring address by the National President, Walter Crafts, on "Facing the Productivity Challenge: Men and Metals of the Next Decade."

The Washington Chapter, ASM, sponsored a series of six Thursday Night Talks on Metallurgy, Oct. 29-Dec. 10, for high school students, metal workers, and others. A second series, sponsored by the NBS and local technical societies, is scheduled for the Department of Commerce auditorium at 7:30 P.M., on Tuesday evenings, Jan. 12, 19, 26 and Feb. 2, 9, on the general topic: "Materials Development in the Space and Atomic Age." All interested persons are invited.

Anthropological Society of Washington

Three meetings were held in the fall of 1959, as follows: (1) Oct. 27, Carlson Gadjusek, National Institutes of Health, an illustrated lecture on "Child Growth and Development Patterns in New Guinea"; (2) Nov. 16, Eugene I. Knez, The Smithsonian Institution, a "Korean Dance Festival," featuring dances in costume by five Korean women and children; and (3) Dec. 11, Louis J. Luzbetak, two color films on tribal life in the interior of New Guinea.

Botanical Society of Washington

President: Harold T. Cook (USDA). *Corresponding Secretary:* Muriel J. O'Brien (USDA)

Dec. 1, presidential address by H. C. Hanson, Catholic University, on the flora of Alaska.

Jan. 6, regular meeting and presentation by H. C. Murphy, Department of Agriculture on "Oat Diseases are Shifty Enemies."

Feb. 2, next regular meeting, Powell Auditorium, 2170 Florida Ave., N.W., at 8:00 P.M.

Chemical Society of Washington

President: Allen L. Alexander (NRL). *Secretary:* John L. Torgesen (NBS).

Dec. 10, general meeting of the society, featuring an address by Wallace R. Brode, Department of State, on "Formulation of a Science Program." A Board of Managers meeting, on the same date, under the chairmanship of President W. W. Walton, heard reports as follows: (1) Committee on Education—CSW is cooperating with the ACS Division of Chemical Education in canvassing local high schools for requests for the Visiting Lecturer Program; (2) Committee on Programs—arrangements are being completed for a joint meeting with the Maryland Section of the ACS, probably Friday, May 6, at the University of

Maryland; (3) from R. F. Gould of ACS Headquarters concerning the chemistry merit badge of the Boy Scouts of America —which problem will be studied by the Committee on Education.

Geological Society of Washington

President: Harry S. Ladd (USGS). *Corresponding Secretary:* J. Thomas Dutro (USGS).

Dec. 9. address by retiring President Joseph W. Greig, Carnegie Institution, on "Development of Phase Equilibrium Studies in the Interest of Petrology."

Jan. 13, council meeting.

Helminthological Society of Washington

President: George W. Luttermoser (NIH). *Corresponding Secretary:* Edna M. Buhrer (USDA).

Dec. 1, joint meeting with the Washington Tropical Medicine Association and the Howard University Chapter of Sigma Xi, at Howard University, at which Sir Phillip Manson-Bahr, London School of Tropical Medicine, spoke on "Wild Game and Man in Central Africa," illustrating with slides the life-cycles of some common parasites of man and animals.

Jan. 20, meeting at 8:00 P.M., McMahon Hall, Catholic University, with two scheduled addresses: (1) Benjamin Schwartz, "Discovery of Trichinae and Determination of their Life History and Pathogenicity"; and (2) Major R. I. Anderson, "Serological Diagnosis of *Schistosoma mansoni* Infection."

Feb. 17, meeting at University of Maryland.

Mar. 16, meeting at National Institutes of Health.

Oct. 8, Fiftieth Anniversary meeting of the Society, with morning and afternoon scientific programs and an evening banquet.

Society for Experimental Biology and Medicine, District of Columbia Section

President: George A. Hottle (NIH). *Secretary:* Edwin P. Laug (FDA).

Dec. 3. four papers as follows: (1) H. Wishinsky, E. Poole, and S. P. Erkel, Sinai Hospital, Baltimore, "Gamma Globulin Separation Using 'Rivanol'"; (2) Jiro Oyama and R. Lorimer Grant, FDA, "Serum Insulin-like Activity as Measured by the Mouse Diaphragm Method"; (3) Elsworth R. Buskirk, NIH, "Study of Human Energy Metabolism as Influenced by Food and by Cold"; and (4) Emilio Weiss and Harry R. Dressler, NMRI, "Centrifugation of Rickettsiae and Viruses onto Entodermal Cells and its Effect on their Absorption."

Feb. 4, 8:00 P.M., program of scientific papers in Hall A, The George Washington University School of Medicine, 1335 H Street, N.W.

April 7, meeting at same location.

June 2, Annual Dinner Meeting, time and place to be announced later.

ACADEMY ACTIVITIES

Board of Managers, January Meeting

These notes are intended to outline briefly, for the information of the membership, the principal actions taken at Board meetings. They are not the official Minutes as prepared by the Secretary.—Ed.

The Board of Managers held its 523rd meeting on December 15 at NAS, with President Campbell presiding.

The Secretary (Dr. Specht) distributed draft Minutes of the 521st and 522nd meetings of the Board. Approval was deferred until the next meeting.

Dr. Campbell reported that in recent balloting on the proposal to increase Academy dues from $6 to $10 annually, only 61 percent of the voting members had favored the change. Since a two-thirds majority was required for adoption, the proposal had failed.

Dr. Campbell reported on the Executive Committee meeting held just prior to the Board meeting, and on a meeting held December 14 between Academy officers and a number of members from the Smithsonian Institution. At the latter meeting,

the Smithsonian members had expressed concern over recent Board actions directed toward changes in the *Journal*—that is, from a publication containing chiefly scientific material of a descriptive character, as in the past, to a publication containing original cross-disciplinary articles as well as news of the Academy and local scientific activities. The Smithsonian members had felt that they should have been given an opportunity to vote on the proposed changes.

The Board agreed that it had acted within its authorization in approving a curtailment of the *Journal*—and indeed, that such curtailment was imperative in view of the failure of the dues increase proposal. However, it was decided that the Secretary should conduct a referendum to determine the preferences of the membership as to the content of the magazine.

Dr. Goldberg reported on two informational resolutions passed at a recent meeting of the Philosophical Society. The Society felt that the Academy should reduce its capital before increasing dues. Secondly, the Society indicated its expectation to publish its papers in national journals, its Minutes in the *Journal* of the Academy.

Chairman Biberstein of the Committee on Awards presented the Committee's recommendations on award recipients at the next annual meeting of the Academy, in the categories of physical sciences, mathematics, engineering sciences, biological sciences, and teaching of science. His report was accepted with the Board's commendation for its thoroughness.

Chairman Schubert of the Committee on Encouragement of Science Talent reported on current activities of the Washington Junior Academy of Sciences. He mentioned that the Junior Academy had scheduled a meeting on December 28 for the presentation of scientific papers, and that at least a third of the membership was expected to be present.

Dr. Schubert introduced David Chen, president of the Junior Academy. Mr. Chen presented a proposed change in Article IX of the WJAS constitution, which would change the procedures for amending the bylaws in order that 7th- and 8th-grade students might be admitted to the Junior Academy. The Board approved the proposed change.

Dr. Campbell presented the recommendation of the Executive Committee, that $4,000 be budgeted to the *Journal* for its expenses in calendar 1960. (This represents less than half the cost of the magazine in 1959, which is estimated at $9,500.) He estimated other Society obligations in 1960 at $8,475 and its income at $9,100, and that a deficit of about $3,400 could accordingly be expected. The Board approved the budget for the *Journal*.

Dr. Frenkiel objected to the apparent inconsistency of approving a budget for the *Journal* while simultaneously preparing to ask the membership's opinion on the future policy of the magazine. Dr. Campbell replied that the proposed referendum was concerned only with the content of the *Journal*, and that a reduction in size and frequency of issue, and hence in overall cost, had already been established.

Dr. Campbell presented a report on four Academy projects for which a 1960 proposal would be submitted to the National Science Foundation. These projects are a continuation of those undertaken in 1959, except that two are to be expanded; the total amount involved is $47,000. The Board approved submission of the grant request.

Chairman Kushner of the Membership Committee presented for first reading the names of seven candidates for membership in the Academy. Dr. Kushner thereupon presented for second reading the names of seven other candidates previously proposed, as follows: Roy J. Barker, Lafe R. Edmunds, Robert B. Fox, Stanley A. Hall, Thomas C. Hoering, Ronald E. Kagarise, and Gunnar Kullerud. These candidates were then elected to membership.

Dr. Campbell presented a report from Chairman Van Evera of the Committee on Grants-in-aid for Research, recommending

grants to two area high school students in a total amount of $141.82. The Board approved the grants.

In the absence of Chairman Shepard of the Committee on Bylaws, Dr. Gurney presented a third draft of the proposed revision of the Bylaws. It was agreed that this draft should be distributed to the Academy membership for consideration and approval.

The Amateur and the Academy

Summary of the Retiring President's Address, to be presented at the February 18 meeting of the Academy.

Because membership in the Washington Academy of Sciences has been restricted to those "who by reason of original research or scientific attainment are deemed eligible . . .." it has been and is an organization composed almost exclusively of professional scientists; that is, of those who earn their living in some kind of scientific work and who are usually highly skilled specialists. Although amateurs are not specifically excluded, few have been admitted to the Academy because as a rule they neither publish original research nor hold important positions in the scientific community.

Past-President Campbell will argue that amateurs, teachers of science, professional neophytes, and intelligent citizens who recognize the philosophic, economic, and social importance of science and seek to understand it should all be encouraged to apply for membership in the Academy after its Bylaws on membership have been suitably amended. He believes that amateur interest in science should be encouraged by the Academy, not only among young students, as is now being done, but among adults; that observation of nature offers the readiest and most interesting introduction to science for the amateur; and that the amateur can, if he tries, add something to the great body of informational data from which knowledge is derived. By way of illustration of what can be done, Dr. Campbell will show some beautiful color photographs of animal and plant specimens that were taken by two enthusiastic amateurs, both over seventy years of age. Frank L. Campbell

JUNIOR ACADEMY NEWS

By David Malin, Chairman Publications Committee, W.J.A.S.

The December 28th convention of the Washington Junior Academy of Sciences held at the Burlington Hotel was the high point of the organization's activities in 1959. Thirty-three papers based on original research were given by junior scientists of this area to more than two hundred of their scientifically minded contemporaries. Separate sessions were held in Biology, Physics, Chemistry, and Mathematics.

To give some indication of the interest and achievement of this area's young scientists, the titles of the papers are listed here:

Biology

Iris Lipkowitz, "Observations on the Nutritional Requirements of *Spirostemum ambiguum*"

Grover Sherlin, "Information from Tree Rings"

Barbara Miller, "The Production of Antibiotics—From Mold to Medicine"

Morgan Morrison, "Determination of the Efficiency of Organic Pesticides on Common Economic Insect Pests"

Mark Levy, "The Sodium Chloride Tolerance of Certain Chlorella"

Carol Anne Love, "The Effect of Temporary Cooling on the Development of the Chick Embryo"

Betty Jane Sherlin, "Studies of Trees in Winter"

Heijia Lee, "Effect of Cholesterol on the Growth of Chorioallantoic Membranes"

David Chen, "Experiments on Hormonal Control of Insect Metamorphosis"

Dennis Marienfeld, "Do the Widely Advertised 'Germ Killers' Really Kill Germs?"

Harlan Himel, "The Cellular Slime Molds"

Daniel Wheeler, "Simple Techniques of Photomicrography Applicable to Biological Research"

Physics

Robert Schooley, "Radioactivity in Washington, D.C. Milk"

Janet Price, "What is a Cloud Chamber?"

Eugene Wengert, "Radioactive Probe Currents and Potential Gradient Related to Storms and Fair Weather"

Barbara Levin, "Analysis of Properties of Concrete"

David Malin, "A System for Automatic Optical Recognition of Printed Characters"

Dennis Herrin, "Solar Energy"

Jerome Dufour, "X-Ray Diffraction"

Michael Brownstein, "A Seismic Model Study"

Delo Mook, "Using a Tape Recorder as a Multi-Channel Recording System for Industrial Control"

Chemistry

Harold Weiler, "Paper Chromotography in Medical Research"

Barbara Blount, "Corrosion of Metals"

Raymond Baggs, "Correlation of Respiratory Decline with Amount of Vitamin E in Rat Liver Tissue"

Michael Mitchell, Jr., "Development of an Experimental Universal Wax Crayon from Ordinary Household Ingredients"

Margaret Ferguson, "Acid Production in the Mouth"

Cathy Briggs, "A Chemical Study of Carotenoids and Vitamin A in Invertebrates"

Gil Fritz, "Physical and Chemical Properties of Polymers"

Morgan Morrison, "Experimental Studies of Proteolytic Enzymatic Hydrolytic Systems"

Mathematics

Joel Dressler, "Universal Mathematics"

David Zalkind, "Theory of Probability and Pascal's Triangle"

Kenneth Taylor, "A Logical Approach to Space"

James Baker, "Game Mathematics"

JOINT BOARD

The Joint Board on Science Education of the Greater Washington Area has announced that it has planned expenditures for 1960 in the amount of $10,500. The items contained in this budget are:

Science fairs expenses-local, national	$ 3,100
Science teacher awards	750
Publication of The Reporter	2,200
Frontiers of Science lecture series	250
Research training projects	300
Publication of Science Projects Guide Book	2,500
Administrative, Committee, and Directory	1,100
Miscellaneous	300
Total	$10,500

In addition, the Joint Board has been intrusted with the administration of the 4-fold science projects of the Washington Academy of Sciences financed by a grant from the National Science Foundation. Although this grant amounts to $35,200, none of these funds may be allocated to the regular program of the Joint Board.

In consideration of other sources of income, the Board will need to raise $8,000 of the above $10,500. These funds are being solicited from technical societies and industrial and business organizations. Although all voluntary gifts from persons are acceptable, no solicitation of individual scientists and engineers is being made, in the belief that they participate indirectly in society or organization giving. Certainly their principal contribution is one of contact, counselling, speaking, or advising, within the Joint Board program.

The success of the local educational program lies in the unselfish services of many scientists, engineers, and teachers freely given and with extreme dedication. It would be very foolish to assume that the importance of this work has lessened. Only on ostrich-like individual could fail to heed to the warnings of Iron-Curtain countries concerning their plans to surpass us, particlarly in science.

Many technical societies of this area have been outstanding in their financial support of the educational activities of the

Joint Board. Others have given only token support. Every scientist in the Washington area is urged to encourage their societies, organizations and business or industrial connections to give liberally to the Joint Board's solicitation for funds for 1960. **John K. Taylor,** National Bureau of Standards.

SCIENCE AND DEVELOPMENT

The annual Tidal Current Tables for 1960 covering: 1. the Atlantic Coast of North America, 2. the Pacific Coast of North America and Asia, 3. Europe and the West Coast of Africa, including the Mediterranean Sea, 4. Central and Western Pacific Ocean and the Indian Ocean have been published by the Coast and Geodetic Survey of the U.S. Department of Commerce. Tide tables have been issued by the Survey since 1853. The tables are now published in four volumes which include the entire maritime world. They contain daily predictions for 190 reference stations and tidal differences and ranges at about 5,000 subordinate stations.

Culminating three years of exploratory work, **a plastic foam shelter** was demonstrated recently by the Atlantic Research Corporation (Arlington, Va.) and the Army Quartermaster Corps. The shelter, twelve feet in diameter and six feet high, was formed by spraying a rigid polyurethane plastic foam onto an inflated canvas hemisphere. The foam rises in a few minutes and hardens in less than an hour. The shelter weighs under 200 lbs. and is almost completely impervious to the elements. A better insulator than cork, the foam, one and a half inches thick, can easily be cut by a knife or bayonet. All components are portable making the foam shelter ideal for field use.

The National Science Foundation estimated in No. 16 of the series "Reviews of Data on Research and Development", that **total funds for scientific research and development in the U.S.A. will reach an all-time high of $12 billion** for the year 1959-60, up $7 billion from the 1953 level. An increase of nearly 160% in funds used in the performance of R&D by private firms and related organizations from 1953-54 to 1959-60 was found.

A highly efficient, large capacity "Fogger" has been developed by the Sanitary Engineering Branch of the U.S. Army Engineer Research and Development Laboratories, Fort Belvoir, Va. for use in control of mosquitoes and other flying insects. Using a solution of DDT the "fogger" can practically rid an area of insects in 10 minutes. In tests, fog was detected more than a mile from the point of release when the fog generator was held in a stationary position and operated at full output.

Modern mass education may be suppressing the development of "genius" claimed Dr. Harold G. McCurdy, University of North Carolina psychologist in a recent Smithsonian Institution report. In his study of the childhood of 20 generally admitted men of supreme ability, Dr. McCurdy found three factors common to all: 1. A high degree of attention focused on the child by parents and other adults, 2. Isolation from other children, especially outside the family, 3. A rich efflorescence of fantasy. The author remarked that "the mass education of our public school system is, in its way, a vast experiment on the effect of reducing all three of these factors to minimal value and should, accordingly, tend to suppress the occurrence of genius".

The history of science, invention and technology is featured in a new publication released in December by the Smithsonian Institution. The volume contains 11 research articles written by members of the Museum's staff. Alexander Graham Bell's part in making the phonograph a workable device is the subject of one article. Among other articles are ones that tell of the introduction of English patent medicines in colonial America, the failure of an early attempt to make a dollar watch, and the battle between Besse-

mer and certain of his contemporaries over patent rights to the process for producing cheap steel.

W. F. Libby, who served as a Research Associate in the Geophysical Laboratory at the Carnegie Institution of Washington during his entire term as Atomic Energy Commissioner, **spent the past year investigating the radioactive strontium content of rainfall** during the crucial period March-May, 1959, following an intensive series of bomb tests fired by the Soviet Union in October 1958. This event afforded a unique opportunity to test the characteristics of fallout from injections of nuclear materials at polar latitudes, as contrasted with the equatorial explosions fired by the U.S. and the United Kingdom. Analysis of samples collected during the critical period showed that the radioactive materials from the Russian shots had approximately one-year of residence in the stratosphere as contrasted with a residence time of three years or more for equatorially injected material. This discussion and many others appeared in the 1958-59 Annual Report of the President of the Institution.

The Optical Society of America has recently undertaken to translate the Russian journal, *Optika i Spektroscopiya,* with the help of a grant-in-aid from the National Science Foundation. This translation journal is being distributed free to OSA members as part of their membership privileges. It is also available to non-members in a package deal with the OSA *Journal,* at $25 per year.

"Preservation of Documents by Lamination", by W. K. Wilson and B. W. Forshee has been issued by the National Bureau of Standards (Monograph No. 5). Subjects covered include properties of an ideal laminating film; properties of cellulose acetate film; degradation of film and paper during lamination; preliminary studies of films other than cellulose acetate; and specifications for archival laminating film formulated from cellulose acetate. The study was requested and supported by the National Archives, U.S. Army Map Service, Library of Congress and Virginia State Library.

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Institute of the Aeronautical Sciences	*Not Named.*
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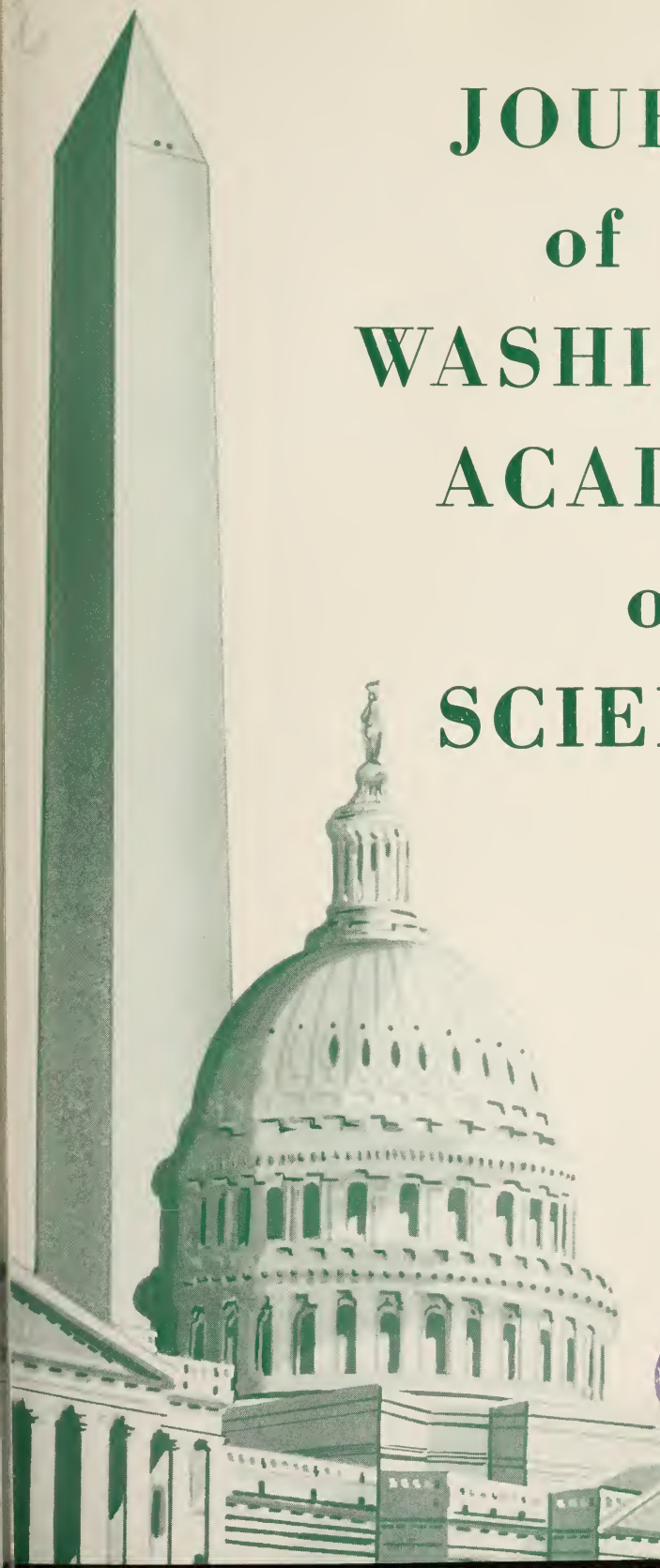

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JOURNAL OF THE WASHINGTON ACADEMY OF SCIENCES

Editor: Chester H. Page, National Bureau of Standards

Managing Editor: Ileen E. Stewart, National Science Foundation

This Journal, the official organ of the Washington Academy of Sciences, publishes: (1) historical articles, critical reviews, and scholarly scientific articles, (2) original research, if the paper, including illustrations, does not exceed 1500 words or the equivalent space, (3) notices of meetings and proceedings of meetings of the Academy and its affiliated societies, and (4) regional news items, including personal news, of interest to the entire membership. The Journal appears eight times a year in January to May and October to December.

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Adaptive Radiation in the Flowering Plants

Hui-Lin Li

Morris Arboretum, University of Pennsylvania

Introduction

The plasticity of living organisms is more obvious in the widely divergent adaptations, which are structural as well as functional, in some groups of animals, such as mammals and insects, than in flowering plants.[1] In these groups of animals, adaptive trends often are reflected in distinctive taxonomic groupings of major rank, such as families or orders. On the other hand, in flowering plants the major orders seemingly all occupy the same range of habitats and most of them have about the same range of types in their external appearance.

This leads Stebbins (1951) to state that "One of the most striking impressions which results from a comparison between the major subdivisions—families, orders, and classes—of the animal kingdom and the corresponding ones in the higher plants, is that while in animals the characters on which these subdivisions are based are for the most part of obvious adaptive significance, and must have evolved through the guidance of natural selection, in plants this is by no means the case."

This seemingly less obvious significance of adaptation in the classification of flowering plants is apparently due to their essentially similar methods of obtaining foods. As photosynthetic autotrophs, they all possess chlorophyll and a root system anchored permanently in the soil to absorb minerals. As the large majority of flowering plants adhere to this basic type of existence, it gives the impression that flowering plants as a whole are less versatile in differentiating into habitat groups along phylogenetic lines.

When all families of flowering plants are reviewed, actually many forms are to be found which are extraordinarily modified in adaptation to the most diverse environmental situations. These adaptations to the same environmental conditions are often repeated independently many times along different and distinct phylogenetic lines and resulted not infrequently in the formation of highly differentiated families or even orders.

The large majority of existing flowering plants are terrestrial plants inhabiting more or less mesophytic habitats. Radiating from this basic and generalized habitat, various other types of plants are evolved which are specialized for very different habitats and modes of existence.

Climbing plants

While the majority of these plants are autonomous, a number of them need support for ascending into the air up into the light. Adaptations for climbing are thus chiefly evident in a lengthening of the stems. This may result in the twining of the stems themselves or the development of modified accessory structures of attachment from the branches or leaves such as tendrils, adventitious roots and sensitive petioles. Climbing plants or klinophytes occur in numerous widely divergent families and among both herbaceous and woody plants. The following families are either exclusively or predominantly vines:

Actinidiaceae
Ancistocladaceae

[1] The term flowering plant is used in this paper as equivalent to angiosperms.

Convolvulaceae
Dioscoreaceae
Lardizabalaceae
Menispermaceae
Passifloraceae
Sargentodoxaceae
Schisandraceae
Vitaceae

Epiphytes

The climbing habit seems to lead in the family Marcgraviaceae into the epiphytic habit. Another essentially epiphytic family, but of an entirely different type of appearance, is the Bromeliaceae, which contains generally acaulescent herbs and are also eminently xerophytic. Epiphytic plants are also found scattered in many other large families, such as the Araliaceae, Ericaceae, Rubiaceae, etc. and are more particularly abundant in the Orchidaceae.

Saprophytes

Deviating from the basic photosynthetic autotrophic mode of nutrition, some plants become heterophytic either as saprophytes or parasites. Not a few flowering plants are saprophytes, deriving their nourishment from humus. Chlorophyll becomes unessential and thus disappears. The stems become yellowish or reddish and the leaves become scale-like. The subterranean rhizome or root system is solely responsible for absorption of nutrients. The individual plants thus become of very small size and the essential dominant feature is often the large inflorescence which is of prime importance for perpetuating the race. Saprophytic plants evolve independently in several distinct families such as the Orchidaceae and the Pyrolaceae. The family Triuridaceae, constituting solely the order Triuridales, is exclusively saprophytic. The family Burmanniaceae, with the exception of a few autotrophic species with greatly reduced green leaves, consists also of chlorophyll-less saprophytes. The family Pyrolaceae consists of strongly geophytic but independent plants (subfamily Pyroloideae) and saprophytes (subfamily Monotropoideae or sometimes treated as a distinct family Monotropaceae).

Parasites

Parasitism in flowering plants begins in hemiparasites, in which the plants remain green but live partially on the roots of other plants. It culminates in holoparasites in which chlorophyll disappears entirely and the plants depend solely on the host plants for nutrition. Parasitism occurs repeatedly and separately in different families, such as *Cassytha* in the Lauraceae and *Cuscuta* in the Convolvulaceae, and also notably in the tribes Geradieae and Rhinantheae of the Scrophulariaceae. The orders Balanophorales and Santalales consist mostly of parasitic plants. The families of these orders as well as other families entirely or predominantly of parasitic plants, including hemiparasites or holoparasites or both, are as follows:

Balanophoraceae
Cynomoriaceae
Hydnoraceae
Lennoaceae
Loranthaceae
Myzodendraceae
Orobanchaceae
Rafflesiaceae
Santalaceae

Geophytes

Among normally terrestrial plants, there are a large number of many different families assuming geophytic habitats. They frequently develop strong underground stems. Families like the Begoniaceae in the Dicotyledons and the Taccaceae and Zingiberaceae and many others in the Monocotyledons are distinctly geophytes persisting for a short or long period by thickened subterranean parts. In extreme cases the plants spend most of their life underground with parts appearing above ground only during a brief period of the year when flowering and fruiting are consummated very quickly. Such families as the Podophyllaceae and others contain nearly all members of the subterranean habitat.

Xerophytes

Plants adapted to extremely dessicated

situations in the deserts and steppes of the Old and New Worlds are found in many families, notably in the Gramineae, Liliaceae, etc. Some of these plants become succulents while others become highly sclerophyllous to check excessive transpiration. The xerophytic Cactaceae and Aizoaceae, predominant in America and Africa respectively, are especially notable. Lack of a large dominant family in the Asiatic deserts may indicate their relatively recent origin. The following families are predominantly xerophytes. The families Cactaceae, Casuarinaceae and Proteaceae are the sole members of the orders Cactales, Casuarinales and Proteales respectively.

Aizoaceae
Cactaceae
Casuarinaceae
Crassulaceae
Portulacaceae
Proteaceae
Tamaricaceae

Aquatic plants

Many large families of flowering plants contain some members that are adapted to the aquatic habitat such as the Ranunculaceae and Scrophulariaceae. A very considerable number of families in the Dicotyledons are solely aquatic or semi-aquatic in habitat. These hydrophytes assume a wide variety of structural differentiation modified for varied existence as floating or attached plants and living in still or rapidly running waters. While most of these are either completely submerged or floating some are adapted to marshy or semiaquatic habitats. These aquatic Dicotyledonous families are:

Barclayaceae
Callitrichaceae
Cabombaceae
Ceratophyllaceae
Elatinaceae
Euryalaceae
Haloragaceae
Hippuridaceae
Hydrostachyaceae
Nelumbonaceae
Nymphaeaceae
Podostomaceae
Tristichaceae
Trapaceae
Trapellaceae

The aquatic habitat is especially predominant in the Monocotyledons, a large proportion of which are aquatics or semi-aquatics. The large order Helobiales contains eight families entirely of hydrophytes. The aquatic families in the Monocotyledons are as follows: (These include plants living in freshwater as well as in brackish water and in the sea).

Alismaceae
Aponogetonaceae
Butomaceae
Hydrocharitaceae
Juncaginaceae
Lemnaceae
Najadaceae
Pontederiaceae
Potamogetonaceae
Sparganiaceae
Typhaceae
Zanichelliaceae

A distinct type of aquatic adaptation is manifested by the so-called mangrove plants with highly specialized modifications in vegetative as well as reproductive structures to survive and perpetuate along muddy coasts and estuaries in the tropics. The most notable modifications are aerial roots and viviparous germination. Mangrove plants are found in the families Sonneratiaceae, Combretaceae, Verbenaceae, etc. The family Rhizophoraceae consists entirely of mangrove plants.

Insectivorous plants

A very special trend of adaptation in plants is the insectivorous or carnivorous habitat which seems to be associated with semi-aquatic habitats where insect life is especially abundant. The order Sarraceniales [2] is entirely insectivorous, with

[2] The Sarraceniales, while generally recognized as an order, are found by many authors to be a composite group of unrelated stocks. The family Nepenthaceae should probably be more appropriately included in the Aristolochiales and the Droseraceae either in the Parietales or the Rosales.

the three families Droseraceae, Nepenthaceae and Sarraceniaceae developing very different structural modifications in their leaves for trapping and digesting insects as a means of nutrition. The large predominently aquatic and insectivorous Lentibulariaceae are of an entirely different phylogenetic stock, of the order Tubiflorae. Another order, the monotypic Cephalotales, with one family of a single species, is also an unique insectivorous plant.

Discussions

The above brief account summarizes the versatile adaptability of the flowering plants, in spite of the limitation in their method of obtaining food. It seems that in the flowering plants there is an inherent potential of evolution to adapt themselves to widely different environmental conditions just as in some groups of animals. As is generally believed and for instance summarized by Stebbins (1950), all long continued evolutionary trends in plants as well as in animals apparently occur through a progressive series of random mutations guided by natural selection. Recently, Waddington (1953), while discrediting the inheritance of acquired characters, considers this current biological belief as an extreme view and postulates a hypothesis of genetic assimilation of such characters, which thus become hereditarily fixed. The whole problem is in need of much more experimental study than has now been made.

The number of plant families recognizable mainly by their adaptive features is impressive. Among these 27 or over 10 percent are entirely aquatic in habitat. Ten families or about 4 percent are climbing plants. Seven families or about 3 percent are solely adapted to dry situations. Similarly 9 families or about 4 percent are wholly parasitic plants. Five families or about 2 percent are adapted to the very unique insectivorous habitat. In view of their immobility and their similar mode of obtaining food, these figures, showing major groupings of flowering plants differentiated by means of adaptive trends, are surprisingly high. This situation compares favorably with the conditions expressed in the mammals which have the different orders occupying different habitats. In addition to the seed habit, the adaptability of the flowering plants is largely responsible for the dominant position they hold in the plant world of today.

The different adaptive trends in these plants require structural modifications of considerable magnitude, not only in internal organization but also in gross outward appearance. The difference in appearance between an aquatic Ceratophyllum, a parasitic Rafflesia and a xerophytic Cactus is as great as if not greater than that between an aquatic whale, a volant bat and a fossorial gopher. It is natural that these modifications in the plants are manifested in vegetative parts like roots, stems and leaves, while the reproductive organs and the methods of reproduction remain little changed. The same is also true in animals.

It seems that botanists on the whole lay more emphasis on the evolutionary significance of reproductive structures than zoologists and consequently overlook generally the relative importance of vegetative structures in phylogeny. Perhaps this is true only in the study of higher plants as habitats are generally recognized as of great importance in the major divisions of lower plants. For instance, if habitats are not considered as of prime importance, some of the Chlorophyceae would perhaps assume closer relationship in phylogenetic schemes with some of the Phycomycetes than among their respective selves.

The various trends of adaptation in the flowering plants seem to radiate from a more generalized terrestrial and moist mesophytic habitat. In other words they represent derivative types. While the relationships of some of these specialized families are uncertain or disputed, the kinships of many others are well established and generally recognized from morphological and anatomical studies.

For instance, among the parasitic families, the Hydnoraceae are regarded as derived from the large family Aristolochiaceae

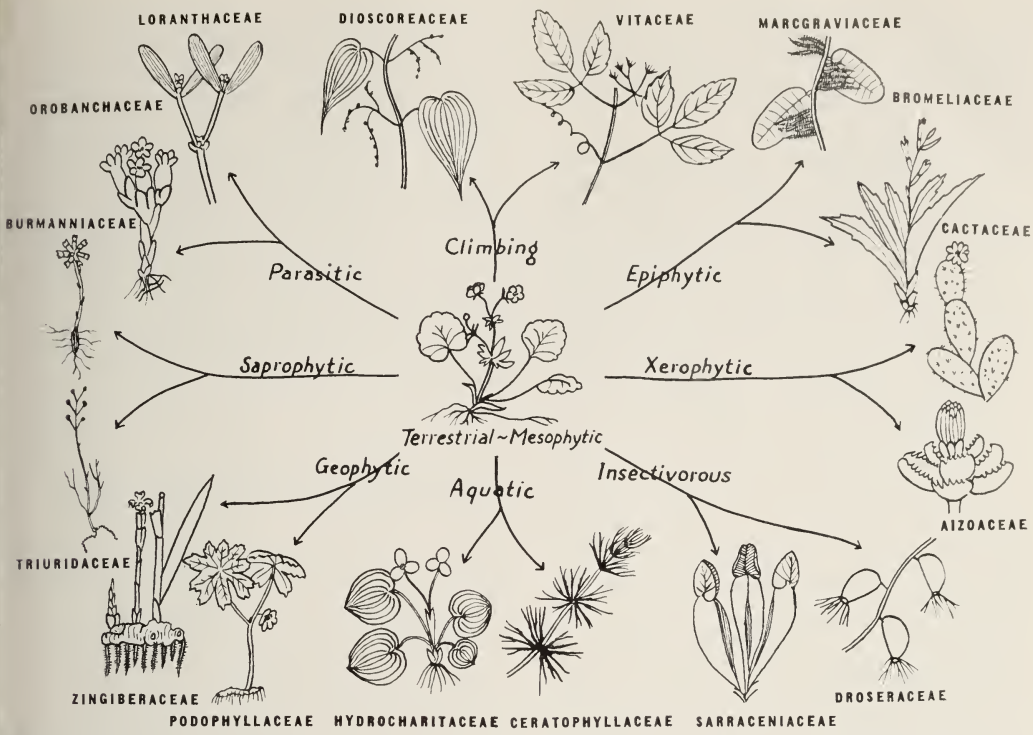

Fig. 1. Diagram of parallelism in evolution and adaptive radiation in the flowering plants.

and the Orobanchaceae from the large family Scrophulariaceae. Similarly among the aquatic plants, the Ceratophyllaceae are supposed to be modified types derived from the Onagraceae, the Trapellaceae from the Pedaliaceae, and the Podostomaceae probably from the Saxifragaceae. Among the others, the mangrove family Rhizophoraceae are probably derived from the Lythraceae, the essentially saprophytic Monotropaceae from the Pyrolaceae and Ericaceae, and the essentially epiphytic Marcgraviaceae from the Ternstroemiaceae.

This situation is comparable to that occurring in the mammals although in the latter, habitat groups are often differentiated at ordinal ranks such as the Chiroptera, an entirely volant group, and the Cetacea, an entirely aquatic group. In others, however, such as the Carnivora, the component groups are adapted to various different habitats as digging, swimming, and walking forms, a situation very similar to most of the larger orders or families of the flowering plants.

It is clear that these various adaptive trends occur repeatedly and independently at different times and from different stocks. This serves to show not only adaptive radiation but also parallelism in evolution in the flowering plants (Figure 1).

As stated above, these trends of adaptation in the flowering plants are sometimes manifested in entire families and orders but also in genera and species among other families. This differentiation presumably has some significance in the relative age of these groups, although the difference in the rate of evolution should also be considered. However, little can be said on either case at our present state of knowledge.

It does seem clear that the flowering plants as a whole are inherent in their great adaptability. In large families, these various trends are sometimes manifested within a single family. As the time goes

on, these trends may lead on to additional parallel but independent evolutionary peaks which represent taxonomically and momentarily as orders and families.

As an illustration, we may select the large and relatively recent family Scrophulariaceae. The family contains over 250 genera and over 3,000 species. They occur widely in all continents from warm to cold parts. There are woody as well as herbaceous members. While the majority are terrestrial plants of mesophytic habitats abundant especially in moist lands in warmer parts of the world, special trends of adaptation are apparent in various other situations. Generally they are erect plants, but some may be prostrate and creeping, as in some Veronicas, and in *Mazus*, *Linaria*, etc. Many plants are adapted to marshy habitats and true aquatics occur in *Ambulia*, *Hydrotriche*, etc. A large number of genera, such as *Euphrasia*, *Pedicularis*, *Odontites*, *Melampyrum*, *Bartsia*, *Rhinanthus*, etc. are hemiparasites which are green plants but attach themselves by suckers or the reduced lateral roots to roots of grasses. In *Lathraea*, *Harveya* and *Hyobanche*, there are true parasites devoid of chlorophyll. The same trend apparently leads into the development of the wholly parasitic family Orobanchaceae. The insectivorous Lentibulariaceae are related and probably derived from the Scrophulariaceae.

On the generic level, habitat groups circumscribed as taxonomic entities are very numerous and are found in nearly all large families. There are many large and ecologically variable genera such as the oaks and willows. However, many smaller genera are adapted to narrow ecological niches. Some such habitat groups are highly specialized and are thus distinctly recognizable, such as the already mentioned parasitic genera *Cassytha* in the Lauraceae and *Cuscuta* in the Convolvulaceae. Others are of a more subtle nature, but their distinct adaptive trends often also become apparent upon closer scrutiny.

In the later category, we may select at random a few examples. In the genus *Alnus*, the Alders, although there are some 30 species distributed widely in the northern hemisphere, they are all more or less restricted ecologically to cool climates and moisture-laden soils. On the other hand, the Chestnut trees, *Castanea*, with some 10 species in the temperate regions of the northern hemisphere, are adapted to warmer situations and well-drained soils. These trees can in fact withstand drought better than most other trees of temperate mesophytic habitats.

A very notable feature in plant evolution, as shown by the many families mentioned above, is that these widely divergent trends of evolution occur most especially in the tropics and subtropics. Bews (1927) has demonstrated that the moist warm conditions are most effective in bringing about a differentiation among the most primitive types of angiosperms. The various derivative types of plants as discussed above are shown by him to originate mostly under moist favorable conditions. Evolution is apparently a subject that is best studied in the tropics where it is being carried on by nature on the fullest scale and at the fastest rate. Our knowledge of evolution will certainly be greatly augmented as we know more about the development of tropical vegetation.

The above mentioned author has made a very important contribution in his attempt to ascertain plant phylogeny from an ecological point of view, which he called ecological evolution. The study of plant taxonomy and plant phylogeny has much to gain from a geographical approach, which in this sense is used to include ecology. The advantage of this approach in plant taxonomy has been amply demonstrated by many modern monographical and revisional studies. As indicated by Camp (1947) and others, its advantage in studying phylogeny is equally promising.

Summary

Among the flowering plants, specialized habitat groups are developed parallelly along different phylogenetic lines. These are usually accompanied by pronounced structural modifications and often resulted in

the differentiation of major taxonomic groupings such as families or orders. Radiating from a generalized terrestrial mesophytic focus, trends of adaptation are particularly notable for climbing, epiphytic, saprophytic, parasitic, geophytic, xerophytic, aquatic, and insectivorous habitats. There are many whole families that follow strictly one of these lines of adaptive radiation. The great inherent adaptability of the flowering plants is largely responsible, in addition to the seed habit, for their dominant position in the plant world of today.

REFERENCES

Bews, J. W. 1927. Studies in the ecological evolution of the angiosperms. New Phytol. *26:* 1-21, 65-84, 129-148, 209-248, 273-294.

Camp, W. H. 1947. Distribution patterns in modern plants and the problems of ancient dispersal. Ecol. Monog. *17:* 159-183.

Stebbins, G. L. 1950. Variation and evolution in plants. Columbia University Press, New York, 643 pp.

Stebbins, G. L. 1951. Natural selection and the differentiation of angiosperm families. Evolution *5:* 299-324.

Waddington, C. H. 1953. The evolution of adaptations. Endeavour *12:* 134-139.

The Referendum

The results of the referendum on the contents of the *Journal of the Washington Academy of Sciences* reveal that the membership is divided into three parts. The largest group is indifferent to the question. the next largest wants a change, and the third group, a vociferous minority, wants the *Journal* to remain a primary research publication. It is clear that the best compromise would require two publications: one like the *Journal* of the past, the other a house organ. At present the Academy cannot afford to publish two periodicals; it cannot even afford to maintain the *Journal* as it was. Therefore an attempt will be made to please the long-suffering majority with a smaller journal of scientific thought and action characteristic of the Academy.

Although we would have accepted a mandate to maintain an archival periodical, our heart would not have been in it. We are not among the minority who believe that the most important function of the Academy is to publish an archival journal. We are not impressed by those who cry that the Academy will lose its dignity, prestige, or reputation if the old *Journal* is not continued.

The practice of publishing in one journal research articles in all fields of natural science is a venerable one and is maintained by the Royal Society, the National Academy of Sciences, and many other academies. No doubt the prestige thought to be connected with such a practice flows down from the old and very distinguished scientific organizations that adopted it of necessity before the rise of specialized scientific societies and their journals and other outlets for the publication of scientific work. Now that natural science has become highly specialized, it takes great prestige to draw good research articles away from specialized journals into over-all journals. The Washington Academy, having relatively little prestige, could get for its journal as a rule only descriptive articles that become effective after they arrive upon library shelves. To a taxonomist it does not matter where his article is published so long as he can get reprints and a good distribution of it in the libraries of the world.

We zealously advocate and defend the need for more systematic work in the life and earth sciences and for its prompt and complete publication and pertinent distribution. At the same time we contend that systematic articles should not be published in the *Journal of the Washington Academy of Sciences*, because it is unfair to accept subsidy for their publication from unwilling scientists and wasteful to distribute them among people who do not need them. We

believe that systematists should re-examine their publication requirements and the means of meeting them in the 1960's.

At present most archival papers are written and offered for publication by professional scientists; i.e., by those who are paid to work in the field on which they write. We believe that a continuous and persistent effort should be made by these workers and all other professional scientists to convince their employers that the cost of publication is an integral part of the cost of scientific work and must be paid for in full by the employer. Looking to the future when the problem of storage, filing, and transportation of special libraries will become acute, we feel that very serious consideration should be given to the original publication of systematic articles on microcards. There is a tendency to dismiss this less expensive, faster, and more manageable system because the present International Rules do not recognize species described in microfilm. Would it not, however, be more progressive to begin to use microcards and press for the improvement of readers and the repeal of the repressive rule?

The Academy should not disregard this problem but, perhaps through the work of a special committee, should try to increase outlets for publication of taxonomic papers. For a time during a period of transition grants might be made from the reserve fund of the Academy to assist publication of professional taxonomic papers in such local journals as that of the Biological Society and of the Entomological Society. We also hope there will always be amateurs at work whose publications ought to receive support from private funds.

Our colleagues who are genuinely concerned about the effect our new publication policy may have on the alleged prestige of the Academy should be invited to state their case in this column as frankly as we have presented our point of view. We do not believe that recent publication of professional scientific research in the *Journal* reflects much credit on the Academy. The work would have been done and no doubt published whether the Academy existed or not. The Academy, as such, usually has played no part in the initiation, guidance, or criticism of the research published in its *Journal;* it has served only as a publisher and payer of bills that should have been paid by the employer. The Academy really counts in those activities that require organized effort toward the promotion of science in the Washington area. In such effort we can take pride and we can make known our work and stimulate our members and many others through the *Journal.*

Frank L. Campbell

Dr. Lawrence A. Wood

1960 President of the Washington Academy of Sciences

At the 62nd Annual Meeting and Banquet of the Washington Academy of Sciences, which was held on Thursday, January 21, 1960, at the John Wesley Powell Auditorium in Washington, D. C., Dr. Lawrence A. Wood was installed as the society's President for the year 1960.

Dr. Wood was born in Peekskill, N. Y. in 1904. He received an AB degree in chemistry and mathematics from Hamilton College in 1925. He then transferred to Cornell University for his graduate work, where he changed his field of science to physics and received his PhD degree in 1932. He remained at Cornell as an instructor in physics for three years, where he conducted research and published papers in the field of electricity, and then came to the National Bureau of Standards as a member of the Rubber Section. In 1943 he became chief of this section, a position which he still holds today.

Dr. Lawrence A. Wood

Dr. Wood's early research work on rubber was concerned with measurement and interpretation of the basic physical constants and properties of natural rubber. However, his interests later turned toward the synthetic rubbers, and his subsequent experience with these new materials proved to be extremely valuable to rubber science and technology. In 1940, when very few people realized the importance of synthetic rubbers, he prepared an excellent comprehensive review article on the composition, properties, and uses of various synthetic rubbers. This paper was published as a National Bureau of Standards Circular, and the demand for it was so great that several reprintings were required by the Government. Because of its timeliness and importance it was translated by the Germans and the Japanese into their languages and printed in their journals.

Dr. Wood is the author or coauthor of more than forty other scientific papers. His early research with rubber was concerned largely with transitions; and as a result of his excellent work in this field he was selected to prepare the chapter on "Crystallization Phenomena in Natural and Synthetic Rubbers" for a book "Advances in Colloid Sciences," published in 1946. He was also selected to write the chapter on "Physical Chemistry of Synthetic Rubbers" for a comprehensive treatise on "Synthetic Rubbers" published in 1954. In 1938, and again in 1948, Dr. Wood was an official delegate from the U.S. Department of Commerce to an International Rubber Conference held in London, England. At both of these meetings he presented invited papers.

As a result of Dr. Wood's recognition as an outstanding authority on synthetic rubber he is called upon very frequently for advice by many Government agencies. He has collaborated with many of them and also with several congressional committees, furnishing them with technical advice and recommendations for guidance on synthetic rubber problems. Several times during World War II he was called into private conferences with the Secretary of Commerce, the Honorable Jesse Jones, concerning vital problems related to the Government's production of synthetic rubber.

For his excellent work and outstanding achievements in research he received in 1943 the Physical Science Award of the Washington Academy of Sciences. In 1958 he also received the Meritorious Service Award from the U.S. Department of Commerce for his valuable fundamental contributions to the science and technology of rubber.

Dr. Wood has always shown a great interest in scientific societies, both locally and nationally. In addition to being a member of the Washington Academy of Sciences he is also a member of the Philosophical Society of Washington and the American Chemical Society and is a Fellow of the American Physical Society. He was one of the founders of the Division of High Polymer Physics of the American Physical Society and has held several offices in this Division, including the chairmanship in 1947. He has also held various offices in the Philosophical Society of Washington, including its Presidency in 1955. Because of Dr. Wood's distinguished career as a scientist and because of his interest and activities in the WAS and other societies, the Washington Academy of Sciences is to be congratulated on its choice of President for 1960. **Norman Bekkedahl**

Academy Activities in 1959

A Report to Nonresident Members

Frank L. Campbell, *Retiring President*

It occurred to me that nonresident members of the Washington Academy of Sciences, who could not attend the Annual Meeting on January 21, would like to have some idea of what the Academy was doing last year. Let me try to report briefly to you as I did to those present at the annual meeting.

The Board of Managers

The Academy is governed by a large Board of Managers consisting of seven officers, six elected members-at-large, and representatives of 26 affiliated local scientific and engineering societies, who have been called vice-presidents of the Academy. These 39 people are expected to meet on the third Tuesday of each month, except July, August, and September. There is a regular order of business calling for reports of the officers, of 13 standing committees, and of whatever special committees are active. Therefore up to 17 chairmen of committees should also appear at Board meetings. These members, plus our paid administrative secretary, add up to a throng of 57 people who might gather for meetings of the Board, which in 1959 were held between 8 and 10 p.m. in the so-called Reading Room of the National Academy of Sciences—National Research Council. Of course no such number ever appeared, but attendance at regular meetings was remarkably good. There is also an Executive Committee consisting of five of the above officers, which often met prior to Board meetings to study and make recommendations to the Board on fiscal matters.

The Board meetings of 1959 departed from the routine, regular order of business at nearly every meeting. Two subjects were of principal concern to the Board: (1) the recommendation of the Executive Committee that dues be increased from $6 to $10 per year and (2) revision of the Bylaws. Both questions would have to go to the membership for approval by mail ballot.

The Journal of the Academy

The first question became connected with the cost of operating a central office and of publishing the *Journal of the Washington Academy of Sciences* because both were responsible for the operating deficit that made necessary an attempt to increase dues. The Board did not attack the central office, but did challenge the *Journal*, calling it a publication not worth to most of the members the money being spent on it. The Committee on Policy and Planning and that on Ways and Means were asked to study the problem and report. The answers did not come easily and are still tentative. The Board favored a change in the character of the *Journal* and gave the president the authority to appoint a volunteer staff that could do more than receive and process manuscripts for publication—a staff that could solicit material, write and rewrite, and establish communication among the members of the Academy and its affiliated societies. The experiment on the *Journal*, as you see, is underway and we want your comments and criticisms, knowing that we cannot please everyone. Please bear in mind, too, that we are allowed only $4,000 to spend on the *Journal* in 1960, whereas $10,000 were spent on it in 1959. The decision of the Board to change the character of the *Journal* was supported by a referendum to the membership.

Revision of the Bylaws

A thorough revision of the Bylaws required hours of the Board's time for discussion of controversial items. Thanks to the willingness of some members to attend

two special meetings of the Board the job was finished (temporarily, of course) in 1959. The revised Bylaws will soon go to the membership for approval. An explanation of substantive changes will accompany the document. I might say here that the Board thought it somewhat ridiculous for the Academy to have 26 vice presidents and to require that they be elected (en masse!) at the annual meeting of the Academy. The revised Bylaws will call them Delegates from the affiliated societies, and the Academy will seat whomever is designated by the affiliated society, provided he is a member of the Academy. There is now a move afoot to make these delegates members of a new Council of the Academy, analogous to the Council of the AAAS. Thus the Board of Managers would be relieved of the weight of their numbers at most Board meetings and yet could get advice from them from time to time, particularly on questions affecting the affiliated societies.

The Joint Board

Enough for the Board of Managers, for there is another Board that should be known to you. I refer to the Joint Board on Science Education for the Washington Area, usually known locally as "the Joint Board." It is composed of the Committee on Science Education of the Academy and a similar group from the D. C. Council of Engineering and Architectural Societies. The Joint Board has its own budget, committees, and meetings and takes only policy direction from the Academy. It effectively helps students and teachers of science in this area, particularly those in the secondary schools. Its Secondary School Contacts Committee provides liaison between every junior and senior high school, public, private, and parochial, in this area and the professional scientific and engineering community. There is a contact man or woman for every school, to help in any way he can. And back of him are large numbers of volunteers who will lecture, teach, counsel, demonstrate, or evaluate as needed. Just the bookkeeping on the roster of volunteers is a large task. Beginning in 1959, thanks to the National Science Foundation and the central office of the Academy, an assistant could be employed to bring the roster up to date, maintain, and operate it. This was one of four projects supported by a grant of $35,000 from the new Academy program of NSF. Our Academy was ready for it and was among the first to receive this support. Two other projects have to do with experimental teaching in elementary and secondary schools, combining mathematics and science, with advice from special committees of the Joint Board. The fourth project brings together for free discussion teachers in secondary schools and universities and scientists in government or private employment on the general topic of improving science education leading to careers in science. All these projects have been under way since last September, and support for a second year has already been requested.

All secondary school teachers are kept informed of Joint Board activities through a monthly 8-page newspaper written and edited by a member of the Board. It is supported by a grant from a private foundation.

In addition to contact work with the schools, the Board is concerned with local science fairs, sending the winners to the national fair, participating in an annual event of the D. C. Council called Engineers, Scientists, and Architects Day, etc.

The Office of the Academy

You have noted that I have so far not mentioned the names of people on or connected with the Board of Managers of the Academy or with the Joint Board. I have omitted them deliberately because there are so many to whom credit is due. I could not name them all even if I would. You will learn the names of many as you read the new *Journal*. However, I do want to mention here our Administrative Secretary, Mrs. R. R. Fell, a woman of unusual competence who works full time for a modest salary in our central office in the room that the Carnegie Institution of Washington has

provided free of charge for the Academy's use. It is just to the right of the entrance of the Carnegie building at 1530 P Street N.W. It is open only during working hours, from 8:30 to 5:30 Monday through Friday. I suggest you drop in when you are in Washington. There you will find Mrs. Fell and Miss Juliette Grant, Assistant to the Joint Board, and you will then appreciate the work they are doing.

I helped to set up the central office in the summer of 1958 when Mrs. Fell came to us from the University of Virginia. It was in full operation in 1959. First Mrs. Fell took over the business of getting out the weekly Science Calendar, a list of meeting announcements of local scientific and engineering societies that is published in the local newspapers. Gradually as the records and materials of the secretary, treasurer, custodian, and archivist were brought into the office, she undertook the routine work of bookkeeping, membership records, filling orders for back issues of the *Journal*, etc.—everything that should be done in the office of a society. She also helped to revise the directory of the Academy's membership, which was published recently, and summarized many of the voluminous minutes of the secretary. More and more the office is serving as the most convenient source of information about the Academy and the Joint Board and their work; the telephone is busy.

I have tried to give you a picture of Mrs. Fell's work so that you can answer anyone who tells you that the office is an unnecessary luxury. As a matter of fact, Mrs. Fell is now doing regularly and well necessary work that some of our volunteer officers did irregularly and incompletely. Her work on *Journal* subscriptions, reprints, and sales of back issues brought in gross receipts greater than the amount of her salary.

Report of the Treasurer

At this point I suggest you look at the appended summary financial report for 1959. You will see that although we had an operating deficit of more than $4,000, the value of the Academy's investments suffered little loss during the year. There is no need to build up this reserve any further; on the other hand, it could be seriously reduced if we should continue to spend more than we receive. That is the reason for curtailing expenditures on the *Journal* in 1960. An increase in dues or in membership or both will permit an expanding *Journal*. On the other hand, income from subscriptions to the *Journal* will probably diminish, because it will no longer be an archival publication that libraries must keep.

Membership

In 1959 a well-organized, hard-working membership committee prevented any net loss of dues-paying members and the total membership increased from 1066 to 1083. In 1960 there may well be a temporary net loss of dues-paying members owing to impulsive resignations of some who opposed a change in the character of the *Journal*. But these defections should soon be overcome by new members who will like a journal that keeps them informed about scientific activities in their own community. The growth of the Academy could be very rapid if it will admit all who are interested or may become interested. The present members, who are persons of considerable experience and achivement in science, could become Fellows of the Academy, and people of all ages without special qualifications could become members and make the work of the Academy in the scientific community more cooperative and less benevolent.

Meetings

The Academy holds eight meetings per year on the third Thursday of the month including the annual dinner meeting in January. In 1959 the annual meeting was held at the Kennedy-Warren apartments. The officers' reports and Academy awards were presented at the annual meeting. In February the meeting was held in the John Wesley Powell auditorium of the Cosmos Club. Retiring President McPher-

son gave a remarkable address on food and civilization, from the beginning of agriculture to the future when expanding populations may require production of food by chemical industry. In March the Academy met jointly with the Junior Academy in the auditorium of the U. S. National Museum to hear Dr. F. O. Rice and recognize members of the Junior Academy who had distinguished themselves in the National Science Talent Search. The next three meetings were held in the Powell Auditorium. In April two Academy award winners, Drs. Bolton and Branscomb, talked about their work in biophysics and physics respectively. In May the Academy was addressed by Dr. Hugh L. Dryden on space science, in October by Dr. Edward Teller on Project Plowshare, the constructive utilization of atomic explosions. In November members of the Academy met for dinner at the Johns Hopkins Applied Physics Laboratory in Howard County, Md. After dinner some of the laboratories were opened for inspection and then a meeting was held in the Laboratory's auditorium at which Academy award winners Rubin and Shen spoke about their work in radiocarbon dating and aeronautical engineering, respectively. The December meeting in the Powell Auditorium was addressed by Mr. Willard Bascom on the Mohole, the project of the American Miscellaneous Society to take a sample of the mantle of the earth and of all that lies above it on the bottom of the deep ocean. All nondinner meetings of the Academy were preceded by small dinners at which the officers entertained the speakers, and all meetings in the Powell Auditorium were followed by light refreshments for all.

Awards for Scientific Achievement

In the preceding paragraph Academy awards were mentioned. These are certificates of merit in the biological sciences, the physical sciences, the engineering sciences, and in teaching. In 1959 for the first time an award was made in mathematics. Each of these fields was represented by a carefully selected panel of six or seven Academy members, each a scholar in his own subject. The task of obtaining nominations, coordinating the work of the panels, and reporting the results was done by the chairman of the overall committee. These awards, established in 1939, have been very significant as shown by the subsequent careers of the young men and women who have received them. Award winners are invited to become members of the Academy, if they were previously overlooked.

Encouragement of Science Talent

A committee on this subject pays particular attention to the Washington Junior Academy of Sciences. In 1959 it had a hand or a voice in various activities of the Junior Academy: The Science Fair; the Science Talent Search; the Science Trip to New York; the first Science Conference, an all-day paper-reading session at the Burlington Hotel attended by 150 high school students, the meetings of the Governing Council, etc. In addition the Committee sponsored a summer research program that gave selected students an opportunity to work without remuneration at the National Institutes of Health. Of course, this committee cooperates with the Joint Board. We are very proud of its altruistic work among the junior scientists of this area.

Miscellaneous

In 1959 the Washington Section of the American Nuclear Society became affiliated with the Academy.

The Academy's second monograph, on microsomal particles, was published by Pergamon Press and had a satisfying sale.

Two small grants-in-aid for research were made to high school students, who requested support of less than $100 each for the purchase of supplies and equipment for their projects on the speed of light and paper chromatography.

Aided by representations from a special committee of the Academy on the need for science service in the Library of Congress after the usual working hours, the Librarian succeeded in getting support for longer Library hours.

Summary Financial Report for 1959

Washington Academy of Sciences
W. G. Brombacher, Treasurer

RECEIPTS

Dues		$5,377.50
Journal subscriptions and reprints		4,572.33
Sales of back numbers of the Journal		1,096.59
Interest and Dividends		3,413.20
Miscellaneous Income		90.60
Total income, 1959		$14,550.22

EXPENDITURES

Journal: Printing, reprints, editorial assistant (11 issues)		$10,712.55
Routine operations; officers and meetings		2,231.62
Headquarters office expense		4,884.75
Membership certificates (backlog cleared up)		338.99
Joint Board, Science Education		500.00
Science calendar		75.00
Total expenditures, closely, in 1959		$18,742.91
Deficit, 1959 operations	$4,192.64	
Cash balance, WAS only, December 31, 1958		$6,919.16
Bonds matured and cashed		2,000.00
Savings bank account closed out		1,586.25
Cash balance, WAS only, December 31, 1959		6,321.82
Investments, WAS only		
Value, December 31, 1958 (includes savings account)		$70,218.98
Value, December 31, 1959		70,097.88
Junior Academy		
In checking account,		
December 31, 1958		$833.59
December 31, 1959		1,337.04
In savings account, American Security & Trust Co., Dec. 31, 1959		2,000.00
Grant, National Science Foundation		
June 1959		$35,250.00
Expended to December 31, 1959		13,512.92
Balance in checking account, December 31, 1959		$21,737.08
Grand total in checking account, December 31, 1959		$29,395.94

Science in Washington

SCIENTISTS IN THE NEWS

This column will present brief items concerning the activities of members of the Academy. Such items may include notices of talks given, important conferences or visits, promotions, awards, election to membership or office in scientific and technical societies, appointment to technical committees, civic activities, and marriages, births, and other family news. Formal contributors are being assigned for the systematic collection of news at institutions employing considerable numbers of Academy members (see list on masthead). However, for the bulk of the membership, we must rely on individuals to send us news concerning themselves and their friends. Contributions may be addressed to S. B. Detwiler, Jr., Associate Editor, 2605 S. 8th St., Arlington, Va.

Catholic University

Virginia F. Griffing, professor of chemistry, participated in a Symposium on "Comparative Effects of Various Radiations," held February 15-20 under the auspices of the NAS Photobiology Subcommittee. The meetings took place on the Rio Piedras campus of the University of Puerto Rico.

Regina F. Herzfeld, professor of anthropology, presented a paper entitled "The Missionary's Knowledge of Local Language and Culture" at the Fordham University Conference of Mission Specialists, January 23-24.

Herbert C. Hanson, research professor of biology, has been elected first vice-chairman for 1960 of the Capital Section, American Society of Range Management.

Frank A. Biberstein, Jr., professor of civil engineering, was a member of the Advisory Panel for the New Laboratory Equipment Program to the NSF, which met in Washington February 4-5.

George Washington University

During the week of January 4, **Benjamin D. Van Evera,** in company with Acting President Colclough and Meredith Crawford, director of the Human Resources Research Office, visited GWU's Human Resources Research Units at Fort Knox, Rucker, and Benning, for conferences and demonstrations of the work these units are doing in the field of Army training.

On behalf of the Washington Board of Trade, **Dean Martin A. Mason** is directing a study of desirable improvements in graduate study opportunities in the Washington area. The purpose is to strengthen and improve the attraction of the area for private research and development companies.

Mary Louise Robbins, professor of bacteriology, was recently elected a Charter Fellow of the American Academy of Microbiology and President of the Washington Branch, Society of American Bacteriologists for 1960.

NAS-NRC

Walter H. Larrimer brought to a successful conclusion, last August, the ten-year NAS-NRC project on the production of Handbooks of Biological Data. Work on the Handbooks will be continued by the Federation of American Societies for Experimental Biology. Dr. Larrimer is now serving temporarily as a staff officer of the Division of Biology and Agriculture, in charge of arrangements for certain meetings and conferences.

Naval Research Laboratory

Herbert Friedman appeared on the CBS Conquest program, "Mystery of the Sun," on January 24, illustrating the background of, and recent advances in, rocket astronomy.

Dr. Friedman was recently elected to the Board of Directors of the American Rocket Society for a three-year term beginning January 1. On January 27 he attended the Board's first 1960 meeting in New York City.

Richard Tousey attended the First International Space Science Symposium of the Committee on Space Research (COSPAR), held recently in Nice, France, and presented a paper, "The UV Spectrum of the Sun." This paper reported recent rocket spectrograms in the range 500-1800A.

Horace M. Trent gave two talks at Virginia Polytechnic Institute on January 18. He addressed the Mathematics Club on "Some Contributions of Mathematics and Mathematicians to the Work Carried on at the U. S. Naval Research Laboratory"; and he addressed the Naval Research Reserve Unit on "The Functions of the Naval Research Laboratory as set up under the Office of Naval Research."

George R. Irwin and **J. A. Kies** presented a paper, "Fracture Theory as Applied to High Strength Steels for Pressure Vessels," at the Golden Gate Metals Conference, held in San Francisco February 4-6. On February 15 Dr. Irwin and **J. S. Srawley** presented a paper, "Brittle Frac-

ture," before the American Institute of Mining, Metallurgical, and Petroleum Engineers in New York City.

Smithsonian Institution

The American Ornithologists' Union has presented the Brewster Award—its highest honor—to **Alexander Wetmore,** research associate and former secretary of the Smithsonian Institution. This award was granted at the Union's 77th Stated Meeting, held August 25-30 in Regina, Saskatchewan. The citation read in part: "In Alexander Wetmore we hail a biologist who, during a career that now spans more than 50 years, has been one of the chief architects of American ornithology."

USDA, Beltsville

Bernice G. Schubert has been appointed technical editor of *Economic Botany*, effective February 1. This journal is now the official organ of the new Society for Economic Botany, formed last summer.

Erwin L. LeClerg, director of biometrical services, Agricultural Research Service, served as chairman of a meeting of Agricultural Experiment Station statisticans, held concurrently with the annual meeting of the Biometric Society in Washington, late in December. Dr. LeClerg was elected to serve again as chairman of this group at its next meeting, at Stanford University next August.

John H. Martin and **Reece I. Sailer** served as members of a USDA team that visited India, Pakistan, and Egypt during October and November, 1959, to negotiate grants for agricultural research by scientific institutions in these countries. The grants will be financed by Public Law 480 funds received from sales of surplus farm products.

Myron S. Anderson, before his retirement an employee of the Agricultural Research Service, has accepted an invitation from William Penn College, Iowa, to conduct a short course next May on the topic, "Soil and Civilization." He has prepared a syllabus designed to present soil science as a cultural subject, suitable for consideration in a liberal arts college.

J. L. Lowe and **R. L. Gilbertson** of the New York School of Forestry were guest workers at Plant Industry Station for two weeks in January, in cooperation with the Forest Disease Research Laboratory and the National Fungus Collections. Both men are specialists in the classification of Polyporaceae, one of the principal groups of wood-rotting fungi.

Paul R. Miller has been appointed to the Editorial Committee of *Annual Reviews of Microbiology* for a five-year term effective January 1.

Lawrence Zeleny of the Grain Division, Agricultural Marketing Service, spoke before the Chesapeake Section, American Association of Cereal Chemists, at its meeting on January 28. Dr. Zeleny's topic, "Wheat Quality Requirements in Asia and Europe," was based upon observations during his trip to Japan, Hong Kong, India, Pakistan, Holland, Germany, and England during the summer of 1959, under the sponsorship of USDA's Foreign Agricultural Service and the Great Plains Wheat Market Development Association.

John W. Mitchell has been appointed head of the Growth Regulator and Antibiotic Laboratory of the Crops Research Division, Agricultural Research Service. Dr. Mitchell, who described his research on plant regulators to Premier Khrushchev during the latter's visit to the United States, has recently published several papers on absorption and trans-location of agricultural chemicals by plants, and on methods used in studying responses of plants to regulating chemicals.

Arthur W. Lindquist represented the Entomology Research Division, Agricultural Research Service, at a meeting of the WHO Committee on Insecticide Evaluation held at Geneva, November 30-December 5. The committee consisted of single representatives from seven research organizations. Purpose of the meeting was to plan how WHO could speed up evaluation

of insecticides for control of *Anopheles* mosquitoes that are resistant to DDT, dieldrin, and BHC.

USDA, Washington

Hazel K. Stiebeling was a member of the U. S. delegation to an FAO conference in Rome, November 1-21, 1959, serving as advisor on matters relating to human nutrition and home economics.

Wilbur T. Pentzer attended the 10th International Congress of Refrigeration, held in Copenhagen last August, as a delegate appointed by NAS-NRC. At the Congress, he was elected vice-president of the Technical Board for the International Institute of Refrigeration, 1959-63, and vice-president of Commission 4, which deals with the refrigeration of foods and other agricultural commodities.

Dorothy Nickerson is author of a paper, "Light Sources and Color Rendering," which appeared in the January issue of the *Journal of the Optical Society of America.* The paper summarizes progress on industrial and agricultural problems concerned with good color rendering of light sources, including progress being made nationally by a committee of the Illuminating Engineering Society and internationally by a committee of the International Commission on Illumination.

Edson J. Hambleton attended the Sixth Session of the FAO Desert Locust Control Committee meeting, held in Rome June 29-July 4, 1959. After the meeting, he made an inspection tour of Regional Insect Control Project operations in Tunisia, Libya, the Sudan, Ethiopia, Lebanon, and Iran.

Last December, Dr. Hambleton attended the annual conference of the Regional Insect Control Project, held in Beirut, Lebanon, and afterward inspected project operations in Ankara. The Control Project is operated by USDA's Plant Pest Control Division in cooperation with ICA.

Joseph R. Spies attended the annual meeting and postgraduate course of the American Academy of Allergy, held at Hollywood, Fla., January 10-13.

On November 3, **Kenneth W. Parker** presented an illustrated talk, "Recent Advances in Range Management Research," before the Botanical Society of Washington. On December 16 Dr. Parker gave his impressions of New Zealand in a talk, "Life Down Under," presented to the Bethesda-Chevy Chase Chapter of the Izaak Walton League of America.

A three-week holiday in Mexico, December 19-January 8, gave **Harold H. Shepard** an opportunity to observe the considerable improvement in road and lodging conditions since his last visit in 1957. In some areas, the economic condition of the people also appeared better. An informal visit to the archeological site of El Tajin, near Poza Rica, was extremely interesting: Dr. Shepard recommends it to others who may desire to learn something of Mexico outside the capital city and Acapulco.

University of Maryland

S. Fred Singer, professor of physics, presented a research paper before the American Astronautical Society on January 21, during its Sixth Annual Meeting in New York City. His topic was, "The Radiation Belts of Planet Mars and Venus."

Monroe H. Martin, director of the University's Institute for Fluid Dynamics and Applied Mathematics, has been appointed honorary lecturer in mathematics at St. Salvator's College in Scotland. Currently on a year's sabbatical leave from Maryland, Professor Martin is now at St. Andrews, Scotland, where he is carrying on studies on the uniqueness of solutions to linear and non-linear boundary problems for partial differential equations.

Retirements

Benjamin Schwartz of the Animal Disease and Parasite Research Branch, Agricultural Research Service, retired November 30 after more than 43 years in Government service. Dr. Schwartz, whose maj-

or interests and contributions lay in the fields of parasitology and helminthology, received his formal education at CCNY, Columbia University, and GWU (Ph.D., 1920). He spent several years in the Philippines, where he served as professor of parasitology at the University of the Philippines, director of hookworm research for the Philippine Health Service, and co-editor of the Philippine Journal of Science. He was U. S. delegate to the International Congress of Tropical Medicine and Malaria in 1948, and president of the American Society of Parasitology in 1951. Dr. Schwartz plans to remain in Washington, and to write a book on parasitology and helminthology.

Deaths

Word was recently received at the Academy office of the death on July 23, 1959, of **C. E. Van Orstrand,** a retired member who had been living in Manito, Ill., since 1947. Mr. Van Orstrand, formerly with the Geological Survey here, was elected to the Academy in 1909.

AFFILIATED SOCIETIES

American Institute of Electrical Engineers, Washington Section

Chairman: Wade M. Edmunds (REA). *Secretary-Treasurer:* Irvin L. Cooter (NBS). Meetings in PEPCO Auditorium, 10th and E, N.W., 8:00 P.M. on 4th Tuesday.

March 22, "Modern Automatic Dispatching for Electric Power Systems," R. L. Tremaine, Westinghouse Electric Mfg. Co.

American Meterological Society, District of Columbia Branch

President: Jack C. Thompson (WB). *Secretary:* Raymond McGough (USN Hydro. Off.) Meetings at NAS-NRC, 2101 Constitution Ave., N.W., on 3rd Wednesday.

March 16, "The Tracks of Tropical Hurricanes," William Haggard, U.S. Weather Bureau.

American Society for Metals, Washington Chapter

President: William L. Holshouser (NBS). *Secretary:* Glenn W. Geil (NBS)

March 21, "Pressure-Induced Transformations in Metals," John E. Hilliard, General Electric Company.

American Society of Civil Engineers, National Capital Section

President: W. O. Hiltabidle. *Secretary:* Daniel P. Jenny. Meetings usually in John Wesley Powell Auditorium

Chemical Society of Washington

President: Allen L. Alexander (NRL). *Secretary:* John L. Torgesen (NBS).

The Board of Managers met on January 14 at the Cosmos Club, with incoming President A. L. Alexander presiding.

Dr. Alexander introduced the Society's guest of the evening, Aristid von Grosse of Temple University, who was later to address the general meeting. He also introduced new members of the Board and several new chairmen of standing committees.

The minutes of the December 13 meeting were read by retiring Secretary W. J. Bailey, and approved. The financial report for 1959 was presented by Treasurer S. B. Dewiler, Jr.; this showed income of $4,147 and expenses of $3,474, with year-end balances of $1,000 in the checking account) $6,198 in the savings account, and $8,511 in the ACS Cash and Investment Pool.

Dr. Bailey stated that a summary annual report of the secretary for 1959 would be read at the general meeting, and that a comprehensive annual report was expected to be completed and forwarded to the American Chemical Society about February 1.

Chairman C. R. Naeser of the Budget Committee presented a 1960 budget of $3,670, stating that it was based on an anticipated allotment from the American Chemical Society of $3,731. Principal changes from 1959 involved increases in

the Hillebrand Award and the Education Committee budget, and decreases in the Entertainment Committee budget and the councilors' travel fund. The budget was accepted by the Board.

J. M. Leonard reported for Chairman Leo Schubert of the Education Committee that $1,600 was expected to be available to pay for bus fare and lunches for high school students who will engage in research projects at NIH next summer. Of this amount, $1,000 will be contributed by the Washington Junior Academy of Sciences and $300 by the senior Academy, while $300 has been authorized by the Chemical Society of Washington. It is anticipated that 20 students may be subsidized with these funds.

Chairman P. J. Hannan of the Entertainment Committee reported on arrangements for the February 11 Board meeting at Caruso's Restaurant, and for the Hillebrand Award dinner on March 10 at the Presidential Arms. In an effort to publicize the dinner, an art contest for posters is being sponsored in colloboration with the Art Academy. After the contest, the posters will be displayed at various insitutions.

Chairman W. A. Zisman of the Programs Committee reported on tentative program plans for 1960. Dr. Bailey announced that the joint meeting with the ACS Maryland Section would be held on Friday afternoon and evening, May 6. The meeting is expected to have co-chairmen, symposia, and twice the number of papers as at the regular May meeting of CSW.

Chairman R. P. Maickel of the Public Relations Committee reported on the Committee's recent survey of other ACS local sections, to determine the use by newspapers of academic titles in referring to scientists. About half of the sections responded; they indicated that of 204 newspapers surveyed, only eight liimted the use of the title, "Doctor," to the medical profession and the clergy.

Insecticide Society of Washington

Chairman: Milton S. Schechter (Ag. Res. Cent.) *Secretary-Treasurer:* James F. Cooper (Plant Ind. Sta.) Meetings in Symons Hall Auditorium, 8:00 P.M. on 3rd Wednesday

Medical Society of the District of Columbia

Secretary: Theodore Wiprud
Meetings in auditorium of Medical Society Building, 1718 M St., N.W.

Society for Experimental Biology and Medicine, District of Columbia Section

President: George A. Hottle (NIH). *Secretary:* Edwin P. Laug (FDA)

April 7, meeting in Hall A. G. W. Univ. School of Medicine, 1335 H St., N.W.

Society of American Foresters, Washington Section

Chairman: James M. Owens

Mar. 17. "The National Wood Promotion Program", Mortimer B. Doyle, Exec. V. Pres., National Lumber Manufacturers Assoc., Washington, D.C.

Washington Society of Engineers

President: Adm. Charles Pierce (CDS). *Secretary:* William R. Ganser, Jr.

Feb. 3, "The Bulldozer and the Rose," Dana E. Doten, USPHS, and Garnet W. Jex, USPHS.

ACADEMY ACTIVITIES

New Members Since October 1959

Akers, Robert P.
National Institutes of Health
Allen, William G.
Maritime Administration
Birks, L. S.
Naval Research Laboratory
Buras, Edmund M., Jr.
Harris Research Laboratories
Burke, Bernard F.
Carnegie Institution of Washington
Crafton, Paul A.
George Washington University
Dawson, Reed
Department of Defense

Drummeter, Louis F., Jr.
Naval Research Laboratory
Haines, Kenneth A.
Agricultural Research Service
Hauptman, Herbert
Naval Research Laboratory
Karle, Isabella
Naval Research Laboratory
Karle, Jerome
Naval Research Laboratory
Krasny, J. F.
Harris Research Laboratories
Kruger, Jerome
National Bureau of Standards
Menkart, John
Harris Research Laboratories
Newton, Clarence J.
National Bureau of Standards
Orem, Theodore H.
National Bureau of Standards
Shen, Shan-fu
University of Maryland
Voss, Gilbert L.
Marine Laboratory, Miami, Fla.
Weil, George L.
Consultant, Washington, D. C.
Yaplee, Benjamin S.
Naval Research Laboratory
Yuill, Joseph S.
Forest Service, Beltsville, Md.

Reinstatement

Withrow, Alice P.
National Science Foundation

Corrections to 1959 Directory

Name	*From*	*To*
Ford, Tirey F.	1AW	1DNRL

JOINT BOARD

As part of the program supported by a grant from the National Science Foundation to the Washington Academy of Sciences, the Joint Board on Science Education is holding a series of curriculum conferences. The purpose of these is to bring together high school teachers, college instructors, and scientists to discuss problems in science education.

The agenda of these conferences consist of informal discussions on such topics as: problems in high school teaching arising from the need for college preparation; problems in college teaching owing to high school preparation; establishing better liaison between high school teachers, college instructors, and the scientific community on matters related to science and mathematics teaching.

In order to facilitate active participation of all attendees, the conferences have been limited to about 30 persons equally divided among the three types of participants. Three area conferences—Maryland area, D.C. area, and Virginia area—have been held for each of the disciplines of biology, chemistry, mathematics, and physics, or 12 in all. Participants met on Saturdays from 9:30 to 4:00 P.M. A group luncheon was sponsored by the Joint Board. The biology meetings were held in public schools while the chemistry groups met at three different universities. Private schools were chosen for the sites of the physics conferences, and government and private laboratories were hosts to the mathematics meetings.

The second phase of the program is now in progress. This consists of one area-wide summary conference in each of the four disciplines. To these have been invited representatives from the preceding conferences and, in addition, a few persons from national scientific societies who are particularly interested in secondary education.

Dr. Falconer Smith of NIH, who is also Chairman of the Joint Board, has chaired all of the conferences in biology; Dr. John K. Taylor of NBS presided at the chemistry conferences. Dr. Franz Alt of NBS has been chairman of the mathematics meetings, while Dr. Raymond J. Seeger of NSF has presided at the physics discussions.

The final phase of the conferences will be a meeting between science and mathematics supervisors of the local school systems and the chairmen of the preceding conferences. Dr. Raymond J. Seeger, chairman of the Joint Board's curriculum committee will preside. One objective of this

meeting will be to explore ways in which the Joint Board and the local scientific comunity can establish better liaison with the schools.

SCIENCE AND DEVELOPMENT

High-purity tungsten can now be easily plated on metal surfaces by using a vapor deposition process developed for the Navy by the National Bureau of Standards. The method, devised by W. E. Reid and Abner Brenner of the Bureau's electrodeposition group, involves reducing gaseous tungsten hexafluoride with hydrogen by passing it over the heated object to be plated. At temperatures above 300°C., tungsten is deposited on the hot surface, and the only other reaction product, hydrogen fluoride, passes out with the excess of hydrogen.

Geophysicists Rutledge Brazee and Frank Werner, of the Coast and Geodetic Survey, are conducting site tests in several Western States for a **suitable location of a proposed seismological laboratory.** Some of the states that are being surveyed are Colorado, New Mexico, Wyoming, Arizona, and Utah. Among its activities, the new laboratory will conduct research programs in the design, development, and calibration of sensitive seismographic instruments.

A "Space Vehicles Group" that has worked together as a unit for seven years **has been added to the staff of Atlantic Research Corporation.** This group has had extensive experience—averaging over 15 years per man—in the design, fabrication, and launching of multi-stage rocket hardware for missions exploring the upper atmosphere and space beyond the earth's atmospheric blanket. Formerly with the Aerolab Development Company (now a division of Ryan Aeronautical Company), principal members of the group have participated in major space projects such as "Argus," in which three atomic bombs were exploded at a 300-mile altitude over the South Atlantic.

Catholic University has begun construction of a new building for the School of Engineering and Architecture. The Engineering Library and the Departments of Civil, Chemical, Electrical, and Mechanical-Aeronautical Engineering, at present located in several buildings, will be housed in the new structure.

The Biology Department of Catholic University is offering a new course, **"Radioisotopes in Biology,"** in the spring semester, 1960. Part of the instrumentation necessary for the course was provided by a grant from the Atomic Energy Commission.

Proprietary medicines have a long and flamboyant history. Some of the fantastic extremes of the past are cited in a study of old English patent medicines which had a wide use in the American colonies, recently published by the Smithsonian Institution. It is the work of George B. Griffenhagen of the American Pharmaceutical Association, and James H. Young of Emory University. Such English nostrums as Daffy's Elixir Salutis, Turlington's Balsam of Life, Steer's Opodeldoc, Hooper's Female Pills, and Bateman's Pectoral Drops appealed to the busy colonial settlers with little time and small means. The proprietors pioneered in both advertising psychology and the development of distinctive packaging. The popularity of these remedies, some of which have lasted into our own century, owed much to the fact that though the ingredients inside varied (unbeknownst to the customer), the shape of the bottle did not.

In a wind-blown, white sand desert of northern South America—the great Guajira Peninsula—a nomadic, polygamous, matrilineal race of Indians has maintained its independence and ways of life for nearly 500 years. The people of this cultural island, **the Guajiros, are described by Raymond E. Crist of the University of Florida, in a report recently published by the Smithsonian Institution.** A notable characteristic of these people is the survival of the matrilineal, polygamous family. A man acquires a wife by pur-

chase from her family, paying in cattle, jewelry, etc.; hence a girl child represents a certain wealth to her parents, while a boy child represents an economic drain. Blood relationship is traced almost entirely through the mother.

The forthcoming seventh edition of the *Merck Index*, an outstanding chemical reference book, is scheduled for publication in March. This unique encyclopedia of chemicals and drugs, now containing 1,600 pages of text, has been published by the Merck organization for more than 65 years, and has become a standard reference work for chemists, pharmacists, physicians, dentists, veterinarians, botanists, and members of allied professions. The prepublication price of the new edition is $11.

A grant of $22,388 has been awarded by AEC to the University of Maryland Physics Department for purchase of equipment to be used mainly in training senior physics students in an atomic and nuclear energy course. Students also will be enabled to use other facilities such as the Department's Van de Graaf accelerator and related equipment purchased from University funds.

A bibliography on plasma physics and magnetohydrodynamics, the first book to be compiled on the subject, has been published by the University of Maryland. Prepared by James D. Ramer, a former librarian at Maryland, the publication contains over 1700 subject titles, an author index, and a numerical index to international atomic energy reports.

Total domestic iron-ore resources of the United States have been placed at about 75 billion long tons of crude ore, according to recent estimates by Geological Survey scientists. Of this amount, about 10 billion tons is classed as reserves—material usable under existing economic and technologic conditions. The remaining 65 billion tons is potential ore—material likely to become available under more favorable conditions. The potential ore may yield 25 billion tons of concentrates and direct-shipping ore.

LETTERS TO THE EDITOR

February 11, 1960

I regret to note the erroneous impression given on pg. 26-27 of the January 1960 issue of the *Journal of the Washington Academy of Science* to the effect that the meeting on December 14 was "between Academy officers and a number of members from the Smithsonian Institution". We made it entirely clear at that meeting that the individuals with whom the officers conferred represented the Geological Survey (Paleontology and Stratigraphy Branch) and the Department of Agriculture (Insect Identification and Parasite Introduction Laboratories) as well as the Smithsonian Institution. As you well know, the Institution provides quarters for staff members of these groups (and also for certain Fish and Wildlife scientists whose viewpoint was implied at our meeting), but they are in no sense to be considered "Smithsonian members".

The quoted notes imply that the viewpoint expressed on December 14 was a Smithsonian viewpoint: this is an error of fact, as a much wider group of scientists was represented. I wish to object to the misrepresentation of the viewpoint as coming only from "Smithsonian members".

An objection must also be registered to the implication that the scientists at the December 14 meeting wish the Journal to contain ". . . chiefly scientific material of a descriptive character, . . .". Our viewpoint was unmistakably stated as favoring the publication of scholarly contributions within the fields of interest of *all members*, without discrimination and insofar as finances permit.

A. C. Smith, Director,
Museum of Natural History
Smithsonian Institution.

Editor's note. This column is now available to Academy members for comments, criticism, statements of policy, and proposals about either the *Journal* or Academy actions. Contributions should be limited to 100-200 words and sent directly to the Managing Editor.

ACADEMY ANNUAL MEETING—1960

AWARD WINNERS AND GUESTS: *(reading from left to right)* ***TOP ROW:*** **Betty Schaaf,** science teaching award; **Helen L. Garstens,** science teaching award; **Harvey R. Chaplin, Jr.,** engineering sciences award; **Frank L. Campbell,** President, 1959-60; ***MIDDLE ROW:*** **Dwight W. Taylor,** biological sciences award; **Geoffrey S. S. Ludford,** mathematics award; **Alan C. Kolb,** physical sciences award; **David Chen,** President, Washington Junior Academy of Sciences. ***BOTTOM ROW:*** **Ralph B. Kennard,** chairman, Committee on Meetings; **Thomson King,** Director, Maryland Academy of Sciences; **W. Doyle Reed,** member, Committee on Meetings. *(Photos by Pat Krauss)*

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Institute of the Aeronautical Sciences	*Not Named.*
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American Inst. of Electrical Engineers	ROBERT D. ELBOURN
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Entomological Society of Washington	HAROLD H. SHEPARD
Society of American Foresters	*Not Named.*
National Geographic Society	ALEXANDER WETMORE
Geological Society of Washington	CARLE DANE
Helminthological Society of Washington	CARLTON M. HERMAN
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Insecticide Society of Washington	JOSEPH YUILL
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Institute of Radio Engineers	ROBERT HUNTOON
American Nuclear Society, Washington Section	URNER LIDDEL
Philosophical Society of Washington	LOUIS R. MAXWELL
Society of American Military Engineers	*Not Named.*

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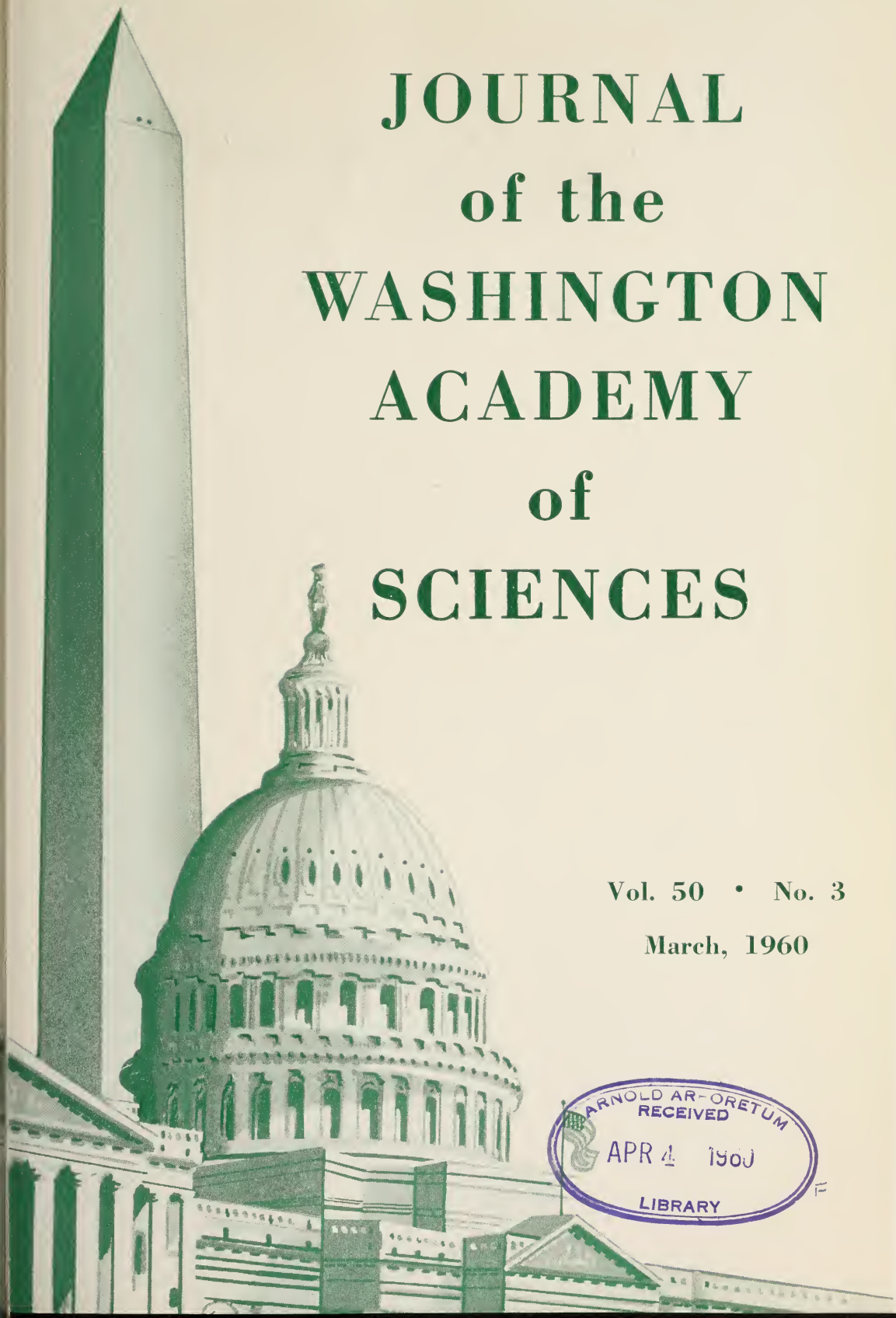

Vol. 50 • No. 3

March, 1960

JOURNAL OF THE WASHINGTON ACADEMY OF SCIENCES

Editor: Chester H. Page, National Bureau of Standards

Managing Editor: Ileen E. Stewart, National Science Foundation

This Journal, the official organ of the Washington Academy of Sciences, publishes: (1) historical articles, critical reviews, and scholarly scientific articles, (2) original research, if the paper, including illustrations, does not exceed 1500 words or the equivalent space, (3) notices of meetings and proceedings of meetings of the Academy and its affiliated societies, and (4) regional news items, including personal news, of interest to the entire membership. The Journal appears eight times a year in January to May and October to December.

Manuscripts and original research papers should be sent to the Editor. They should be typewritten, double-spaced, on good paper; footnotes and captions should be numbered and submitted on a separate sheet. The Editor does not assume responsibility for the ideas expressed by any author.

Contributions to the regular columns should be sent to the appropriate Associate Editor whose name appears at the beginning of each column, or to one of the Contributors, listed above. The deadline for news items is approximately three weeks in advance of publication date. News items should be signed by the sender.

Proof of manuscripts will generally be sent to an author if he resides in the Washington area and time allows. Otherwise the Editor will assume responsibility for seeing that copy is followed.

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Claims for missing numbers will not be allowed if received more than 60 days after date of mailing plus time normally required for postal delivery and claim. No claims will be allowed because of failure to notify the Circulation Manager of a change of address.

Changes of address should be sent promptly to the Academy Office, 1530 P St., N.W., Washington, D. C. Such notification should include both old and new addresses and postal zone number, if any.

Advertising rates may be obtained from the Managing Editor, Ileen E. Stewart, Office of Science Information Service, National Science Foundation, Washington 25, D. C.

Reprint prices may also be obtained from the Managing Editor.

Prices of back numbers and volumes, of Monograph No. 1, "The Parasitic Cuckoos of Africa" by Herbert Friedmann, Index to Vols. 1-40, and Proceedings may be obtained by writing to the Academy Office.

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Chemistry, Food, and Civilization

Synthetic Organic Chemistry Ushers in A New Era of Civilization

Archibald T. McPherson

National Bureau of Standards, Washington, D.C.

The Washington Academy of Sciences and its affiliated societies embrace a wide range of interests in the physical, biological, and earth sciences, and engineering. The members of the Academy, as individuals, living at this critical time in history, are deeply concerned with broad social, political, and economic problems as well as with their own scientific endeavors. Consequently it is appropriate for a retiring president to address the Academy on an important problem of world affairs, and for him to relate his own field of science to this problem. Accordingly, the problem to be considered in this address will be that of providing sufficient and adequate food for the world's explosively expanding population; the solution that will be proposed will stem from the field of synthetic organic chemistry.

The Population Problem

A major problem confronting statesmen and scientists today is that of stepping up food production at a rate which will keep pace with the explosive increase in the world's population. The unprecedented increase in population has come about largely through advances in sanitation and the elimination of infectious diseases which have greatly increased the span of human life.

The ultimate solution of the population problem lies in the field of social science; but social changes that will limit the population will, of necessity, be slow, and it is unlikely that they can be implemented in time to meet the present emergency. To gain the necessary time the physical scientist must provide an immediate solution.

The problem of food supply is not new. At the dawn of civilization 9,000 years ago food was scarce and food gathering was the principal concern of man. Even so, the population of the better-favored regions of the earth probably did not exceed one or two persons per square mile. The world population was probably about one million persons, and was certainly less than five million.

The development of agriculture at about 7,000 B.C. permitted an enormous increase in population, after which a condition of saturation was slowly reached. From the heyday of the Roman Empire up to about 700 A.D. the world population was relatively stable and has been estimated at about 200 to 300 million people. The population dropped during the Dark Ages, particularly with the devastation of the plagues; but it rose again during the Renaissance; and at the beginning of the present scientific age it has been estimated at about 545 million. Since 1650 the world population has been increasing at an ever accelerating rate. Figures recently released by the United Nations Department of Economic and Social Affairs give 2,497 million as the world population in 1950 and 3,828 million as the estimated population in 1975. Considering North America alone, the population increased from 137 million to 190 million in the short interval from 1933 to 1950.

In the light of these increases both abroad and on our own continent the present abundance of food and the large crop surpluses in the United States and Canada appear to be a very minor and transitory factor in the world food picture. These sur-

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This address, of a retiring President of the Washington Academy of Sciences, was delivered February 19, 1959.

pluses are large in relation to the population of the United States, but our population is only 7 percent of the population of the world. If, by some miracle of transportation, our surpluses could be distributed among the underprivileged peoples of China who subsist on 1800 calories per day, and among the only slightly more favored peoples of India, Burma, the Philippines, and Japan who live on 2000 to 2300 calories per day, such surpluses would suffice for only a few weeks to bring the diets of the ever-hungry peoples to the 3070 calorie average of the American population.

Vigorous efforts are being made to increase the food supply of the perpetually hungry countries by improved agriculture, by bringing more land under cultivation, and by improving the practices of food storage, preservation, utilization, and distribution. In agriculture two developments —one, present, and the other, in prospect —are of particular significance for increasing the food supply. They are the production of chemical fertilizer, and the soilless culture of both present crops and new types of crops.

Greatly increased crop yields are possible through the use of fertilizers specifically designed for local soil conditions. These fertilizers can be produced in very large quantities by the fixation of nitrogen from the atmosphere and by obtaining potassium, calcium, phosphorus, and other essential elements from mineral deposits.

The soilless culture of plants gives promise of being a much more efficient operation than conventional agriculture from the standpoint of the utilization of space and materials. The techniques are applicable to many though not all common food plants and afford the possibility of developing special types of algae and other new food plants which may prove highly efficient as food crops. Some algae have been developed which give a high yield of protein; other algae produce fat, and still others, carbohydrates. Heretofore the cost of tanks has presented a major problem in soilless culture. Now, however, tanks can be provided very simply by the use of inexpensive plastic film supported by earth embankments as is done for small swimming pools.

It is difficult to estimate how rapidly and to what extent these and other means will increase the production of food by agriculture. However, with the present supply of food barely adequate, it seems improbable that agricultural production can be stepped up so rapidly as to supply a more adequate diet and, at the same time, keep up with the rapidly growing population. Certainly agricultural production cannot be increased indefinitely and the inexorable law of diminishing returns will slow down and ultimately check the increase in production.

A similar situation exists in relation to increasing the supply of food through better preservation, storage, and distribution. A practical limit will be reached in the utilization of food at which the waste and other losses will be so small that further improvements can have no effect on the over all food situation.

In earlier ages when the population exceeded the food supply equilibrium was restored by mass migration or by widespread starvation. Today, barriers on immigration and the lack of suitable undeveloped land will prevent any extensive population movement. Under previous governments the Asiatic peoples have submitted to mass starvation, but with the present political leadership any large food deficit might precipitate a conflict between the have- and the have-not nations with disaster to both.

To meet the growing emergency, then, it is necessary to look for a solution that is entirely new but yet practical and capable of speedy implementation. There can be such a solution,—indeed, a solution that has such vast potentialities that it cannot only meet the present emergency, but it can usher in a new era of civilization.

The Chemist's Solution

The solution is based on the fact that it is now possible to make all substances essential for human nutrition by synthesis.

The raw materials required may be the chemical elements themselves or any readily available materials containing these elements. The raw materials that are the most practical at the present time are petroleum or coal as sources of carbon, nitrogen from the atmosphere, and phosphorus, sulfur, calcium, chlorine, fluorine, manganese, and other elements from mines or from the ocean.

The methods of synthesis, for the most part, are still in the laboratory stage. Before large-scale manufacture can be achieved it will be necessary to develop practical chemical engineering processes, and to build manufacturing plants. To accomplish such a development in the space of a few years will require a major coordinated research program comparable in magnitude to the present atomic energy program. The engineering phase of this investigation will require facilities of much larger capacity than the present chemical engineering industry in its entirety. However, the experience in previous crash programs, such as the wartime production of synthetic rubber, indicates that there will be no insuperable difficulty if a far greater program is undertaken. In the synthetic rubber program the output of synthetic rubber in less than three years reached a level that was approximately as high as the plantation industry had been able to achieve in 30 years.

The Beginnings of Agriculture

The production of food by synthesis affords the possibility of as far reaching a change in human affairs as was brought about by the discovery or development of agriculture about 9000 years ago. Agriculture made possible our present civilization by providing a reasonably dependable source of food that could be produced on a small area and stored for use throughout the year. This availability of food permitted large groups of men to live together in fixed habitations and gave them time for activities other than food gathering and thereby enabled each new generation to build upon the discoveries and knowledge accumulated in the past.

The early development of agriculture is still shrouded in darkness, and archaeologists are only beginning to obtain definite information about it. Very probably this discovery took place in the vicinity of the Tigris-Euphrates valley. The well known Fertile Crescent bounds this valley on the northeast, the north, and the northwest. A hilly zone flanking this crescent appears to archaeologists to have been the habitat of potentially domesticable plants and animals.

One of the earliest sites authentically associated with agriculture is the village of Jarmo. Braidwood, who excavated this site, states [1] "Jarmo must lie near, but not at the very beginning of the era of village-farming communities; in my judgment this beginning should be put at about 7000 B.C. It should be made clear that Jarmo is *not* conceived as *the* spot where the village-farming community level of existence came into being—we do not believe that there ever was one single such spot—but only that Jarmo represents the earliest example of settled village life which the accident of prior discovery has allowed us to use as a basis for description."

Solecki [2] in excavations of the cave of Zawi Chemi Shanidar found querns and manos dated as 10,870 years old or about 2000 years earlier than Jarmo. These querns and manos were presumably used for the grinding of cereal foods, but no evidence was found as to the identity of the grain or other material. Thus the domestication of plants and the practice of agriculture may have been slow and random in the early stages, but, once developed, the advantages were so many and so obvious that the village-farming pattern of life quickly spread throughout the Tigris-Euphrates valley, and from there into other areas.

The economy of Jarmo was based on the

[1] Science *127*; 1419, June 20, 1958.

[2] Solecki, Ralph S. (Smithsonian Institution), Private communication.

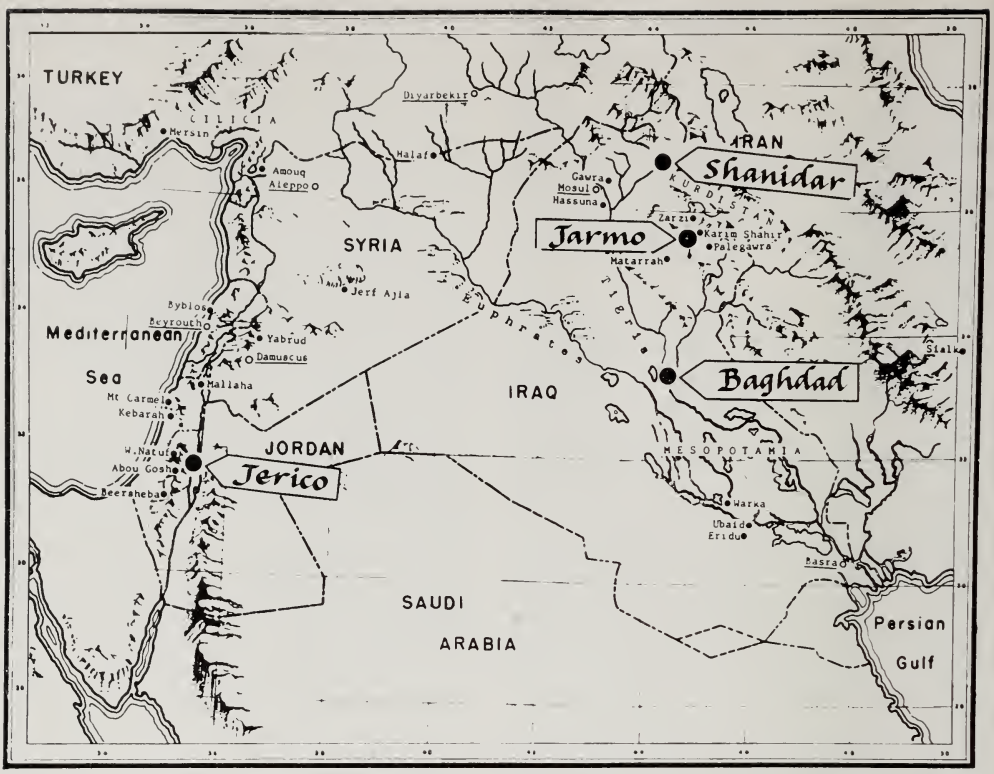


Fig. 1. The Fertile Crescent bounds the Tigris-Euphrates Valley, on the east, north and west.

cultivation of wheat and barley and the keeping of herds of goats and sheep. From the standpoint of nutrition there was good reason for this combination of vegetable and animal foods, as will be discussed later in this paper.

The Jarmo "Academy of Sciences"

Some early discoveries in science, mathematics, and engineering were undoubtedly made in villages such as Jarmo. It is very probable that senior citizens of Jarmo came together to discuss these discoveries and to exchange speculations about strange phenomena of nature that they now had the time and opportunity to investigate. We can imagine that these gatherings were about an evening fire for warmth and sociability. An early mathematician in the group may have developed a system of counting jars of grain in his storehouse and dividing them by the number of moons so as to assure a uniform supply of food for his household until the next harvest. A primitive engineer may have found how to burn brick in order to construct rain-resistant buildings. An early metallurgist —this was long before the discovery of bronze—may have made some tools from bits of meteoric iron picked up in the desert that were vastly superior to the bone and flint tools then in common use.

Not all of the discoveries were of a utilitarian nature. Undoubtedly some keen observer who guarded the herds at night must have noted that the star which we know as Algol waned in brightness for a brief period at intervals of about 3 days.

Agriculture, Food, and Civilization

At times the discussions around the evening fire at Jarmo undoubtedly centered on their mode of life, and the great advantages that they enjoyed over the people who still lived in the desert or the wilder-

ness and subsisted by hunting and the gathering of food where they found it. The leader of such a discussion may have pointed out that the city of Jarmo—it is estimated to have had about 700 inhabitants—occupied no more land with its fields and pastures than had previously been the hunting ground of a single family in the time of their ancestors. Such a speaker would undoubtedly have noted the great advantages of a fixed abode with houses to provide shelter and an abundant year-around food supply. He would have looked forward to a time when all of the inhabitants of the earth would live in cities such as Jarmo, and that it would no longer be necessary to fight for the possession of hunting grounds and caves because the new method of living would provide food and shelter for vastly more people and would give them leisure to cultivate the arts and learn about the strange and wonderful world in which they lived.

The title of such a discourse might have been, "*Agriculture*, Food, and Civilization." Our title this evening is "Chemistry, Food, and Civilization."

Chemistry of Life Processes

The bold assumption that chemistry can make as great a contribution to civilization in the next century as agriculture did 9000 years ago is based on the fact that the chemist has produced from non-living materials almost if not all of the substances essential to human nutrition. Furthermore many of the less abundant and more expensive of these substances are already being manufactured in relatively large tonnages. This does not mean that plant and animal tissues have been duplicated, but rather that the basic substances which they provide for the nutrition of the body have been synthesized, and that these substances are identical in every respect with the substances obtained from plant or animal sources. This identity has been established by a large amount of research, beginning with the classic chemical investigations of Wöhler in 1828, and continuing through a great number of chemical researches and feeding studies up to the present time. Whenever the feeding of synthetic materials has failed to satisfy nutritional requirements for normal growth it has invariably been found that some previously unrecognized essential constituent was present in trace amounts in the natural product but not in the synthetic. Such a finding has been at once a challenge to the chemist to separate, identify, and ultimately to synthesize the missing constituent.

The plant or animal grows and produces substances such as carbohydrates, fats, proteins, and vitamins by chemical reactions. Many of these reactions are well known and have been duplicated in the laboratory. The chemist, in synthesizing natural products, is by no means restricted to the reactions by which they are made in nature. He is often able to use simpler and more efficient methods of production.

Synthesis of Non-Food Agricultural Products

The major contribution that the chemist has thus far made to the problem of feeding the world has not been through the synthesis of food materials themselves, but rather through the synthesis of non-food agricultural products and the consequent freeing of agricultural lands for food crops. Many common products that were once obtained from plant or animal sources are now manufactured in large quantities by direct synthesis from petroleum, coal, atmospheric nitrogen, and other non-living materials. The extent to which synthetic products have displaced natural products is shown in Table 1. Dyes lead the list

Table 1. Natural Products now Made Synthetically*

Dyes	99 percent
Drugs and medicines	75 percent
Resins and plastics	97 percent
Paints	60 percent
Soap and detergents	59 percent
Rubber	52 percent
Textiles	25 percent

* The Chemical Industry Facts Book, 2nd Ed., p. 5, Manufacturing Chemists' Assoc., Washington, D.C., 1955.

with 99.5 percent synthetic production, and only textiles, with the enormous crops of cotton and wool, are still derived from natural sources to the extent of more than 50 percent.

Alizarin. It was only about 100 years ago that Perkin synthesized the dye, alizarin, which gives the color commonly known as turkey red. Chemically alizarin is 1,2-dihydroxyanthraquinone; it is readily made from coal tar as a raw material. Until 1870, 12 years after its synthesis, the sole commercial source of alizarin was the madder root, which was cultivated in France and other parts of Europe to the extent of 400,000 acres. The yield of pure dye from this area was about 750 tons per year, or only about 4 pounds per acre. By 1914 the cultivation of madder had been completely abandoned and the world supply of alizarin—now 2000 tons of the pure dye per year—was the output of a few men working in chemical manufacturing plants.

Indigo. The replacement of natural indigo by the synthetic product was accomplished at about the same time. In 1897 India produced 8,000 tons of the familiar blue dye; but only 17 years later, in 1914, the once thriving and lucrative plantations produced only 4 percent of the world's supply of the dye, in spite of extremely cheap labor.

Dyes, drugs, and other products that were among the first to be made synthetically had the advantage of being relatively small in tonnage and high in price, and hence could give a large return on the investment in facilities for their production.

Rubber. Rubber was the first product in the large volume—low price category to be synthesized commercially on a large scale. Prior to World War II relatively small quantities of Neoprene had been produced and sold at about a dollar a pound in competition with natural rubber at less than 10 cents a pound because of its superior oil-resistant properties. The shutting off of natural rubber during the war led to a crash program which, in the brief space of 3 years, produced large tonnages of both general purpose and special purpose synthetic rubbers at a cost in the same range or even below the price of natural rubber.

Under the stress of competition the per-acre yields of natural rubber have been greatly increased and economies in production have been effected that were not thought possible before the war. The different synthetic rubbers compete with natural rubber for the manufacture of some products because of superiority of their properties for particular applications. In other areas the competition is on a price basis. One synthetic rubber is identical in composition with natural rubber but, on account of cost, it is not yet in commercial production.

To illustrate the impact of the synthesis of rubber on the world food situation, let us assume that the land used for the growing of rubber would produce foodstuffs equivalent in calories to the rubber. Let us assume further that food requirements amount to 2350 calories per person per day, a high figure for Asiatic countries where most of the rubber is grown. On this basis the 1,054,625 long tons of synthetic rubber produced in the United States in 1958 would have required, if grown on plantations, land capable of providing food for 12 million people.

A broader view of the possible effect of synthesizing non-food agricultural products may be had by comparing the food and the non-food items in the world farm output. The summary in Table 2 shows that 88 percent of the farm output, weighted by prices, is in food items, and 12 percent in non-food items. Thus the complete replacement of cotton, wool, tobacco, rubber, coffee, tea, and other natural products by synthetic materials would release enough land to feed many million people, but the maximum that could be accomplished in this way would provide for the increase in population that would occur in 5 or 6 years.

Food Compared with Other Sources of Energy

The production of food by synthesis

Table 2. World Farm Output (Quantities weighted by prices)*

Food:	Wheat	10 percent
	Rice	10 percent
	Meat	20 percent
	Milk	15 percent
	Other	33 percent
	Total food products	88 percent
Non-food:	Cotton	4 percent
	Wool	2 percent
	Tobacco	2 percent
	Rubber	1 percent
	Coffee and tea	1 percent
	Other	2 percent
	Total non-food	12 percent

* Anon., "New Statistical Light on the World's Farm Output," Foreign Agriculture (United States Department of Agriculture), p. 14, April, 1958.

would employ petroleum, coal, and wood as the principal raw materials, together with atmospheric nitrogen and inorganic mineral products. Petroleum, in the form of either oil or natural gas, is now the principal raw material for the synthesis of rubber, resins, plastics, and other large-volume synthetics. Petroleum and coal, and to a lesser extent wood, are likewise the world's principal sources of energy for heat and power. Hence, it is important to look at the quantities involved to determine whether the wholesale production of food by synthesis would seriously deplete the raw materials needed for other sources of energy.

As has already been mentioned the energy content of the food consumed in the United States is 3070 calories per person per day, and is the highest of any country in the world. At the other extreme is mainland China with only 1830 calories per person per day. For purposes of the present calculation 2500 calories per person per day may be taken as the world-wide average. Then the energy requirement for the 1950 world population of 2,497 million was about 6.0×10^{12} calories per day or 2.2×10^{15} calories per year. In terms commonly used for fuels this figure is 2.55×10^{12} kilowatt hours.

The energy required for food is shown in comparison with the other sources of energy in Table 3. The heating value of the wood produced is practically the same as the food energy while the heating value of the oil is twice as great and that of the coal, four times as great. Thus, neglecting the energy that would be required in manufacturing operations, all of the food for the world could be synthesized from about one-seventh of the fuel supply.

In the United States the situation is quite different. While each person consumes 3070 calories per day in food, the fuel that he uses directly or indirectly in coal, oil, gasoline, and natural gas amounts to 160,000 calories per day. Hence, only one-fiftieth of the consumption of energy from other sources would suffice to provide the calories needed in food.

Looking to the future the fossil fuel resources of the world would quickly be exhausted if all countries should come to use fuel to the same extent as the United States. However, solar energy and nuclear energy will undoubtedly be called upon to replace fossil fuels to an increasing extent as sources of heat and power. The role that solar energy can play is indicated by the figures in the table which show that the solar energy reaching the land amounts to 100,000 times the energy represented by all of the food consumed in the world. The potentialities of atomic energy are vast, but no reliable estimates of the future en-

Table 3. World Sources of Energy *

	Energy per year (Unit, 10^{12} KW hr)
Food consumed by human beings	2.55
Wood production	2.5
Oil production	6.0
Coal production	10.5
Water power production	0.4
Photosynthesis by land vegetation	45.
Solar energy reaching the land	260,000.

* Table compiled from data by Thirring, Hans, "Energy for Man," p. 164, p. 222, and p. 262, Indiana University Press, Bloomington, 1958.

ergy production from this source can as yet be made. With the advent of the utilization of solar energy and atomic power, it may be possible to conserve the reserves of fossil fuel for chemical synthesis, including the synthesis of food.

Present and Potential Manufacture of Different Types of Food

Having made the general determination that food manufacture is possible and feasible, consideration will next be given to the specific accomplishments that have been made to date, and to the methods which appear practical for future development. In making this survey consideration will be given to the three major constituents of foods—carbohydrates, fats, and proteins—and to the minor constituents—vitamins, minerals, colors, and flavors. These minor constituents are minor only in the sense of being small in percentage.

Carbohydrates. Carbohydrates are the principal source of energy in the human diet and are the cheapest and most abundant food products in nature. The yields in which starches and sugars can be produced by agriculture render it unlikely that they will be an early target for commercial synthesis. Carbohydrates can, however, be synthesized directly from carbon by the following schematic reactions.

$$n\,C + \tfrac{1}{2}nO_2 \rightarrow n\,CO$$
$$CO + H_2 \rightarrow HCHO$$
$$6\,HCHO \rightarrow C_6H_{12}O_6$$

If the chemist is called upon to meet shortages of carbohydrates it is unlikely that he would use these reactions. Instead, he would probably turn to cellulose as the raw material since it is produced in nature in great abundance as the principal constituent of all plants, both terrestrial and marine.

Cellulose can be readily broken down by acid catalysis to forms of lower molecular weight, and ultimately to glucose. Under accurately controlled conditions the yield of glucose from cellulose is quantitative. Cellulose serves as a food for cattle and other ruminants because it is broken down by microorganisms in the rumen to a form capable of being assimilated, presumably glucose. It is likewise through the instrumentality of microorganisms that the termite is able to subsist on a diet of wood.

The production of edible carbohydrates from the cellulose in wood or woody materials is entirely possible, but the cost of removing lignin and other interfering materials and obtaining cellulose in a reasonably pure form is such that production is not economically profitable in competition with the growing of sugars and starches at the present time.

If the production were economically feasible it would provide a means of utilizing the vast amounts of waste paper produced in the United States. The annual consumption of paper and paper products in the United States is 34.5 million tons, or 400 pounds per person, in round num-

bers. Assuming that half of this paper is discarded and that it could be collected in the form of clean waste paper, it would amount to 200 pounds per person per year. This could be converted to about 180 pounds of edible carbohydrate, or about one-half pound per person per day. This amount of carbohydrate would provide about 900 calories, or a little less than one-third of the daily energy requirement.

Much larger amounts of cellulosic material are available from other sources such as farm crop wastes, and wastes in the production of lumber which may amount to more than one-half of the wood in the tree.

Fats. Fats are glycerides of both unsaturated and saturated fatty acids. Those most common in nature are the glycerides of palmitic, stearic, and oleic acids. The natural fats are mixtures of the glycerides of various fatty acids. Those in which the saturated fatty acids predominate are solid at room temperature; those in which the unsaturated fatty acids are in the larger proportion are liquid. The liquid fats such as cottonseed oil or whale oil can be readily converted to solid fats by hydrogenation, as is done in the production of oleomargarine.

In the process of digestion fats are broken down to the corresponding fatty acids and glycerine. Hence, for purposes of nutrition it would be necessary to supply only the requisite fatty acids. However, present day preferences relating to taste, consistency, and other factors would doubtless call for the glycerides rather than the fatty acids themselves.

Fats were produced in Germany during World War II from the paraffin-like products obtained by the hydrogenation of carbon monoxide. These paraffins were oxidized to the corresponding fatty acids which, in turn, were esterified with glycerine to produce low-melting fats. Reports state that these fats were of good taste and odor and that they were found to be digested and metabolized in the same way as the natural fats. For any really large scale synthesis of fats it would seem most practical to employ petroleum as a raw material and to separate or to build up from cracking products those hydrocarbons which could be oxidized to the desired fatty acids.

Unlike carbohydrates which appear to be interchangeable for meeting the body's energy requirements, certain fats are regarded as essential to the human diet. These are the fats of the unsaturated acids —linoleic, linolenic, and arachidonic acids. When more is learned about the role of fats in nutrition it may, at some future time, be desirable to undertake the synthesis of certain fats that might serve as dietary supplements. The current availability of fats from natural sources, however, is such as to discourage efforts at commercial production.

Proteins. Proteins are more critical items in the human diet than are carbohydrates or fats. They cost more, especially when derived from animal sources. They cannot be stored in the body, hence must be provided as needed. Furthermore, many proteins are not adequate to supply the body's needs, but must be supplemented by other proteins; for example, most plant proteins require the addition of some animal proteins to provide an adequate diet.

Proteins are high molecular weight polymers of amino acids and are usually made up of a number of different amino acids. Amino acids are characterized by an amino group, $-NH_2$, and a carboxyl group, -COOH. In the protein molecule the amino group of one amino acid is linked with the carboxyl group of another amino acid and this process is repeated so as to produce a chain. When the chain is short the product is a polypeptide; when the chain is long and the molecular weight is of the order of ten thousand to one million the product is a protein. The different amino acids in a given protein molecule are thought to be arranged in an orderly manner since the molecules, as viewed by the electron microscope, are uniform in shape and size, and may be crystalline.

The different amino acids differ widely in composition and structure, except for

the $-NH_2$ and the -COOH groups which all of them possess. Some are straight chain compounds; others contain benzene rings and other ring structures. Some are characterized by the presence of sulfur, and others by hydroxyl groups. Through the number and diversity of the amino acids the great number of different proteins found in nature are built up.

Proteins are utilized by the body in the form of amino acids into which they are broken down in the process of digestion. The amino acids themselves can be used to replace proteins in the diet, and are so used to some extent as will be discussed in subsequent paragraphs. For the human diet amino acids may be categorized as essential and non-essential. Eight are considered to be essential: isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophane, and valine. The non-essential amino acids can be produced in the animal body from other amino acids or even from some other sources of nitrogen. Some authorities recognize three amino acids as semi-essential — histidine, tyrosine, and arginine. These can be formed slowly by the body from other substances, but under stress of growth the rate is too slow for the maintenance of normal conditions.

The proteins from actively metabolizing tissues, whether plant or animal, are complete. Thus meat, seed germ, growing grass, and growing microorganisms all provide essentially the same nutritive value from the standpoint of furnishing a complete protein. The percentages of protein that they contain are, of course, different, and they differ widely with regard to other constituents.

The storage proteins such as those in grain, on the other hand, are incomplete to a greater or lesser degree and must be supplemented to provide an adequate diet. Thus it was no accident that the early western civilization in villages such as Jarmo was based on a wheat-barley-sheep-goat economy. Meat and milk were essential to provide the amino acids that were lacking in the grains. All subsequent civilizations which have made extensive use of grains have supplemented the grains by animal food.

The Chinese economy, on the other hand, has been based from the early beginning largely on the cultivation of the soy bean, with relatively less attention to animal husbandry than in the west. The reason is that the soy bean provides a much more nearly complete protein than does grain, and a relatively small supplement of animal food is required. Efforts to introduce the soy bean into the American diet have met with little success because the large consumption of meat provides the essential amino acids in proportions better suited to human nutrition than would the soy bean.

The storage proteins from grain are deficient in only a few of the essential amino acids—principally lycine and methionine, or a combination of cystine and methionine. These deficiencies are made in the present-day diets by amino acids from meat, milk, eggs, or other foods of animal origin. The disadvantage of this practice is that the total protein consumption may include more of some proteins than actually needed in order to secure a sufficient quantity of those containing the scarce amino acids.

A logical procedure, then, would be to supplement the incomplete protein by the addition of just the requisite quantities of the amino acids needed to make it complete. This procedure is coming to be the practice in animal feeding, using synthetic amino acids. For example, methionine, which has the formula

$$CH_3SCH_2CH_2\underset{\underset{NH_2}{|}}{C}HCOOH,$$

is produced under the trade name, HYDAN, for use as a supplement in feed for poultry, swine, and other animals. It is used along with fish meal to supplement the proteins in grain. A vitamin supplement is also used. The effectiveness of these supplements is shown by the fact that it is now possible to produce 3-lb broilers with 25 percent less feed and in 2 weeks less time than formerly.

The use of amino acids in human food has lagged behind its use for the feeding of animals. However, one amino acid is currently sold in many food stores. It is glutamic acid, in the form of monosodium glutamate. Though almost tasteless itself, it is employed as a condiment since it has the property of augmenting the flavor of other foods; in soup or rice it gives the flavor of chicken. Because the amounts used are small and because the glutamic acid is not an essential amino acid, the monosodium glutamate cannot be said to serve any significant nutritional need.

The production of amino acids in 1957 was 4,345,000 lb. at market prices for the most part in the range from $1.25 to $2.25 per pound of the pure materials. At first glance these prices seem high in comparison with natural foods, but such is not the case when consideration is given to the net protein content. Meat, for example, contains only 10 to 20 percent of protein. Hence, to supply amino acids at $1.25 to $2.25 per pound meat would have to sell at 12½ to 45 cents per pound.

The relation between price, volume of production, and types of use of amino acids is illustrated by a market study that was made of lysine.[3] Lysine was first produced commercially in 1955 by extraction from natural sources at $12.00 per pound. In 1959 it was produced by a fermentation process at the rate of about 100,000 pounds per years at a price of $6.00 per pound. The major outlet was in the pharmaceutical industry for protein supplementation, appetite improvers, and vitamin formulations. It was also used in the food industry in specialty products such as high-protein breads and cereals. The market studies indicated that if the price could be reduced to $1.50 or $2.00 per pound the demand would increase by 50-fold. Even at $3.00 per pound lysine would be expected to move into the field of animal feeding as a supplement to the incomplete proteins of cotton-seed meal. An extrapolation of the curve showing the decrease in the price of lysine as a function of time indicates that the $2.00 per pound price may be reached by 1962 to 1964.

From the standpoint of chemical manufacture the production of amino acids is still in the stage of a small scale specialty operation. Large scale production would undoubtedly lead to a great reduction in the prices that now obtain. The only raw materials needed are petroleum, nitrogen of the atmosphere, and sulfur. All are available and cheap. In the early part of the century the fixation of nitrogen presented a major problem but now synthetic ammonia is produced in very large tonnages from atmospheric nitrogen. Ammonia is, of course, the substance used to introduce the amino group, $-NH_2$, into the amino acid molecule. Efficient, large-scale production of the amino acids might require the discovery and development of new reactions, and would certainly require extensive engineering research to put the processes into operation with automatic control. Experience in other fields of chemical manufacture indicates that all of this can be done within a relatively short time if sufficient manpower and funds are provided.

Vitamins. The composition and structure of vitamins have presented a particular challenge to the chemist because of the important role of vitamins in nutrition. As a result of intensive research the major vitamins have been identified chemically and made synthetically. The chemical manufacturer has been especially interested in vitamins because of the possibility of a large return from the production of relatively small quantities.

Vitamin C or ascorbic acid was once a scarce item in many diets because it is found in only a limited number of foods and is easily destroyed by cooking and by inadequate methods of food storage or preservation. The absence of this vitamin leads to scurvy, once a common afflication among persons of restricted diet, particularly in winter. The production of ascorbic acid in 1957 was 3,429,000 pounds. This output would provide a 25-milligram tablet for

[3] "Lysine prospects brighten," Staff article, Chemical and Engineering News, p. 25, April 20, 1959.

every person in the United States every day of the year. The wholesale price, $4.76 per pound, is equivalent to one-fortieth of a cent for a 25-milligram tablet. This is far below the price of citrus fruit or other foods containing the same amount of ascorbic acid.

Other vitamins, likewise, are produced in quantity. The 1957 output was 7,802,000 pounds, with an average price of $12.18 per pound. As an indication of the price range niacin at $2.42 per pound may be compared with vitamin B_{12} at $22,500 per pound. The high price of vitamin B_{12} is offset by the fact that the daily dose is only 1 microgram costing 0.005 cent.

It is ironical that the production and consumption of vitamins should be so high in the United States where there is such an abundant supply of adequate natural foods that some authorities regard much of the current use of vitamin supplements as unnecessary. However, if synthetic vitamins have made a contribution to the well-being of the American people, certainly the large scale production and use of vitamins elsewhere in the world would make an even greater contribution to the health and well being of many peoples having a much more restricted food supply.

Minerals. The minerals required for nutrition can, with a few important exceptions, be readily utilized by the body if supplied in inorganic form. Some animals are capable of producing their own supply of vitamin B_{12} if cobalt is fed in the form of an inorganic salt. However, the human body is not able to do this.

Mineral supplements such as those containing calcium, iron, and occasionally other elements are rather commonly added to bread made from white flour to replace elements lost in milling. Mineral supplements are regularly added to prepared feed for animals since the amounts normally present in grain and other constituents may not be adequate for optimum growth.

Colors and Flavors. Colors and flavors contribute little if anything to the nutritional value of foods but they add a great deal to the pleasure of eating. A very significant proportion of the colors and flavors used in the food processing industries, as well as those sold at retail, are manufactured by synthesis because they can be thus produced in far greater variety and more cheaply than from the natural products. The 1957 production of colors and flavors was 45,294,000 pounds, with an average price of $1.38 per pound. In other terms this output amounts to about 4 ounces per year for each person in the United States. Natural flavors usually consist of a major constituent with a variety of minor constituents, whereas the synthetic flavor may consist of a single, pure substance. The principal constituent of vanilla extract is vanillin. The artificial extract made from pure vanillin can be distinguished by some but not all persons from the natural product. To duplicate natural vanilla or any other natural flavor it would be necessary to identify, synthesize, and add the minor constituents.

The color and flavor industry is by no means confined to the duplication or imitation of natural products; the soft drink industry affords an illustration of the almost endless variety of colors and flavors that can be made which never occurred in nature.

Food Synthesis and the Present Chemical Industry

The order of magnitude of the task of synthesizing food for the world's increasing population can be estimated by comparing the additional amount of food that will be required with the present output of the synthetic organic chemical industry in the United States. According to estimate by the United Nations the world population will increase at the rate of about 53 million people a year between 1950 and 1975. Assuming that food for all 53 million persons is to be produced by synthesis at the rate of 500 pounds on a dry basis per person per year, the amount required would be 26,500 million pounds per year. In 1957 the sales of synthetic organic chemicals produced in the United

States amounted to 21,696 million pounds, valued at $5,367 million. Thus, to enable synthetic food to keep pace with the increase in population, the problem would be that of constructing each year plant and facilities for producing a quantity of amino acids, carbohydrates, fats, vitamins, and other materials only a little greater than the total output of the American synthetic organic chemical industry. The problem, however, would not be nearly as great as would be the duplication of the present industry because only a small number of items would be produced on the largest practical scale, whereas the present manufacture of organic chemicals involves the production of many thousand items, the majority of which are made on a small scale. But even with much of the production on a small scale, the average value of the synthetic organic chemicals produced in 1957 was only 25 cents per pound. If food products could be made at this price the 500 pounds required per person per year would cost only $125 at wholesale.

The capital outlay for plant and facilities can be estimated roughly by assuming a figure for the cost per pound of production per year. This figure would vary greatly with the items to be produced, the labor and materials available in the different countries, and the degree to which the processes had been developed to achieve maximum efficiency. Assuming a figure of $0.50 per pound per year, an annual investment of the order of $13,000 million would be required to step up synthetic food production so as to keep pace with the population during the next few years. This investment is about seven time the $1,775 million that was invested in 1957 by the American chemical industry for making chemicals of all kinds. On a world-wide basis this amount is small in comparison with military expenditures and lies within the realm of achievement. Certainly it would be a small price to pay if it would forestall major conflicts that might otherwise arise from population pressure.

Acceptance of Synthetic Foods

The acceptance by the American public of synthetic food products is an accomplished fact so far as vitamins, colors, flavors, and supplements to processed foods are concerned. The acceptance of completely synthetic foods, however, may present problems because of the conservatism of most people with regard to food habits, in addition to the prejudice in many quarters against anything that may be regarded as "chemical" or synthetic. To aid in overcoming objections the synthetic food materials can be produced in any desired texture,—soft, hard, brittle, plastic, tough, and even fibrous. There need be only an extension of the techniques already exploited by the breakfast food manufacturers. Natural flavors can be duplicated and a wide range of intriguing new flavors can be created.

Opposition is to be expected particularly from food faddists who base their practices on the long outmoded vitalistic theory that materials produced by plants or animals are inherently different from those obtained from non-living sources. Any such difference has, of course, been disproved by research over the last 150 years, but the lag in the general acceptance of scientific information is such that the vitalistic theory still has many vigorous champions.

One popular misunderstanding that is to be expected is that the synthetic foods will be produced in the form of pills in which the food is so highly concentrated that a few of the pills will constitute a day's ration. Facetious and serious references to such pills were added to some of the accounts of this address which have appeared in the daily press.

The acceptance of synthetic foods can be brought about most simply by the gradual extension of present practices of adding essential synthetic ingredients as supplements to agricultural food products that are known to be inadequate in themselves, such as white bread in the West and polished rice in the East. Public education coupled with the first hand experience of improved health and well-being will serve to minimize and ultimately to dissipate completely any problems with regard to acceptance.

Conclusion

The synthesis of food offers a solution of the problem of feeding the world's rapidly increasing population that is within the realm of practicality. The technical manpower and the capital outlay required to develop large-scale methods of manufacture and to construct the initial facilities would be large in comparison with most civilian manufacturing operations but would be small in comparison with the cost of military preparedness or a small war. Once the methods of production were fully developed they would be practical for utilization in even the now backward countries where the greatest population pressures are developing.

In the immediate future synthetic production could most profitably be devoted to materials designed to supplement those foods that can be produced by agriculture most economically and in the largest yields. Beginnings have already been made in the production and use of synthetic vitamins and amino acids as supplements to grains and other relatively abundant agricultural products, particularly for the feeding of animals. The use of these supplements could be extended so as to replace the less economical foods of animal origin. The signal advances that have been made in animal nutrition could be extended to human nutrition with a correspondingly great improvement in growth, health, and general well-being.

In the longer range, with continued population pressure, synthetic production could be extended beyond the supplements to provide the major foods themselves, including all of the essential amino acids, the fats, the carbohydrates, and the vitamins.

The history of synthetic organic chemistry shows clearly that synthetic foods can and undoubtedly will ultimately be developed to the stage at which they can be produced in such large quantities and at so small an expenditure of human effort that they will replace agriculture, just as agriculture replaced the hunting of game animals and the gathering of wild plants for food.

Such a development would permit a very great increase in the population of the earth, and at the same time would enable the population to be distributed in such a way as to avoid crowding. The consequent changes in the entire pattern of living would mark a new era as different from the present as the city of Jarmo was different from the cave of Shanidar.

Acknowledgment

The author gratefully acknowledges advice and assistance from Aaron M. Altschul, Augustus R. Glasgow, Clem O. Miller, Ralph S. Solecki, Neil W. Stuart, Francis Joseph Weiss, and other colleagues who have read this paper and offered helpful suggestions and comments.

Ed. Note: Page charges for excess material (above 8 pgs.) have been honored by the author.

Other Academies

Lawrence A. Wood

Following my recent installation as President of the Washington Academy of Sciences I thought that it would be fitting to find out just what an academy might be. The encyclopedia quickly led me back to an olive grove in a pleasure garden about a mile outside the walls of Athens, where Plato discoursed and founded a school of philosophic thought that continued to flourish for more than nine hundred years. In modern times, the encyclopedia continues, the word academy has come to denote a society having for its object the cultivation and promotion of science, art, or literature for the pure love of these pursuits. The first academy of science,

founded in Naples in 1560, was the Academia Secretorum Naturae, and membership was conferred only on those who had made some discovery in natural science. Its establishment must have been premature, for its founder, although acquitted on charges of practicing black magic, was ordered to close the academy. Various natonal or local academies devoted to science founded in the seventeenth century continue to this day. Our own organization does not conform to a general rule laid down in the encyclopedia to the effect that modern academies have almost without exception some form of public support in being either founded, endowed, or subsidized by a national or local government.

In this country our academy is a member of a federation called The Academy Conference of the A.A.A.S., which includes 35 academies of science bearing state names, 3 bearing regional names, and 5 bearing city names. Other well-known academies not affiliated with the Academy Conference are the American Philosophical Society of Philadelphia (1743), the American Academy of Arts and Sciences of Boston (1780), and the New York Academy of Sciences (1817).

The range of activities of these academies of science is very great and strongly reflects local conditions. Many of the state academies have only a general meeting once a year with the place of meeting rotating among the colleges and universities of the state. Many of the others sponsor more frequent meetings on specialized topics. The New York Academy of Sciences, for example, may have a dozen or more divisional meetings each month. Junior academies of science and other activities in secondary schools are often sponsored by the academies, some of them receiving grants for these purposes from the National Science Foundation. Collegiate sections for undergraduates are maintained by some academies. Some of the academies give annual awards of various sorts. Many of them publish journals or "proceedings" of varying content.

The most ambitious programs of academies include the ownership and operation of museums of science or natural history, planetaria, aquaria, libraries, etc., as well as the sponsorship of field expeditions, weekly television programs, and other activities. Only a few academies, located in large cities, find it possible to engage in activities of this sort, Some of the work of this type is supported by the income from endownments; other academies receive grants or other benefits directly from a state or city government.

In many ways the Washington Academy of Sciences is similar to other academies representing a state or a large city. The major difference from most of them lies in our activities as a federation of the local sections of the 27 affiliated societies.

Founded in 1898 the Washington Academy of Sciences has developed slowly over the years. In the past twenty years, during which I have been in a position to observe the Academy, the changes in the organization have been too few and too limited to reflect properly the tremendous growth of scientific activity in the Washington area and the emergence of our city as one of the outstanding world centers of scientific research. The present officers will be deeply appreciative of suggestions from the members and affiliated societies as to steps by which the Academy can increase its effectiveness and begin to assume again a more important position of leadership in the scientific life of the Nation's Capital.

E, S, and A Day

E S and A Day, as it is called colloquially, is the most publicized contribution of the DC Council of Engineers and Architectural Societies to the encouragement of education leading to careers in engineering, science, and architecture. When this local, annual event was first staged five years ago, it was called E and A Day and was limited to engineering and architecture and to education underlying these professions. Two years ago the cooperation of the Washington Academy of Sciences was sought, and S, for science, was added to E and A Day. But the work required to prepare for E S and A Day is still done by members of the DC Council and credit for it belongs to that organization.

E S and A Day attempts to accomplish its mission by turning a public spotlight for a half day each year on noted engineers, scientists, and architects and their work, and on dedicated secondary-school teachers who might otherwise remain in obscurity. But its impact is not limited to the effect of the program of the Day on its audience. Preparation for the Day is a highly organized effort that goes on for months preceding the event, and the process of seeking financial support for it, of obtaining nominations of outstanding teachers, engineers, scientists, and architects for awards, of advertising the Day and selling tickets to the luncheon—all this probably makes an impression on more people than does the Day itself.

On February 25, 1960, the featured event of the Day was a luncheon that more than seven hundred people attended at the Presidential Arms, 1320 G Street, N.W. The ballroom floor and a mezzanine floor above one side of it were crowded with circular or rectangular tables, each seating eight. The tables along the mezzanine railing faced an elevated head table on the other side of the floor below. There ten persons were seated: G. R. Tatum, General Chairman; Joseph L. Gillman, Jr., Toastmaster; Ralph I. Cole, Chairman, DC Council; Lawrence A. Wood, President, Washington Academy of Sciences; the featured after-luncheon speaker James A. Van Allen; and the members of the morning symposium on "Space"; i.e., Thomas J. Killian, Herbert Friedman, C. F. Gell, Paul A. Goettelman, and Hugh L. Dryden. In front of the head table and at a lower level was a longer table seating at its center those who were to receive the National Capital Awards in engineering, science, and architecture; i.e., Thorndike Saville, Jr., M. Lee Rice, and Anthony T. Zaia, respectively. On either side of them were places for six teachers: Mrs. Sarah B. Adams, Mrs. Edith M. Allen, Mrs. Virginia W. Biedler, Mrs. Edith L. Carter, Mrs. Helen N. Cooper, Mrs. Pauline Desmond, Mr. Thomas P. Hillman, Mr. Charles Kilbourne, Mr. Howard E. Kerr, Miss Johanna B. Kirstein, Dr. Bernice G. Lamberton, and Miss Katherine Shiels. By each of these twelve plates was placed a one-volume encyclopedia of science as a gift to the recipient of a Science Teacher's Award. Other nominees for awards were named in the program. The teachers were seated in the audience as guests of the Joint Board on Science Education. Very few members of the Washington Academy were present.

The presentation of awards to those named above preceded the address by James A. Van Allen on the "Radiation Environment of the Earth." Dr. Van Allen directed the design and assembly of instruments in Explorer I that detected around the earth radiation belts now named after him. It is well known that he is head of the Department of Physics at the State University of Iowa and that he played a leading role in the US earth satellite program before and during the International Geophysical Year, but it is not as well known as it should be here in Washington that for almost a decade he was a worker in the Washington scientific community and was a member of the Washing-

ton Academy of Sciences. From 1939 to 1942 he was a research fellow in the Department of Terrestrial Magnetism of the Carnegie Institution of Washington. During World War II he served as Lieutenant Commander in the Navy, ordnance and gunnery specialist and combat observer. After the war he returned to Washington and worked in the Applied Physics Laboratory, Johns Hopkins University, until he went to Iowa in 1951. In January 1949, when he was 34 years old, he received from the Washington Academy of Sciences its annual award for 1948 in the physical sciences "for his work in nuclear physics and cosmic rays." In April 1959 he was elected a member of the National Academy of Sciences.

Dr. Van Allen gave a long illustrated lecture on the methods and results of his investigations of the radiation environment of the earth. His slides gave his audience some appreciation of the complexity of the instrumental packages, or payloads, that were carried by five of our space vehicles. Results were shown in the form of graphs and maps of the radiation zones. At the end he touched on the biological effects of radiation found in these zones.

Science in Washington

SCIENTISTS IN THE NEWS

This column will present brief items concerning the activities of members of the Academy. Such items may include notices of talks given, important conferences or visits, promotions, awards, election to membership or office in scientific and technical societies, appointment to technical committees, civic activities, and marriages, births, and other family news. Formal contributors are being assigned for the systematic collection of news at institutions employing considerable numbers of Academy members (see list on masthead). However, for the bulk of the membership, we must rely on individuals to send us news concerning themselves and their friends. Contributions may be addressed to **S. B. Detwiler, Jr., Associate Editor, 2605 S. 8th St., Arlington, Va.**

APPLIED PHYSICS LABORATORY

Ralph E. Gibson was guest of honor and speaker at the annual dinner of the Cleveland Chapter, National Defense Transportation Association, on January 14.

Alfred J. Zmuda has been appointed a consultant to the Geophysics Panel of the Air Force Scientific Advisory Board. A paper by Dr. Zmuda entitled, "Some Characteristics of the Upper-Air Magnetic Field and Ionospheric Currents," appeared in the January issue of the *Journal of Geophysical Research.*

CATHOLIC UNIVERSITY

Frank A. Biberstein, Jr., professor of civil engineering, has been appointed chairman of ASTM Subcommittees III (Concrete and Sand Lime Units) and XI (Editorial).

Henry P. Ward, professor of chemistry, participated in a Summary Conference on Chemistry Teaching in the Washington Area, held at American Chemical Society headquarters on February 13.

COAST AND GEODETIC SURVEY

David G. Knapp received the Department of Commerce Meritorious Service Award on February 18, for unusual contributions to highly technical areas of the C&GS Geomagnetic Program.

Dean S. Carder spent most of February in Los Angeles as technical adviser to AEC on its current series of "Cowboy" experiments.

The Franklin Institute has awarded its Boyden Premium to **Carl I. Aslakson** "in consideration of his contribution to the measurement of the speed or radiation in space through the use of Shoran techniques and thereby as the first American to aid in establishing a new and significantly more nearly accurate value of 16 km per second higher than the long-accepted value." Captain Aslakson was expected to receive this award, which involves a cash payment of $500, at ceremonies in Philadelphia on March 16. The Boyden Premium, established in 1859, has been awarded on only two previous occasions.

GEORGE WASHINGTON UNIVERSITY

Mary L. Robbins has been appointed to an Educational Advisory Committee for a conference to be sponsored by the Women's Bureau of the Labor Department, in commemoration of its 40th anniversary next June.

HOWARD UNIVERSITY

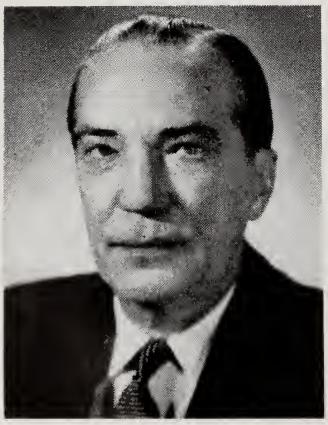
Lloyd N. Ferguson, professor and head of the Chemistry Department, served as visiting scientist at Hamlin University, St. Paul, Minn., February 8-10. The Visiting Scientist Program is sponsored by the American Chemical Society's Division of Chemical Education.

Moddie D. Taylor, professor of chemistry, is the author of a recent textbook, "First Principles of Chemistry," published by D. Van Nostrand Company (Princeton, 1960).

NATIONAL BUREAU OF STANDARDS

Harry A. Bright, chief of the Analytical Chemistry Section, retired on February 29 after almost 47 years of service in the Chemistry Division. Members of the staff and other friends gathered at the Senior Lunch Club to wish him well on his retirement, and to congratulate him for winning the 1960 Anachem Award for Outstanding Achievement in Analytical Chemistry.

Benjamin L. Page has been appointed chief of the Length Section, Optics and Meteorology Division, effective January 24. Mr. Page had been acting chief of the Section since March 1959.



Fourteen NBS Staff members were honored by the Department of Commerce at its Twelfth Annual Honor Awards Program on February 18. They were: **Francis C. Breckenridge, Frank R. Caldwell, Francis M. Defandorf,** and **Irvin H. Fullmer,** who received two-point diamond pins on solid gold and blue enamel emblems, in recognition of 40 years of excellent service; **Garbis H. Keulegan, Alvin G. McNish, Chester H. Page, Charlotte M. Sitterly, Herbert P. Broida,** and **Arnold M. Bass,** who received gold medals for exceptional service; and **Hugh Logan, Benjamin L. Page, John K. Taylor,** and **John Wachtman, Jr.,** who received medals for meritorious service.

On February 19, **Samuel N. Alexander** addressed the Philosophical Society of Washington on "World Wide Activities in Computing and Data Processing Technology."

John A. Bennett spoke on "Fatigue Fracture" at the Seminar on Mechanics of Fracture in Metals, held in Windsor, Conn., by the Hartford Chapter of the American Society of Metals.

A paper on "Deposition of Tungsten Coatings from Fused Salt Baths and from the Gas Phase" was presented by **Abner Brenner** on January 19 at MIT.

Florence H. Forziati has been elected secretary of the Washington Section of the American Association of Textile Chemists and Colorists.

Hans P. R. Frederikse spoke on "Properties of Titanium Dioxide" at the General Electric Research Laboratory, Schenectady, on February 19.

Walter J. Hamer presented a paper on "Aircraft Storage Batteries" before the American Institute of Electrical Engineers in New York City, February 1, and a paper on "New Developments in Batteries" at the regional meeting of the American Transit Association in Washington, on February 9.

Archibald T. McPherson, associate director for engineering, spoke on "Recent Developments in Standards" before the American Society for Quality Control at Parkersburg, W.Va., on January 20.

Aaron S. Posner has been appointed to serve on the Advisory Editorial Board of the *Journal of Dental Research.*

Bourdon F. Scribner attended the Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, February 29 to March 4, and presented a paper on "Relative Intensities for the Arc Spectra of Seventy Elements."

On January 22, **James L. Thomas** participated in the dedication of a new laboratory of the Arma Corporation at Garden City, N.Y., and reviewed "The State-of-the-Art in Electrical Standards".

NATIONAL INSTITUTES OF HEALTH

Sara E. Branham, currently participating in the visiting biologist program of the American Institute of Biological Sciences, has been named Medical Woman of the Year by the Washington, D.C., branch of the American Medical Women's Association. She retired as chief of the section

on bacterial toxins at the National Institutes of Health last July, after 30 years of work for the Public Health Service.

NAVAL RESEARCH LABORATORY

Richard L. Dolecek, superintendent of the Solid State Division, represented NRL at the Fourth Navy Scientific Symposium, entitled "Naval Problems in Electromagnetic Radiation," which was held in Pasadena, Calif., March 9-11. Dr. Dolecek is well known for his pioneering work on the entropy of superconductors and his role in the prediction of the isotope effect in superconductors.

William A. Zisman addressed the Chicago Section of the American Chemical Society on February 18. His topic was, "Wetting and Surface Constitution."

Herbert Friedman presented an invited talk, "X-ray Absorption Edge Spectroscopy," at the Norelco Eastern X-ray Spectroscopy School, New York, on February 18. On February 28 Dr. Friedman appeared as a guest on Johns Hopkins' File 7 television program, "A New Look at the Universe." He presented the story of rocket astronomy and reported on the latest developments in this field.

L. S. Birks, head of the X-ray Optics Branch, Optics Division, is author of a new book, "X-ray Spectrochemical Analysis" (Interscience Publishers, New York). This is Volume XI of "Chemical Analysis," a series of monographs on analytical chemistry and its application.

USDA, BELTSVILLE

Clarence H. Hoffman spoke on "Recent Advances in Entomology" on January 13, before the 37th Annual Meeting of the Pennsylvania Entomological Society at Harrisburg, Pa. On January 26 Dr. Hoffman presented a paper, "Insecticide Residues on Fruits, Vegetables, and Forage," at a symposium on chemical residues in agriculture held in East Lansing under the sponsorship of the Michigan Department of Agriculture and the Michigan AES. And on February 4 he presented a paper, "Aerial Applications of Insecticides in Relation to Fish and Wildlife," at the 9th Annual Nebraska Aerial Applicators Short Course, held in Norfolk, Neb.

Edward F. Knipling, director of the Entomology Research Division, Agricultural Research Service, was one of five scientists selected to receive the *Progressive Farmer* 1959 "Men of the Year" award. Dr. Knipling originated the idea of releasing sexually sterile males as a means of controlling or eradicating insect populations. The five scientists played a vital role in the development and application of this principle for the eradication of the screw-worm, an important insect pest, from the southeastern United States.

The possibilities of applying the sterile male method to control other insects and higher animal pests was discussed by Dr. Knipling in the October, 1959, issue of *Science*.

Frank P. Cullinan, associate director of the Crops Research Division, Agricultural Research Service, has been elected president of the Scientific Manpower Commission for the calendar year 1960.

USDA, WASHINGTON

Elbert L. Little, Jr., dendrologist with the Forest Service, has accepted the position of visiting professor of dendrology at the spring term of the Forestry School, University of the Andes, at Merida, Venezuela. He held the same position in 1953-54.

Harold T. Cook and **Herbert L. Haller** served on a USDA team that negotiated agricultural research grants and surveyed research institutions in Poland, Finland, Spain, France, Italy, Yugoslavia, and Israel during the last three months of 1959. The trip was undertaken in connection with the foreign research program that is being conducted under Public Law 480 and financed with funds received from sales of surplus farm products.

Harold H. Shepard is the editor of Volume II of "Methods of Testing Chemical on Insects," recently issued by Burgess Publishing Company of Minneapolis. The book includes techniques for the selection of effective insecticides, attractants, and repellents, with special attention to the factors affecting experimental results. Individual chapters are devoted to such subjects as the handling of spider mites, systemic chemical control of internal pests of livestock, etc.

Among other activities, **Ashley B. Gurney** of the Entomology Research Division is working on a taxonomic study of the Blattoidea (cockroaches) of the Philippines, Formosa, and Japan. This work is being done in collaboration with K. Princis of Lund, Sweden, who is coming to the U.S.A. under an NSF grant administered by the Smithsonian Institution.

UNIVERSITY OF MARYLAND

S. Fred Singer spoke at a convocation of the College of Arts and Sciences on February 25, on the topic, "Rockets and Outer Space." This was the first of what the College hopes will be a regular series of convocations, at which faculty members returning from sabbatical leaves can report on their activities.

DEATHS

William D. Urry, an active resident member since 1941, died of a coronary occlusion on December 16, at his home in Bethesda. Dr. Urry had been employed by the Air Force.

AFFILIATED SOCIETIES

American Institute of Electrical Engineers, Washington Section

Chairman: Wade M. Edmunds (REA). *Secretary-Treasurer:* Irvin L. Cooter (NBS).

April 26, "Power and Communications Problems in the Design and Construction of Dulles International Airport," Herbert H. Howell, Federal Aviation Agency.

May 24, program of technical papers in electrical engineering.

American Society for Metals, Washington Chapter

President: William L. Holshouser (NBS). *Secretary:* Glenn W. Geil (NBS).

April 18, "Titanium and Competitive Stainless Steels," Walter L. Finaly, Crucible Steel Company.

May 16, National Officers Night, featuring address by the National President, Walter Crafts, on "Facing the Productivity Challenge: Men and Metals of the Next Decade." This meeting will be at the Officers Club, Naval Weapons Plant and not at the All States Restaurant.

American Society of Mechanical Engineers, Washington Section

Chairman: Alfred F. Bochenek (Bit. Coal Inst.) *Secretary:* Virgil L. Pence.

April 20, annual banquet, Terrace Dining Room, Arlington Towers; speaker will be W. H. Upson, writer and lecturer; music by a Navy choral group; presentation of awards to local section members by the President of ASME, Walker Cisler.

Anthropological Society of Washington

President: Harvey Moore (AU). *Secretary:* Frank Anderson (U.Md.).
Meetings on third Tuesday, except June-Sept., Room 43, Museum of Natural History, at 8:15 P.M.

March 22, "Culture Change Among the Utes," Dr. Gottfried Lang, Catholic University.

Botanical Society of Washington

President: Harold T. Cook (USDA). *Corresponding Secretary:* Muriel J. O'Brien (USDA).
Meetings on first Tuesday, John Wesley Powell Auditorium, 8:00 P.M.

Columbia Historical Society

President: Maj. Gen. U. S. Grant, 3rd. *Executive Secretary:* John T. Gibbs.

April 14, "History of the Cosmos Club," Paul H. Oehser; meeting at Heurich Memorial Mansion.

May 14, "The Friday Morning Music Club, a Record of 75 Years," Mrs. Frank P. Howard; meeting at Heurich Mansion, musical program and exhibit of sheet music.

Entomological Society of Washington

President: Paul W. Oman (USDA). *Corresponding Secretary:* Paul Woke.
Meetings on first Thursday, October to June, Room 43, National Museum.

Insecticide Society of Washington

President: Milton S. Schechter (USDA). *Secretary-Treasurer:* James F. Cooper (USDA).
Meetings on third Wednesday, Oct., Nov., Jan.-May, in Symons Hall Auditorium, U. Md., at 8:00 P.M.

Institute of the Aeronautical Sciences, Washington Section

Chairman: B. C. Myers II (NASA). *Secretary:* Harold Andrews.
Meetings usually on the second Tuesday of each month, at the International Room, Occidental Restaurant.

Philosophical Society of Washington

President: Louis R. Maxwell (NOL). *Secretary:* F. N. Frenkiel (DTMB).
Meetings held on alternate Fridays, John Wesley Powell Auditorium.

Society for Experimental Biology and Medicine, District of Columbia Section

President: George A. Hottle (NIH). *Secretary:* Edwin P. Laug (FDA).

April 7, meetings in Hall A, G. W. Univ. School of Medicine, 1335 H. St., N.W.

Society of American Bacteriologists, Washington Branch

President: Mary L. Robbins (GWU). *Secretary:* Elizabeth J. Oswald (FDA).
Meetings on the fourth Tuesday, Oct., Jan.- April, and sometimes May, at Walter Reed Army Medical Center, 8:00 P.M.

At its meeting on January 26, the members unanimously approved a series of recommendations prepared by its Executive Committee, reaffirming its support of the idea of the Science Fairs, but urging that: (1) preparation of a project for entry not be required as part of a formal course; (2) that no form of pressure be applied to induce students to prepare a project for competition; (3) that the project be prepared entirely in the home or school; (4) that major equipment used be made and assembled by the student, not borrowed from a scientific institution; (5) that a realistic limit be placed on the amount to be spent on project materials; (6) that the use of pathogenic organisms be prohibited; (7) that the student's advisor be notified

of the rules of the Science Fairs. These recommendations are being sent to appropriate organizations in the Washington area for consideration.

Society of American Foresters, Washington Section

President: James M. Owens (Dept. Commerce). *Secretary:* Matt C. Huppuch (Dept. Army). Meetings usually on third Thursday, during the winter season, at the YWCA.

No meeting in April.

The Fifth World Forestry Congress, first to be held in the Western Hemisphere, will be in Seattle, Washington, August 29-September 10, 1960.

The 60th Anniversary, Society of American Foresters, will be held in Washington, November 13-16, at Sheraton Park, with Arthur Greeley (USFS) serving as General Chairman.

Society of American Military Engineers, Washington Post

Secretary: Col. Robert P. Tabb, Jr. Meetings on third Monday, each month, at 12:15 for luncheon at Y.W.C.A.

Chemical Society of Washington

President: Allen L. Alexander (NRL). *Secretary:* John L. Torgesen (NBS).

The Board of Managers met on February 11 at Caruso's Italian Kitchens, with Pres. A. L. Alexander presiding. The officers of the Washington Junior Academy of Sciences were present as guests.

In a discussion of responsibilities of the Awards Committee it was suggested that the Committee consider nominations of members for awards other than those sponsored by the American Chemical Society.

Dr. Alexander read a letter from President Elkins of the University of Maryland, expressing appreciation to the Chemical Society for its interest in a suitable memorial to the late Nathan L. Drake. The letter stated that a new building adjacent ot the Chemistry Building will be named the Nathan L. Drake Lecture Halls, and that an appropriate plaque will be erected therein.

President-elect W. J. Bailey reported that a comprehensive annual report of the secretary for 1959 had been completed and forwarded to ACS headquarters. Several copies of the report are available for circulation among the membership of the Society. Dr. Bailey pointed out several little-known items of interest in the report: (1) numerous local section members serve in national offices; (2) as many local section members serve as councilors of ACS divisions as serve on the general ACS Council; (3) attendance at general meetings of CSW has averaged only 5 percent of the total membership.

The 696th general meeting of the Society was held on February 11 in the auditorium of the Museum of Natural History. This was a joint meeting with the Washington Junior Academy of Sciences. James H. Schulman, associate superintendent of the Solid State Division, Naval Research Laboratory, presented a lecture demonstration on "Crystals: A Study in Order and Confusion."

ACADEMY ACTIVITIES

Board of Managers, January Meeting

These notes are intended to outline briefly, for the information of the membership, the principal actions taken at Board meetings. They are not the official Minutes as prepared by the Secretary. —Ed.

The Board of Managers held its 525th meeting of January 19 at NAS, with President Campbell presiding.

For the Committee on Meetings, Dr. Campbell reported on arrangements for the dinner meeting of the Academy on January 19, and on the meeting of February 18, at which he will give the address of the retiring president.

On behalf of Chairman Van Evera of the Committee on Grant-in-aid for Research, Dr. Campbell reported on the application of a Fairfax High School student for a $45 grant, to be used in buying equipment for a science project. The Board provisionally accepted the application, subject to receipt of Dean Van Evera's formal recommendation.

Chairman Schubert of the Committee on Encouragement of Science Talent reported on the first Science Convention of the Washington Junior Academy of Sciences, held December 28 at the Burlington Hotel. About three dozen papers based upon original work were presented before an audience of 150 persons; this attendance comprised somewhat more than a third of the membership of WJAS (see list of papers in Jan. issue).

Dr. Schubert also reported on activities of a committee on research opportunities for high school students, which is arranging for some 20 students to work at Government laboratories during the summer. John M. Leonard of the Naval Research Laboratory is chairman of the committee. It is expected that a fund of $1600 will be available to provide transportation and lunches for the students; of this amount, $1,000 is being provided by WJAS, $300 by the Chemical Society of Washington, and $300 by the senior Academy.

The treasurer questioned whether the WAS Board had specifically authorized appropriation of $300 for the foregoing purpose; it was left that the secretary would check the Minutes of

previous meetings to determine what action had been taken.

For the Special Committee on Bylaws, Dr. Specht reported that the next action on the revised Bylaws (approved by the Board at its meeting of December 15) is to put them into form for consideration and approval by the Academy membership. In the version that is to be sent out, proposed changes will be indicated.

Dr. Campbell recommended that this committee be continued in operation during 1960, until action could be taken on a revision of the Standing Rules.

The Board took note that the new 1959 Directory had just been issued and was being mailed out to the membership.

Dr. Campbell suggested that incoming President Wood consider the appointment of a special committee on science in the proposed National Cultural Center. He felt that the Center might be used for international scientific congresses, or large national scientific meetings.

Dr. Campbell observed that the administrative secretary of WAS is bearing the burden of compiling and distributing the Science Calendar. He felt that the Joint Committee on Press Relations should be reactivated to direct this and other public relations activities.

Chairman Kushner of the Membership Committee presented for second reading the names of seven candidates previously proposed for Academy membership, as follows: Seymour L. Friess, Sydney Geltman, William A. Geyger, Samuel K. Love, Raymond L. Nace, Bertram stiller, and Madelyn Womack. These candidates were then elected to membership.

Dr. Specht reported that as of January 15 the Academy had 765 regular resident members, 61 retired residents, 191 regular non-residents, 60 retired non-residents, and 6 others, for a total membership of 1083. This represents a net increase of 17 over last year's total.

Dr. Specht reported the results of the recent referendum on the preferences of the membership on the future content of the *Journal*. The majority was clearly in favor of including news of the Academy and local scientific activities, as well as original scientific articles.

Dr. Brombacher presented the treasurer's financial report for 1959. This showed a total income of $14,550 and expenses of $18,743, giving a deficit of $4,193. The value of investments decreased from $70,219 to $70,098.

Dr. Rehder, custodian of publications, reported that the Smithsonian Institution needed the room in which Academy publications are kept, and that he is hoping to find space at the Carnegie Institution.

Board of Managers, February Meeting

The Board of Managers held its 526th meeting on February 16 at NBS, with incoming President Wood presiding.

The minutes of the 525th meeting were approved with minor corrections.

Dr. Wood announced the names of such 1960 committee chairmen as had so far been appointed. (See list elsewhere in this issue.)

The Board confirmed the appointment of an editor, a managing editor, and four associate editors of the *Journal*. (See list on masthead.)

The 1960 budget was presented by Treasurer Aslakson and discussed. This showed estimated receipts of $12,900, including $5,500 from dues, $2,000 from *Journal* subscriptions, $1,000 from sales of back issues of the *Journal*, and $3,500 from interest and dividends; and estimated expenditures of $13,560, including $4,000 for printing the *Journal*, $5,515 for the headquarters office, and $1,000 for the secretary's office. The budget was passed with the proviso that an item be included under Receipts to show that the $660 deficit was being offset by a withdrawal from reserve funds.

Dr. Wood presented a recommendation of the Executive Committee, that $300 be appropriated —as an unbudgeted item—to the Committee on Encouragement of Science Talent to defray transportation and lunch expenses for high school science students who will conduct research studies at NIH during the summer; these funds are to be supplemented by $1,000 from the Junior Academy and $300 from the Chemical Society. The recommendation was approved.

Chairman Hall of the Membership Committee presented for first reading the names of two candidates for membership. There were no candidates for second reading.

Chairman Schubert of the Committee on Encouragement of Science Talent discussed an aspect of the March meeting of the Academy, which will be a joint meeting with the Junior Academy. At this meeting some 25 winners of the Science Talent Search will be present as dinner guests. Dr. Schubert indicated that in the past, the cost of meals for the guests had been personally defrayed by Committee members; but that the affair had grown to such an extent that some relief was needed.

There was extended discussion of the wisdom of using Academy funds for the indicated purpose. The matter was resolved by formal action appropriating $200 to the Committee for 1960, to spend as it sees fit. (Presumably this item is to be added to the budget.)

Dr. Schubert reported on plans to hold a national meeting of Junior Academies of Science next fall, for the discussion of common problems; for the conduct of this meeting, it is hoped to obtain an NSF grant of perhaps $30,000. Dr. Schubert moved that the Academy serve as one of the sponsors of the event, without financial obligation. The motion was passed.

In a discussion of the *Journal*, various members commented favorably on the new format and content of the January issue, and on the important part that the publication can begin to play in giving the membership a picture of Academy activities. On motion of Aurel O. Foster, the Board formally commended the editors for their maiden effort.

Dr. Wood read a letter from the Society of American Bacteriologists, suggesting the development of improved rules for Science Fair exhibits. It was recommended, for example, that preparation of an entry should be voluntary, and not a requirement of high school science courses; that pathogens should not be included in exhibits; and that exhibits should be self-made. The letter was referred for comment to the Committee on Encouragement of Science Talent, as a preliminary to referral by the Board of Managers to the Joint Board on Science Education.

JOINT BOARD

Local Teachers Honored on E S and A Day

The annual Engineers, Scientists, and Architects Day luncheon held at the Presidential Arms on Thursday, February 25 was the occasion for the presentation of Distinguished Teacher Awards to twelve local elementary, junior high, and senior high school teachers. In addition, seventy five others were presented Citations for outstanding teaching of science and mathematics in the local area schools.

Engineers, Scientists and Architects Day was established several years ago to honor and call attention of the public to the contributions of these professions to human progress. Each year distinguished members of these professions who have made outstanding contributions are singled out for recognition. Because of the prime importance of good teaching in technologic advancement, it seemed proper to honor outstanding teachers at the same time. Accordingly, the Distinguished Teaching Award was inaugurated by the Joint Board on Science Education in 1958. From nominations by school principals, twelve are selected for the award which consists of a Citation and a personalized copy of a scientific encyclopedia. Others are presented Certificates of Citation. All are honored guests of the Board at the luncheon.

Distinguished Teacher Awards were presented to Mrs. Sarah B. Adams, Calvin Coolidge H.S.; Mrs. Edith M. Allen, Burrville Elementary School; Mrs. Virginia W. Biedler, Randle Highlands Elementary School; Mrs. Edith L. Carter, Adelphi Elementary School; Mrs. Helen N. Cooper, North Bethesda Jr. H.S.; Mrs. Pauline Diamond, Sherwood H.S.; Mr. Thomas P. Hillman, Gunston Jr. H.S.; Mr. Charles Kilbourne, Suitland Sr. H.S.; Mr. Howard E. Kerr, Francis C. Hammond H.S.; Miss Johanna B. Kirstein, McLean H.S.; Dr. Berenice G. Lamberton, Paul Jr. H.S.; Miss Katharine Shields, Garfield Elementary School.

Certificates of Citation were presented to: Mrs. Dorothy Arnold, Tuckahoe Elem. S.; Mr. Alfred H. Benna, Newport Jr. H.S.; Sister Mary Bennet, Sacred Heart Academy; Mrs. Anita Bickford, Leland Jr. H.S.; Mrs. Ellen Bortz, Walter Johnson Jr. H.S.; Mrs. Catherine S. Bride, Takoma Park Jr. H.S.; Col. K. T. Brunsvold, St. Stephen's S.; Rev. Angus N. Carney, Archbishop Carroll H.S.; Mrs. Althea R. Carrick, Glenn Dale Elem. S.; Mrs. Lillian Casey, Bethesda Elem. S.; Sister M. Margaret Charles, Academy of the Holy Cross; Mrs. Elsie Covell, Annandale Elem. S.; Mrs. Madeline H. Curtis, Western H.S.; Mrs. Helen Dawson, Cynthia Warner S.; Mr. James R. Dietz, Mt. Rainier Jr. H.S.; Mr. William W. Duncan, Francis Jr. H.S.; Mrs. Sophia R. Edwards, Anacostia H.S.; Mrs. Margaret Eimer, Chesterbrook Elem. S.; Mrs. Lucille R. Foncannon, Mount Daniel Elem. S.; Miss Willye B. Freeman, Jackson Elem. S.; Mrs. Thelma L. Garrett, Hyattsville Jr. H.S.; Mr. James S. Gaskins, Luther Jackson H.S.; Miss Mattylen Gassett, Suitland Elem. S.; Mrs. Ruth S. Genzler, Rollingcrest Jr. H.S.; Mrs. Virginia M. Good, Eastern Jr. H.S.; Mrs. Alice B. Goode, Pine Crest Elem. S.; Mrs. Katharine M. H. Hammond, Falls Church H.S.; Mrs. Pamela G. Hanrahan, Oxon Hill H.S.; Mrs. Anna B. Hawes, Fairlington Elem. S.; Mrs. Francis L. Hiett, Jefferson S.

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JUNIOR ACADEMY

Reported by David Malin, Chairman Publications Comm. WJAS

Ten members of the Junior Academy were recently honored by the national Science Talent Search. One of them, Samuel R. Friedman of Woodrow Wilson High School, has been selected as one of the 40 national finalists. As a finalist, he will exhibit his research work in astronomy at a Washington exhibition early in March and will be eligible for scholarship awards.

Friedman's research project was entitled "An Analysis of Dark Markings On The North Equatorial Belt of Saturn". The markings were observed primarily through the National Capital Astronomers' five-inch refractor telescope on the Naval Observatory grounds and were analyzed for spatial frequency. The resulting frequency curves did not conform to theoretical expectation. Friedman theorizes that this may be due to optical illusion, or to the pattern of reflection from the planet's rings. He is now planning further work on this problem.

Other Junior Academy members who have been selected for the Science Talent Search honors group include the following high school seniors: Patricia Page, Anacostia, Kenneth D. Taylor, Anacostia, Steven Bollt, Bethesda-Chevy Chase, Cathy Briggs, Bethesda-Chevy Chase, Michael Brownstein, Northwestern, Frederick Moore, Richard Montgomery, Thomas Pike, Washington and Lee, Gilbert Fritz, Wakefield, and Frank Taylor, McLean. The research work of these winners will be published in the first issue of the Journal of the Junior Academy.

The research work of these area winners varied widely. For instance, Frederick Moore performed experiments on thermo-electric conduction, while Cathy Briggs made a study of Carotenoids and Vitamin A. Steve Bollt designed computer circuits and Gilbert Fritz designed a rocket system. Michael Brownstein presented a seismic model study.

The annual joint meeting of the WJAS with the Chemical Society of Washington was held on February 11. The main speaker was Dr. James Schulman of Naval Research Laboratory, who spoke on "Crystals: A Study in Order and Confusion". Dr. Schulman emphasized the development of our concepts of the crystal lattice on one hand, and such diversifying factors as dislocations, interstitial vacancies and impurities on the other.

During the program, the officers of the Junior Academy summarized the activities of this Fall and Winter. They stressed such achievements as the Science Convention, the publication of the Redbook, the Science Trips, and the closer relationship with the school science clubs.

The Annual joint meeting of WJAS with the Washington Academy of Sciences takes place on March 19. At that time, the Junior Academy will honor the Talent Search winners.

SCIENCE AND DEVELOPMENT

A new physical sciences lecture hall at the University of Maryland has been named in honor of Nathan L. Drake, former head of the Chemistry Department, who died last October after 33 years of distinguished service to the University. The building, adjacent to the chemistry building at the north end of the campus, was constructed under Dr. Drake's supervision at a cost of about $250,000. It has a large lecture hall with a capacity of 360, a smaller lecture hall, and a classroom.

Ciencia interamericana is the name of a new bimonthly periodical, of which Volume 1, Number 1 has just been issued by the Panamerican Union. This publication will carry news of scientific accomplishments in countries of the Western Hemisphere, as well as reports on activities of the Panamerican Union in various fields of science. The first issue contains a feature article by Bernardo Houssay, "Importancia del adelanto cientifico para el desarrollo y prosperidad de las Americas"; another on "El Oceano —La ultima gran frontera"; news of the Organization of American States; and sundry reports on hemispheric scientific activity.

The Smithsonian Institution has received and placed on display a carbon specimen received from French Equatorial Africa, that weighs 740.25 carats and is the largest in any U. S. museum, and possibly in the world. Carbon, sometimes called carbonado or black diamond, is an opaque, black, tough, compact variety of diamond. It is unexcelled for diamond rock drilling, but because of its scarcity is used only where ordinary industrial diamonds cannot operate. It is also useful in truing hard rubber wheels and other difficult grinding operations.

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Acoustical Society of America	Richard Cook
Institute of the Aeronautical Sciences	*Not Named.*
Anthropological Society of Washington	Regina Flannery
Society of American Bacteriologists	Mary Louise Robbins
Biological Society of Washington	Herbert Friedman
Society for Experimental Biology and Medicine	Kathryn Knowlton
Botanical Society of Washington	Herbert C. Hanson
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American Society of Civil Engineers	*Not Named.*
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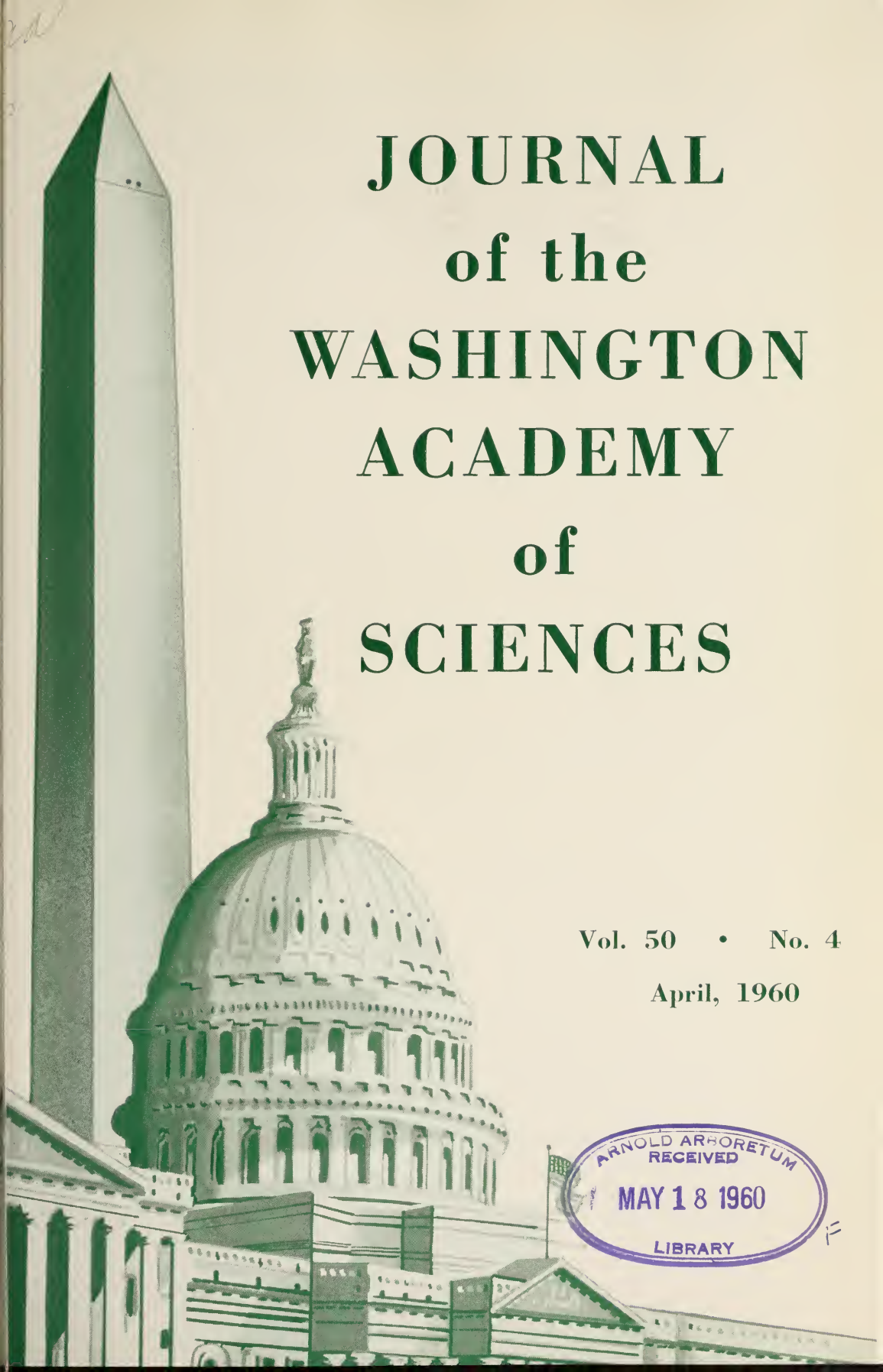

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JOURNAL OF THE WASHINGTON ACADEMY OF SCIENCES

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Managing Editor: Ileen E. Stewart, National Science Foundation

This Journal, the official organ of the Washington Academy of Sciences, publishes: (1) historical articles, critical reviews, and scholarly scientific articles, (2) original research, if the paper, including illustrations, does not exceed 1500 words or the equivalent space, (3) notices of meetings and proceedings of meetings of the Academy and its affiliated societies, and (4) regional news items, including personal news, of interest to the entire membership. The Journal appears eight times a year in January to May and October to December.

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The Number System Based on Six in The Proto* Finno-Ugric Language**

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The concept of number and the skill of counting developed well before recorded history. It appears certain that even in the most primitive times men had a sense of "number". (Number sense is not to be confused with counting, which is probably of a later development and involves a rather intricate mental process (1)).

A primitive number sense hardly greater in scope than that possessed by many animals, was the nucleus from which the number concept grew.

The next step was that an assortment of vocal sounds evolved to denote "couples", "trios", and perhaps a few other "numerosities."

Man's ability to observe the different "numerosities" of things is probably just as old as its ability to distinguish different colors.

Our present number words very likely originally referred to a set of concrete objects exhibiting the feature of being a "couple", a "trio", and so on, although these original connections are now lost to us.

As man began to rely more and more on language, the sounds replaced the images for which they stood, and the originally concrete objects gave way to the abstract form of number words.

With the gradual evolution of the society a simple counting became necessary.

To create a counting process, the "numerosities" represented by the number words had to be arranged in an ordered sequence.

When counting made it necessary, names for larger numbers were compounded with the original "simple" numbers and a "base" by repeating the simple numbers in combination with a base.

There is evidence that 2, 3, 4, and 5 served as primitive number bases.

The natives of Queensland count like: one, two, two and one, two twos, much. A tribe of Tierra del Fuego has its first few numbers based on 3. Some South African tribes use 4 as a base. The Api language of the New Hebrides have their numbers based on 5. Some of the natives of Africa and Australia have independent numbers for one and two and "composite" numbers up to six; beyond this everything is a "heap" (2).

The names of the cardinal numbers from 1 to 6 in the various Finno-Ugric (Fu)[1] languages are similar. The Hungarian (Hu) variants of these numbers are shown in Table I. These six numbers are of great antiquity. They existed before the separation of the various Fu languages. (The time of the separation of Fu unity is usually placed in the II millenium B.C.).

* Proto is equivalent to primordial, primitive and denotes a reconstructed, hypothetical stage of the language.

** A brief account of the Finno-Ugric language group is given in the appendix.

[1] Abbreviations used:
Ch=Cheremis, IE=Indo-European, Fu=Finno-Ugric, Fi=Finnish, Hu=Hungarian, La=Lappish, Md=Mordvin, Os=Ostyak, Vg=Vogul. Vt=Votyak, Zr=Zyrien.

Following the practice of *Professor Collinder* (3), the Hungarian words will be written with Hungarian orthography. For the rest of the Finno-Ugric words a simplified spelling will be followed.

There is no indication that these six Fu cardinal numbers were developed with the use of a base. However, the numbers larger than six show interesting features, which allows us to reconstruct that the original five numbers were simple numbers and the larger numbers were generated in a number system based on six.

TABLE I

The First Stage in the Development of the Finno-Ugric Numbers Is Illustrated With Present Day Hungarian Words

The simple numbers: (4)

egy = 1
kettö = 2
három = 3
négy = 4
öt = 5

hat, mis, min = many, numerous, number, six.

These numbers already existed before the separation of the Finno-Ugric group from the Samoyed.

At this stage there were developed five simple numbers and words to designate the concept: a lot, many, numerous . . .

It is not certain whether the words *hat, mis, min* at this stage carried the specialized meaning of six. The variants of *hat* appear as number six in the Finno-Ugric languages but not in Samoyed. According to Sauvageot (5) the Finno-Ugric (-proto) people developed six numbers.

The particle *mis* today appears in Hungarian only in composed numbers in the shortened form: *-nc, -c, -s* (6). Similarly, *min* appears in composed numbers in the form: *-van, -ven* (6).

In the following I intend to discuss three such features of the Fu numbers.

1. The Fu numbers 8 and 9 are not simple numbers but composed numbers (combination of a simple number and a base).

2. In religious folklore 7 and 6 show a puzzling "equivalence" as if no difference existed between them.

3. In building up the tens (combination of simple numbers and the base), the base changes in some of the Fu languages at 70, where a new base appears.

These features so far stood isolated and resisted satisfactory explanation. Nevertheless, I believe that when these features are examined in the proper light they supply strong arguments for believing that the original Fu numbers were built up in the number system built on six.

There are many details that enter into the picture I am presenting. In this discussion I selected only three features of the Fu languages that, I believe, show quite convincingly that the Fu people developed their numbers in the system based on six.

To my knowledge this is the first time that the invention and actual use of the number system based on six is indicated. There is, of course, nothing strange about having a number system based on six. People in various parts of the earth at various times, as we have seen, developed number systems that were based on various numbers.[2]

In a system based on six we would have

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[2] It is interesting to speculate why these people developed their numbers in the system based on six.

According to *Lenormant* (7) six for these people was a number "par excellence". According to *Varga* (8) the importance of six is related to the observation, that for six days the moon crescent represents an arc, but on the seventh day it becomes a half disc.

This arc of the moon can be brought into correlation with a counting process. Some tribes in Northern Siberia have 13 months (9) in the year and count them on the joints of the two arms and the head. The first joint on the pointing finger is one, the second joint two and so on. The wrist is four, the elbow is five and the shoulder six. The head represents seven, then come the six joints again on the other arm. In order to properly demonstrate the joints, there must be a little bending at all the joints, thus the finger, the hand and the arm form an arc, which could represent the crescent moon on the sixth day.

In this connection it is interesting to point out that Monday in Hungarian is *hétfö* and means the beginning of the week. Literally, the ex-

the names of the first five numbers. Then a base would be selected and the larger numbers would be compounded with the simple numbers and with the base (Table II).

TABLE II

Schematic Representation of How Numbers May be Developed in a System Based on Six

Simple numbers	Composed Numbers The "Teens"	Composed Numbers The "Tens"
1	1 + B = 7	1 × B = 6
2	2 + B = 8	2 × B = 12
3	3 + B = 9	3 × B = 18
4	4 + B = 10	4 × B = 24
5	5 + B = 11	5 × B = 30
6; Base		6 × B = 36

The capital letter "B" stands for the base.

For examples on how to carry out arithmetical operations in the number system based on six and for the use of the multiplication table, the reader is referred to: Theory of Numbers by B. M. Stewart, The MacMillan Company, New York. 1952.

In a number system based on six the numbers 7, 8, 9, 10, and 11 would be composed numbers; composed with a simple number and a base.

Our first inquiry is then to find out if the numbers 7, 8, and 9 in the Fu languages were composed numbers compounded with a "base" and a "simple" number.[3]

Let us look at the Hu numbers 8, 9, 20, and 30. At first glance they do not look "composed" (Table III), but students of Fu languages discovered that they are composed. The letter *-c* in three of them and the letter *-s* in one of them is the remnant of the word *-mis*. The transformation of this particle takes place through these stages: *-mis*, *-ms*, *-ns*, *-s*, *-c*, and so on (6).

TABLE III

The Composition of the Hungarian Numbers, Nyolc, Kilenc, Husz, Harminc (4)

2 + b	Nyol—c	(= 8)
	(Nyo—c)	
2 × b	Hu—sz	(= 20)
3 + b	Kilen—c	(= 9)
3 × b	Harmi—c	(= 30)
	(Harmi-nc)	

The original forms of these numbers were then something like this: 8=*nyó-mis*, (*nyol-mis*), 9 = *kilen-mis*, 20 = *hu-mis*, 30 = *harm-mis*.

In the Zr and Md languages the composed formation with *-mis* is still clearly noticeable even today in numbers like: 8 = *kikja-mis*, 9 = *ok-mis*, similarly in Md 9 = *ko-mis* (6).

These examples show that 8 and 9 are indeed composed numbers, and the same particle *-mis* is used in the composition, that also serves as the base in the formation of the tens.

Let us now examine the first component of these composed numbers. It is easy to see that the Zr 8 and 20, & the Hu 20 are compounded with the simple number 2. The words *kik-*, *ki-*, *ko-*, and *hu-* are phonetic variants of the Fu word for two. This number had the form *kikt* or *kakt* in the "proto" language (6). This form later changed to forms such as *kik-* or *ket-* or further to *ko-*, *hu-* by losing *-t*. No doubt, then, that the structure of 20 and 8 in these examples has the pattern: "two-base".[4]

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pression means: the head (=*fö*) of the week (=*hét*). But since *hét* also means number seven, the expression could also mean: Seven is head. It would be interesting to investigate whether this latter connotation of *hétfö* is related to the counting process just mentioned, where the head represents the seventh number.

[3] Today 7 is not a composed number in any of the Fu languages, but a loan word, borrowed from some Iranian tongue some 3000 years ago. To show that 7 was originally a composed number requires special considerations as will be shown later.

[4] The Hu word for 8 does not contain the above discussed form of the simple number 2.

Finno-Ugric linguists do not have satisfactory

The situation with 30 is also quite clear; it has the structure "three-base". (See Hu harm-inc) (4).

Let us now turn to the Hu *kilenc* (= 9). We have seen that this is also a composed number, where *-c* is the remnant of the original base *-mis*. The first part of the composition, *kilen-* may easily be recognized as a variant of the words for three [5] (Table IV). The Hu 9 thus has the pattern: "three-base".

TABLE IV

The Number "Three" in the Finno-Ugric Languages (3,5)

Hungarian	három
	harma-
Finnish	kolme
Lappish	galbma
	golma
Cheremis	kom
	kum
Votyak	küjn
Zyrien	kujim
Vogul	qorem
	qurem
Ostyak	kolom
Mordvin	kolmo

The Hu 8, 9, 20, and 30 have the same base (originally *mis*). In the course of time this base became reduced to essentially one consonant, which almost fused into the rest of the word.

We may summarize that in the Fu languages, 8 and 9 are composed numbers. Eight is constructed with the simple number 2 and a base. Nine is also constructed with a base, but the simple numbers of the construction are now recognizable as number 3 only in the Hu language.[6]

The important point here is, that these numbers are composed numbers, whether nine fits into the pattern of "three-base" in all instances is not important. The important point is that at least one example survived where the construction of nine fits into the pattern.

These findings give strong arguments to suggest that the Fu people generated their numbers in the system based on six.

Six Simple Numbers

Depending on whether the operation between the simple numbers and the base is

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explanation for the meaning of the particle *nyó-* (or *nyol-*). I believe the simplest explanation is that it is another word for two. This particle appears in the construction of 8 in the three Ugric languages only.

[5] In the customary handling of *kilenc* (=9), the *-nc* (rather than *-c*) is considered to be the contracted form of *-mis*. But for *kile-* no satisfactory etymology has been found so far (4). If *-nc* rather than *-c* would be the remnant of the base *-mis* then we could expect a variant of *kilenc* to be *kilec* (in analogy to *harminc, harmic* =30). Such a variant, however, is not known. This strongly indicates that only *-c* is the remnant of the base, and *-n* is an integral part of the word *kilen-*.

Since the Fu languages show both the "l" and "r" as well as the back and front vowel variants of 3 (Table IV) (10), the etymology proposed here for the Hu *kilen-* is not objectionable on linguistic grounds (11).

The reconstructed ancient forms of one (=*igt, ogt*) and two (=*kikt, kakt*) have both the front and back vowel variants. It is not surprising that 3 also has the front and back vowel forms.

[6] While the Hu *kilenc* fits into the pattern "three-base", the Zr *ok-mis* for example, does not fit.

The word *-mis* in *ok-mis* is generally accepted to mean ten and *ok-* as a variant of number 1 (which is the "proto" language had the form *ogt.* or *igt*). And the expression *ok-mis* is explained to mean: "one-(minus)-ten".

It is further pointed out that this formation is analogous to the Latin duodeviginti (2 minus 20) and undeviginti (1 minus 20).

The idea of subtraction, however, is not indicated in *ok-mis*, thus the literal translation is: one-ten.

Most of the expressions today for 9 in the Fu languages correspond to this "one-ten" pattern.

The likely explanation for the "one-ten" pattern is that it is not original; that after the original system based on six became forgotten and *-mis* became identified to mean ten (originally it simply meant number), the pattern "two-base" (=8) was interpreted to mean "two-(minus)-ten". Similarly, since at this stage three in combination with ten (3-base=9) made no sense, it was changed to the "one-(minus)-ten" pattern. It is fortunate that such a "rational" re-evaluation was not carried out in the Hu language and

addition or multiplication, we would get the composed numbers of the "teens" and the "tens".

Probably the "tens" 12, 18, 24, 30, and 36 developed after the realization that "base + base" means "two base". With this "two-base"[7] pattern (for twelve) 18, 24 . . . . followed in an analogous manner. probably in quick succession.

With the "tens" fully developed each "number-base" combination acquired a double value. The expression "five-base", for example, could mean "five and six" (= 11), also "five times six" (= 30). See Table V.

Such a scheme must not necessarily have given rise to confusion. The number 11 represents sufficiently smaller numerosity than 30. Undoubtedly, linguistic differences also developed to avoid confusion. In Hungarian, e.g., "three-(and)-base" is *kilen-c* (9), and "three-(times)-base" is *harmi-c* (=30, originally=18).[8]

The appearance of these double values as a result of the formation of the "tens" may explain why number six in the Fu language is a word different from the base: in order to avoid confusion of the composed six (one-(times)-six) with the composed seven (one-(and)-six), a new word had to be selected for six, or perhaps if six was already fully established by long usage, a different base was selected for the composed numbers. In either case number six became different from the base.

thus *kilenc* retained in its original form, meaning "three-six" (=9).

[7] It should be pointed out, that in Hungarian an expression such as "two base" has a structure similar to the English "door knob". The expression indicates that the "base" belongs to "two", that is, to a class of doubles. This is why the noun following a cardinal number is not put into plural in Hungarian.

[8] In Hungarian the back vowel in word pairs such as *kever*~*kavar* (=stir) refers to a greater intensity (12). It is then quite natural to expect that *három* (back vowels) is used in the construction of the "tens" and *kilen* (front vowels) in the construction of the "teens".

TABLE V

A Schematic Representation of the Second Stage in the Development of Finno-Ugric Numbers

The simple numbers	Composed numbers "teens"		"tens"
1	1-mis	7	6
2	2-mis	8	12
3	3-mis	9	18
4	4-mis	10	24
5	5-mis	11	30
6	6-mis		36

In this stage the composed numbers ("teens" and "tens") were formed with the particle *mis*. It is very likely, that in addition to *mis*, the particle *min* with its variants also may have played a similar role (see appendix).

The simplest method of adapting this pattern to the decimal system is to take over the group of "tens" to mean, 10, 20. 30 . . . . 60. This can be done if 24 (=40) and 30 (=50) are sufficiently different phonetically from 10 and 11. In such a case 10 and 11 can be dropped without fear that 40 and 50 can be confused with 10 and 11. To form the tens above 60, a new base has to be introduced because 7 is already a composed number (otherwise there would be a duplication of the same base).

The Zyrien numbers come closest to exhibiting this method of change with the exception that the composed six (1-b) was not taken over to represent ten.

Since in all the Fu languages the words for number six are common, on the other hand the base in the composed numbers varies (6), it is very likely that the base was adjusted to avoid the complications of the composed six. Already in the proto language there were several words with the original meaning: "number", which apparently were used to represent the base. See for example: Vg *-lau*, Ch *-lu* (*Ko-lu*=20); Zr *-mis* (*ko-mis*=20) (6).

I believe this is a satisfactory explanation for the fact that there are apparently

six simple numbers rather than five in the Fu languages.

The Seven-Six Equivalence

With such a change the confusion in counting was removed, but the fact still remained that the composed seven conceptually could refer to six. In the Fu religion seven was a holy number, a sacred number. There were seven chief gods. In religious ceremonies repeating certain acts seven times was an important feature (12,13,14).

In a society where seven was a sacred number, this "equivalence" of seven and six must have brought far-reaching repercussions. When a property of a god was represented by the composed seven, this also must have had the value of six. Thus six must have entered into religious incantations and folklore together with seven. Since such religious patterns tend to persist an extremely long time we may expect to find remnants of such an "equivalence" of seven and six in the remnants of religious folklore.

This expectation is fulfilled. In religious stories and incantations we find numerous examples of this "equivalence" of 7 and 6.

Ancient religious incantations, especially in the Ostyak and Vogul language, survived to the present day. In these incantations we can observe the amazing fact that seven is mentioned together with six, and always in this order (not six, seven).

Karjalainen describes the religious offering of an Ostyak tribe in 1898 to their idols (15). In the incantation following the sacrifice of a rooster there was the following passage: "I am asking for a black stag, for a brown stag from the regions of the Seven Lands of the Six Lands, from a branch of the Seven Rivers of the Six Rivers".

In the same year Karjalainen (15) observed another religious ceremony of this tribe performed at a forest holy place devoted to the chief god called Sanke. The prayer to this god started like this: "You are the light of seven lights, Oh Sanke, You are the light of six lights, Oh Sanke".

These examples demonstrate that the 7-6 equivalence really existed. Let me illustrate this relationship between seven and six with some other examples from Vogul mythology:

"The Seven Stallion, the Six Stallions (branch) of the god Numi-Tarem" (16). "The god Ajas of little Ob is a Hero of Seven Arrows of Six Arrows" (17). "Snowshoe Man made of seven Animal Hides, six Animal Hides" (18). "Stone-eyed Seven Demons, Iron-eyed Six Demons of the Ural" (19).

This "equivalence" of 7 and 6 has been quite puzzling to students of Fu folklore and religion. Karjalainen called this "equivalence" of 7 and 6 "poetische Zusammenstellung" (poetical composition). This "equivalence" of 7 and 6 in religious incantations is the result of the number system in which this group of people happened to develop their numbers. In fact, this "equivalence" of 7 and 6 is a very strong argument for the existence of the number system based on six because it shows that seven was a composed number, composed with the simple number 1 and the base.

It is interesting to point out that Lenormant (7) as early as 1875 expressed the opinion, that it should be possible to prove that 7 in these languages is composed from 1 and 6. To my knowledge, however, he never presented evidence to prove this point.

The Change of Base at 70

The Fu people now count in the decimal system, but from the manner they form their numbers we can detect that an original number system based on six at a later date was converted into the decimal system. This conversion also reveals to us that seven must have been originally a composed number.

Let us see how such a switch can be made. In the system based on six the composed numbers $1\text{-}B_1$, $2\text{-}B_1$, $3\text{-}B_1$, $4\text{-}B_1$, and $5\text{-}B_1$ with the meaning 7, 8, 9, 10, and

11 . . . . could also mean 6, 12, 18, 24, and 30, depending on the operation between the simple number and the base (Table VI).

TABLE VI

The Last Stage in the Development of the Finno-Ugric Numbers

Base = 6

	"teens"	"tens"
1		
2		
3		
4		
5		
6		
7	= $1\text{-}B_1$	$1\text{-}B_1$ = 6
8	= $2\text{-}B_1$	$2\text{-}B_1$ = 12
9	= $3\text{-}B_1$	$3\text{-}B_1$ = 18
10	= $4\text{-}B_1$	$4\text{-}B_1$ = 24
11	= $5\text{-}B_1$	$5\text{-}B_1$ = 30
		$6\text{-}B_1$ = 36

The switch to the decimal system.

Base = 10

1	
2	
3	
4	
5	
6	
7 = *	tens
8 = $2\text{-}B_1$	$2\text{-}B_1$ = 20
9 = $3\text{-}B_1$	$3\text{-}B_1$ = 30
10 = *	$4\text{-}B_2$ = 40
teens	$5\text{-}B_2$ = 50
10 + 1	$6\text{-}B_2$ = 60
10 + 2	$7\text{-}B_2$ = 70
and	$2\text{-}B_1\text{-}B_2$ = 80
so	$3\text{-}B_1\text{-}B_2$ = 90
on	* = 100

The change has taken place after the termination of the Finno-Ugric unity (between 2000-1000 B.C.). Illustrated schematically with the pattern exhibited by the Hungarian numbers.

Stars represent the places in the pattern, where loan words were introduced.

Numbers separated by broken lines became deleted during the switch to the decimal system.

Notice the doubly composed nature of 80 and 90.

When this system is converted to the decimal system, the expression $2\text{-}B_1$, $3\text{-}B_1$, and so on could be taken over to mean 20, 30. . . . 60. The difficulty starts with 70. Seven in the original system was already a composed number; so were eight and nine. It is inadmissible to compound these numbers with the same base once more in order to get 70, 80, and 90. The solution for this problem is: (1) to compound the numbers 7, 8, and 9 with a newly selected base to get 70, 80, and 90, or (2) to form the tens uniformly and replace the base in 7, 8, and 9.

If all the Fu people selected the second alternative for adapting their numbers to the decimal system, we would have very little chance to discover the original number system because as soon as the base became identified to mean "ten", the construction 3-B = 9 would make no sense. Thus in analogy to 8 (= 2-B) to be interpreted as "two-(minus)-ten", nine would be reinterpreted to mean "one-(minus)-ten".

If the first alternative was adopted, we could expect better success. In this method the original base for the "teens" would not be changed; thus these numbers would have a better chance to survive in their original linguistic form.

We should then direct our attention to those languages that have the same base in the construction of 8 and 9 that also appears in 20 and 30.

Let us see then if any of the Fu languages exhibit the feature of changing the base at 70 in the formation of the tens. Indeed, this situation is clearly seen in the Zyrien language. The tens are formed with the base *-mis* (*-min*) including 60, but at 70 a new base *-das* takes over (20).

A new base had to be selected because 7, 8, and 9 were already composed numbers constructed with the base "-mis". If the number 7 was not originally composed, but was a simple number, the selection of a new base would have taken place at 80. The change at *70 is a definite indication*

that 7 originally was a composed number.[9] In appendix 1 an attempt is made to reconstruct the original form of the composed seven.

In the Finnish language the change to the decimal system apparently has taken place without a change of the base at 70. Ten in Fi is *kümmen* and it is used for the formation of all the tens (6,21). Thus the numbers in the Fi language show the application of the second alternative for changing the number system. We should expect, then, that the base for the composed 7, 8, and 9 would be different.

This is indeed the case. The base for the composition of 8 and 9 is *deksa-*, an IE loan word (6). It is interesting that instead of borrowing 8 and 9 from the IE language, these people took the trouble to conserve the composed nature of these numbers.[10]

Discussion

The main advantage of the theory presented here is that practically all the scattered data about Fu numbers now appear in a consistent picture.

In this picture the seven and six "equivalence" so puzzling to students of Fu mythology, acquires a simple explanation as being the result of the number system in which the number names were formulated.

The only linguistic problem raised in this paper and for which a solution is offered is the etymology of the Hu *kilenc*. The rest of the arguments follow from the properties of the number system based on six.

I think the solution here offered for *kilenc* is a straightforward one and the probable reason why linguists have not advanced it before is that the strength with which other data lead to the postulation of the number system based on six has not been appreciated.

The few loan words Fu people have borrowed to complement their already existing numbers when the switch to the decimal system was made, came from one of the eastern branches of the IE languages.

An interesting feature of the change to the decimal system is the conservatism exhibited in these changes. Apparently all effort was made by these peoples to bring about the change in their own linguistic domain with the least amount of borrowing. And even when borrowing is made, the loan word is used for special purposes. For example, the Zr language borrowed the old Iranian *-das* to serve as the new base. But in Iranian *-das(u)* (meaning 10) is never used for the formation of the tens (20).

The spectacle of minimum borrowing and tenacious adherence to their own pattern indicates that the change of the number system was carried out with the understanding of the properties of the number systems.

Summary

It is argued in this paper that the names of Finno-Ugric numbers originally were built up not in the decimal system, but in a number system based on six.

It is pointed out that in most of the

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[9] A similar situation exists with the ancient Gothic numbers. The tens are formed with two different bases. The tens including 60 are formed with the base *tigjus* (e.g. *twa tigjus*=20), but at 70 a new base *tehund* takes over. (*Sieben tehund*=70).

The meaning of this change at 70 in the Gothic numbers is still debated. It has been suggested, that it reflects the influence of the sexagesimal system (20).

[10] In the number system based on six, the numbers 10 and 11 are also composed numbers. It may be inferred from the pattern of the formation of the tens in the Hu language, that 10 originally was a composed number: The change of base of the tens in this language takes place at 40. Number 30 (*harmi-nc;* three-base) is formed with the base *-mis* (reduced to *-nc*), but number 40 (*negy-ven;* four-base) is formed with a new base (*-ven*).

The composed number "4-base" originally must have meant 10 and 24. When the decimal system was introduced, a new word (*tiz*) replaced the composed 10. But when the composed ten was discarded, the composed 24 (meaning 40 in the decimal system) also had to be remodeled in order not to bring back the composed 10. This was achieved by employing a new base in the formation of forty.

Finno-Ugric languages the names of the numbers eight and nine are composed with a "simple" number and a base. Arguments are marshalled to show that originally seven also must have been a composed number, although at present it is a loan word from some Arian language. The change from the original number system to the decimal system was made in such a way that it also permits the conclusion that the original number system was based on six.

A definite success of the theory is that from the properties of the number system based on six, a rational explanation can be given for the puzzling equality of "seven and six" in Vogul and Ostyak mythology and religion.

Appendix 1

An Attempt to Reconstruct One Form of the Original Fu Composed Seven

In this paper several arguments are presented to show that in the Fu languages the original number seven was a composed number. At present, however, in all these languages seven is a loan word borrowed from some IE (Arian) language.

In the following an attempt is made to reconstruct how the original Fu seven may have looked. In this attempt it is recalled that the original seven must have had the same "one-base" pattern as the composed six. In the switch to the decimal system this composed six in some of the Fu languages may have been taken over to mean ten, thus preserving the original form of seven. We have to look then for a composed Fu ten in which the presence of the base and number one is still recognizable. The Md *kemen* and Fi *kümmen-* stand for ten and are used for the formation of the tens. Already Lenormant (7) surmised that *kemen and kümmen* are composed words formed from *-men* and *ke-* or *kü-*. His identification of the components, however, cannot be accepted in the light of progress made in Fu linguistics since Lenormant's time.

According to Collinder (25), also *kümmen* is a complex of two particles, where *küm-* probably means big. The second part of the complex, *-men* has the same etymology as the Hu *-ven*, Zr *-pen*, and thus means ten or number.

Since in the original Fu number system based on 6, the composed six was the first member of the "tens", it could have been called the "big" unit. The particle *küm-* could thus indeed mean "big". On the other hand, *ke-* in the Md *kemen* could very well be identified as a variant *of* number one (e.g. Hu *eg* (arch.) Fi *üh-*) Thus the original meaning of *kemen* could have been "one ten", a combination of number one and the base. These considerations argue strongly for identifying *kümmen* and *kemen* as the composed forms of the original composed six (one-base). And since the original form of the composed seven was similar, the Fu *kümmen*, the Md *kemen* may thus have preserved for us one of the original forms of the composed seven.

Appendix 2

The Members of the Finno-Ugric Language Group

The Hungarian (12,000,000), the Vogul (5,000) and the Ostyak (22,000) people form the Ugric branch of the Finno-Ugric language group. The Vogul and the Ostyak called the Ob-Ugrians, live now along the Ob river and its tributaries.

The Finnic sub-branch includes: Zyrien (400,000), Votyak (600,000), (called together the Permic sub-branch); the Finnish (4,000,000), Estonian (1,400,000), Cheremis (480,000), Mordvinian (1,500,000), Lappish (28,000) (the Volga-Finnic sub-branch).

The Samoyed (21,000) and the Finno-Ugric group is often referred to as the Uralic language group.

On the basis of the Indo-European loan words, one has to accept that the Proto Finno-Ugric people lived in the close proximity of the Proto Indo-European peoples. According to the most probable theory, the Proto Indo-European people

lived in central Europe, their eastern boundary reaching to the Russian steppes (23). Accordingly, the Proto Finno-Ugric people must have lived east of this region, very likely in the southern and western part of the Russian steppes (6). At this time their neighbors were the Proto-Samoyed and some yet unidentified Turkic tribes.[11]

Again judging from the loan words, the Proto Finno-Ugric people were still in one group when the Arian influence started. The separation of the Proto Indo-European group into the western and eastern (Arian) branch is not known definitely, but it appears that it occurred in the middle of the 4th millenium B.C. Apparently as a result of this mass movement, the Samoyed and the unidentified Turkic tribe were separated from the Proto Finno-Ugric people and were pushed to the east of the Ural mountains.

The Finno-Ugric people themselves were pushed to the western side of the Ural mountains in the region of the Kama river.

From here on the Finno-Ugric people lived on the northern fringes of the Russian steppe. An otherwise uninviting land of vast forests, tundra, and marshes provided security for them. The countryside itself was enough deterrent from penetration by Scythians (24) and other people of the steppes. Nevertheless, as the testimony of the loan words shows, there was a contact between the various Indo-European people of the steppes and the Finno-Ugric tribes.

The centuries at around 2000 B.C. were again a period of immense migrations. This was the period when the Indo-Europeans penetrated to Asia Minor (Hittites) and when about 1700 B.C. Indo-European tribes reached as far as the Yenissei River.

Apparently in this great migratory movement the Finno-Ugric group became split into two groups: the Finno-Permic branch and the Ugric branch. The exact time of the separation cannot be given but it is believed to have occurred sometime between 2000 and 1000 B.C.

[11] For a somewhat different interpretation of the data see: Molnár, The Ancient History of the Hungarians (23).

REFERENCES

1. H. Eves. An introduction to the history of mathematics. Rinehart and Comp., New York, 1955.
2. T. Dantzig. Number. The Language of Science, New York, 1954.
3. B. Collinder. Fenno-Ugric Vocabulary. Almqvist & Wiksells, Uppsala, 1955.
4. G. Barczi. Magyar Szófejtö szótár. Királyi Magyar Egyetemi Nyomda. Budapest, 1941.
5. A. Sauvageot. Langues Ouraliennes. In "Les Langues du Monde", Paris, 1952.
6. J. Szinnyei. Finnish-Ugrische Sprachwissenschaft. G. I. Göschen'sche Verhandlung, Leipzig, 1910.
7. F. Lenormant. La langue primitive de la Chaldee et les idiomes Touraniens. Paris, 1875.
8. Zs. Varga. Ötezer év távolából. Dr. Bertok Lajos Bizománya. Debrecen. 1942.
9. P. Hunfalvy. A számlálás módjai és az év hónapjai, Értekezés az akadémia nyelv és széptudományi köréböl XI. Budapest, 1884.
10. J. Budenz: Magyar-Ugor összehasonlitó szótár, 1873-81. Magyar Tudományos Akadémia Könyvkiadó Hivatala.
11. E. Bakó. Personal communication. Library of Congress, Washington, D. C.
12. J. Lotz. Appendix C in the book by G. Roheim on Hungarian and Vogul Mythology (see ref. 13).
13. G. Roheim, Hungarian and Vogul Mythology. J. J. Augustin Publisher, Locust Valley, New York, 1954.
14. B. Munkácsi. Vogul Népköltési Gyüjtemény. Vol. I (1892-1902), Vol. II. pt. 1 (1910-1921), pt. 2 (1892-1921), Vol. III. (1893, Vol. IV (1896), Budapest.
15. K. F. Karjalainen. Ostjakkeja opimassa. Journ. de la Soc. F. ougr. XVII.
16. Ref. 14, III. 40
17. Ref. 14, II 4

18. Ref. 14, II, pt. 1, p. 0202
19. Ref. 14, II, pt. 1, p. 0263
20. F. Sommer. Zum Zahlwort. Verlag der Bayerischen Akademie der Wissenschaften. München, 1951.
21. G. Orbán: A finnugor nyelvek számnevei, Budapest, 1932.
22. P. Thieme. 1958. The Indo-European Language. Scientific American, *199*, 63.
23. E. Molnár. A magyar nép östörténete. Szikra, Budapest, 1953.

Finite Groups Having Elements of Every Possible Order[1]

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A finite group G is said to have elements of every possible order if G contains an element of order n whenever n is a proper divisor of the order of G. This paper gives a characterization of such groups. The authors wish to thank Dr. Olga Taussky Todd for suggesting this problem.

Theorem. *A finite group* G *has elements of every possible order if, and only if,* G *satisfies one of the following conditions.*

(1) G *is cyclic.*

(2) G *is a* p*-group containing a cyclic subgroup of index* p.

(3) G *has order* $p\alpha q$ *for distinct primes* p *and* q. *It contains only one* q*-Sylow subgroup, and this subgroup is the commutator subgroup* G′ *of* G. *Also, if* S *is a* p*-Sylow subgroup of* G, *then* S *is cyclic, say* $S = \langle b \rangle$, *and* b^p *is in the center of* G.

Proof. If G satisfies one of (1), (2), and (3) it is easy to see that G has an element of every possible order.

We suppose henceforth that G has elements of every possible order. If G is a p-group, then (2) obviously holds. If G has composite order the Sylow subgroups of G must be cyclic. Therefore (1) holds if G is abelian. It remains to show that (3) holds if G is a non-abelian group of composite order. Since G has cyclic Sylow subgroups it is known [1; page 145] that G is generated by two elements a, b with defining relations

$a^m = b^n = 1$, $a^{-1}\ b^{-1}\ a\ b = a^{r-1}$, $(n,m) = (r-1,m) = 1$, and $r^n \equiv 1$ modulo m. Thus $G' = \langle a \rangle$, the cyclic group generated by a, and every element of G can be written as $a^s b^t$ for positive integers s and t. A computation shows that $a^s b^t = b^t a^{r^t s}$, and it follows by induction that (I) $(a^s b^t)^k = b^{tk} a^u$ where $u = sr^t(r^{tk} - 1)/(r^t - 1)$.

We denote the order of an element g of G by $|g|$. If $x = a^s b^t$ and $|x| = nm/q$ where q is a prime dividing m, then $(n,t) = 1$ since x has order n modulo $\langle a \rangle$. Therefore G is generated by a and b^t. It follows from $a^{-1} b^{-t}\ a\ b^t = a^{r^t - 1}$ that $G' = \langle a^{rt-1} \rangle$. Thus $(r^t - 1,\ m) = 1$. Letting $k = n$ in (I), we have $x^n = (a^s b^t)^n = 1$ since $b^n = a^m = 1$ and $r^n \equiv 1$ modulo m. Therefore $nm/q = |x|$ divides n, and hence $m = q$.

Suppose now that p is a prime dividing n and pick $y = a^s b^t$ such that $|y| = nq/p$. Then y has order n/p modulo $\langle a \rangle = G'$. Therefore $t = pt_1$ where $(t_1, n) = 1$. If $(r^t - 1, q) = 1$ then, using (I), we see that $y^{n/p} = (a^s b^t)^{n/p} = 1$, which is impossible

[1] This work was supported in part by a National Science Foundation pre-doctoral fellowship.

for y of order nq/p. Thus q divides $r^t - 1$, and it follows from $a^q = 1$ that $a^{-1}b^{-t}a\,b^t = a^{r^t - 1} = 1$. That is, $b^t = b^{r^t}$ is in the center of G. But $(t_1, n) = 1$, hence $\langle b^p \rangle = \langle b^{pt_1} \rangle$ and $\langle b^p \rangle$ is in the center of G. It only remains to show that n is a power of p. For $\langle b \rangle$ is then a cyclic p-Sylow subgroup of G with b^p in the center of G, and the theorem will follow since all p-Sylow subgroups of G are isomorphic.

Suppose p_1 divides n, where p_1 is a prime distinct from p. Then a p_1-Sylow subgroup of G is contained in $\langle b^p \rangle$, and hence is in the center of G. Repeating the above argument for p_1 instead of p we see that a p-Sylow subgroup of G is also in the center of G. Since this is true for every prime dividing n, it follows that b is in the center of G if n is not a power of p. But b is not in the center of the nonabelian group G. This completes the proof.

REFERENCE

1. Zassenhaus, H. *The theory of groups*, (trans.) New York, Chelsea, 1949.

Journal of the Washington Academy of Sciences

Chester H. Page, Editor

In statistics, a sample of four is too small to permit generalizations. In journalism, the first four issues of a new or modified journal may be enough to indicate what is to come, if the reader does not draw too specific a picture. The current feature article, however, differs sufficiently from the previous three to indicate the broad range of the Journal coverage, and at the same time to indicate its coherence.

Our aim is to present original research that stimulates thought, and general scholarly articles of scientific interest. The Journal should be published for the benefit of its readers, not for the convenience of its authors. Unfortunately, budget considerations make it impossible to publish a large journal, without additional support. The editorial board has therefore decided that *short* (1500 words) research papers are preferred, and that eight pages is the normal limit on longer papers. On the other hand, many worthwhile papers are longer than eight pages and would suffer unduly from being cut. This dilemma can be resolved by a simple ethical consideration: The results of research have little value until they are published.

The cost of publication is part of the cost of doing research. This fundamental principle is nowadays accepted almost universally. The Academy therefore expects that the Journal page charges will be honored by all institutions that have legal authority to meet this moral obligation—the Academy cannot afford to subsidize the broad research programs of the Washington Area.

Since some institutions are "poverty-stricken", and some research is financed by individual authors, the Academy will in such cases continue to subsidize publication, but not in excess of eight pages per article. Longer papers will not be accepted unless page charges are to be honored, and these longer papers will carry a footnote to the effect that the *excess* printing cost has not been at the expense of the Academy.

By holding the line on the moral and fiscal issues involved, your editors feel that we can maintain a journal in which the membership can take pride.

Science in Washington

SCIENTISTS IN THE NEWS

This column will present brief items concerning the activities of members of the Academy. Such items may include notices of talks given, important conferences or visits, promotions, awards, election to membership or office in scientific and technical societies, appointment to technical committees, civic activities, and marriages, births, and other family news. Formal contributors are being assigned for the systematic collection of news at institutions employing considerable numbers of Academy members (see list on masthead). However, for the bulk of the membership, we must rely on individuals to send us news concerning themselves and their friends. Contributions may be addressed to **S. B. Detwiler, Jr., Associate Editor, 2605 S. 8th St., Arlington, Va.**

APPLIED PHYSICS LABORATORY

Ralph E. Gibson participated in the Brookings Institution's Fourth Science Conference on February 11 at Williamsburg. Dr. Gibson and Irving H. Siegel, economist of the Council of Economic Advisors, were the speakers at that meeting on the topic, "Science, Technology, and Economic Growth."

On March 9, Dr. Gibson received the fourth annual Captain Robert Dexter Conrad Award "for outstanding contributions to the Department of the Navy in the development of solid rocket propellants and guided missiles." This is the highest scientific achievement award granted by the Navy.

Albert M. Stone addressed a meeting of the Organization of Professional Employees of the Department of Agriculture on February 24. His topic was "APL, Guided Missiles and Their Descendants."

GEOLOGICAL SURVEY

William W. Rubey presented the 1960 Silliman Lectures at Yale University on April 6, 7, 12, and 14. His subject was, "The Origin of the Continental Masses."

Victor T. Stringfield will serve as chairman of the Resolutions Committee of the American Association of Petroleum Geologists, at its annual meeting in Atlantic City, April 25-28.

HARRIS RESEARCH LABORATORIES

On March 15, in New York, ASTM Committee D-12 (Soaps and Detergents) presented its annual award to **Anthony M. Schwartz** for his contributions to the science of detergents.

Lyman Fourt attended a meeting of ASTM Committee D-12 (Textiles) in New York, March 1-3, and served as chairman of Subcommittee B-1 on Chemical and Performance Test Methods.

On March 11, Dr. Fourt presented a paper entitled "Comfort in Textiles in Relation to Simultaneous Transfer of Heat and Moisture" at the Fiber Society meeting in New Orleans.

Leo Mandelkern of NBS visited the Laboratories recently to present a seminar on "Contractile Mechanisms in Fibrous Polymers."

GEORGE WASHINGTON UNIVERSITY

Dean M. A. Mason, School of Engineering, The George Washington University was chairman of an advisory group reporting to the Metropolitan Washington Board of Trade on graduate education needs in the Washington area. The report will be made public by the Board of Trade.

HOWARD UNIVERSITY

Lloyd N. Ferguson, professor and head of the Chemistry Department, spoke on "Physicochemical Studies on the Sense of Taste" before the Susquehanna Valley Section of the American Chemical Society on March 9. The meeting was held at Bucknell University, in Lewisburg, Pa.

Dr. Ferguson was also a participant at the annual National Conference on Higher Education held in Chicago, March 6-9; the conference theme was "Platform for Higher Education: Guide Lines for the Sixties." In addition, Dr. Ferguson visited Providence College March 23-25, under the American Chemical Society Visiting Scientist Program; here he gave a public lecture on "Careers in Science," gave a seminar talk on "The Spectra and Basicities of Isomeric Sweet and Tasteless m-Nitroanilines," and held several class meetings of the elementary organic class.

Lewis K. Downing, dean of the School of Engineering and Architecture, has been elected secretary-treasurer of the Joint Board on Science Education. Dean Downing also has been elected chairman of the Civil Engineering Division of the American Society for Engineering Education for 1959-60. In the latter capacity, Dean Downing will organize a panel composed of representatives of the engineering education committees of various professional engineering societies, which will appear on the program of the 58th annual meeting of ASEE, next June 20-24 at Purdue University.

NATIONAL BUREAU OF STANDARDS

Allen V. Astin, director of the Bureau, was selected by the National Civil Service League as one of the top ten career employees in the Federal civil service for 1960. The League, a non-partisan citizens' organization for better government through better personnel, honored the award winners at a dinner held here on March 15.

William T. Sweeney received the Souder Award of the Dental Materials Group of the International Association for Dental Research, at its meeting in Chicago on March 19. The award was established by the Association in honor of Wilmer Souder for his pioneering efforts and outstanding scientific accomplishments in dental materials research. It represents the highest honor conferred by their colleagues upon scientists who, through achievement in the field of dental materials research, bring about outstanding advances in dental health.

Lewis N. Branscomb has been appointed chief of a new scientific division—Atomic Physics—at NBS. Atomic Physics was created by partitioning the Atomic and Radiation Physics Division; the other half of the old division will be renamed the Radiation Physics Division, and Lauriston S. Taylor will continue as its chief. Research areas of the new division will include precise determination of atomic constants and other physical properties associated with free electrons, atoms, ions, and molecules.

Gerhard M. Brauer and **George C. Paffenbarger** presented papers on "Synthesis of Eugenol Isomers" and "Dimensional Changes in Artificial Dentures on Drying, Wetting, and Heating in Water," respectively, at meetings of the International Association for Dental Research held in Chicago March 17-20.

Marion M. Davis served as a member of a panel that discussed "Women Scholars at Work" before a meeting of the Washington Branch, American Association of University Women, on March 5.

John K. Taylor spoke on "High Precision Coulometry" before the Howard University chemical seminar on March 10.

Russell W. Mebs, of the Mechanical Metallurgy Section, received the Burgess Memorial Award from the Washington Chapter of the American Society for Metals, at a banquet given on February 8. The award, named in honor of the late George K. Burgess, former director of NBS, was presented to Dr. Mebs "in recognition of his outstanding representation of the metallurgical profession in local educational and engineering activities, and his application of mathematical principles to metallurgical research."

TARIFF COMMISSION

Frank Gonet, the Commission's authority on coal-tar intermediates and dyes, has been made chief of the Chemical Division, succeeding the late James H. Hibben. The Chemical Division prepares the Commission's annual report on "Imports of Coal-Tar Products" and the preliminary and annual reports on "Synthetic Organic Chemicals, U.S. Production and Sales."

USDA, BELTSVILLE

Dewey Stewart was elected president of the American Society of Sugar Beet Technologists at its Eleventh General Meeting, held recently in Salt Lake City. The Society has more than a thousand members, of whom about half were present at the four-day meeting.

Clarence H. Hoffmann of the Entomology Research Division, Agricultural Research Service, gave two talks at the University of New Hampshire on March 10-11. In connection with a University-sponsored series of lectures on "Environmental Health in Relation to Man," Dr. Hoffmann gave the initial public address on the subject, "The Effects of Pesticides on Man and Animals." He also spoke at a seminar on eradication of the screw-worm by irradiation, and possibilities of using this method against other insects.

William B. Ennis was among the participants in a symposium on "The Nature and Fate of Chemicals Applied to Soils, Plants, and Animals," sponsored by the Farm Research group, Agricultural Research Service, at Beltsville on April 27-29.

USDA, WASHINGTON

Hazel K. Stiebeling attended the annual meeting of the National Institute of Animal Agriculture, held April 4-5 at Purdue University. Dr. Stiebeling spoke on "The Consumer's Concern about Chemicals and Food."

Kenneth W. Parker has been appointed to represent the Forest Service on the NAS-NRC Advisory Committee for Arid Zone Research. Dr. Parker also has been invited to present a paper, "Principles of Grazing Management as Related to Vegetation Conditions and Soil Stability," at the Fifth World Forestry Congress, to be held in Seattle from August 29 to September 10.

Harold R. Curren and **Arjen Tamsma** are authors of a paper, "Some Observations on the Ultraviolet Irradiation of Milk (Centrifilmer Process) with Emphasis upon Organoleptic Effects and Sporocidal Efficiency," that appeared in *J. Dairy Sci. 43*, 410 (1960)

Birth: To Dr. and Mrs. Floyd E. Kurtz, a daughter, Martha Anne, on February 26.

UNIVERSITY OF MARYLAND

Ronald Bamford, dean of the University's Graduate School, was recently appointed a member of the Board of Natural Resources for the State of Maryland. A professor of botany at the University since 1931, Dean Bamford specialized in cytology, chromosomes, and the behavior of cells in toxic solutions. He was appointed to the remainder of a four-year term which began in June, 1958.

John S. Toll, professor and chairman of the Physics Department, spoke on "Where We Stand in Space" at the recent annual banquet of Phi Kappa Phi, honorary scholastic fraternity. Dr. Toll's speech was not directed to a comparison of United States and Russian achievements, but rather to recent scientific theories and develop-

ments, including the theory of relativity and the quantum theory, and their application to space phenomena. Eventually, Dr. Toll said, intensive study of gravitational fields may reveal greater insight into our universe.

Charles E. White and **Frank Cuttitta** presented a paper, "A Fluorometric Study of the Magnesium Bissalicylidene — Ethylenediamine System," at the Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, on March 4.

"Experimental Celestial Mechanics" was the title of a recent talk by **S. Fred Singer** at the first of a series of Arts and Sciences convocations. Tracing the development of this new science over the past 10 years, Dr. Singer pointed to three important discoveries: There are two belts of intense radiation around the earth; the atmosphere around the earth extends to 40,000 miles; at 200 miles from the earth, the density of the atmosphere is 15 times greater than previously expected.

DEATHS

Beno Gutenberg, former director of the Seismological Laboratory at Pasadena, Calif., on January 25.

Harley H. Bartlett, botanist, of Ann Arbor, Mich., on February 21. Dr. Bartlett was elected to non-resident membership in 1915.

AFFILIATED SOCIETIES

Acoustical Society of America, Washington Chapter

President: Harold Burris-Meyer. *Secretary:* Gerald J. Franz (Taylor Model Basin)
Meetings on third Monday of month during the academic year, usually at Gallaudet College.

On March 21 Fred Schloss presented a lecture demonstration on the Measurement of Mechanical Impedance, with special reference to development of instruments to evaluate isolation mounts used by the U. S. Navy. The Chairman appointed a committee of three persons to coordinate Chapter participation in judging the D. C. Area Science Fair and to determine an appropriate award for possible winners in acoustics.

April 26 is planned as a combined meeting with the AIA and the Audio Group of IRE to discuss architectural acoustics, at a time and place yet to be determined.

American Institute of Electrical Engineers, Washington Section

Chairman: Wade M. Edmunds (REA). *Secretary-Treasurer:* Irvin L. Cooter (NBS)
Meetings in PEPCO Auditorium, 10th and E, N.W.

The General Meeting for March 8 was the Eighteenth Annual Student night, with D. L. Greene, Vice-President of the Middle Eastern District as guest of the section. Awards were presented to Bernard Zempolich, David Lokerson, Earl Folsom and Earl Channell, Student Branch members, and a certificate of appreciation to Professor L. J. Hodgins, of the University of Maryland.

April 5, General Meeting, presented Dr. W. S. Gillam, Office of Saline Waters, Department of the Interior, on "Demineralization of Saline Waters." Election of officers for the coming year took place at this meeting.

April 26, Technical Meeting, "Power and Communications Problems in the Design and Construction of Dulles International Airport," Herbert H. Howell, Federal Aviation Agency. Technical papers selected for annual awards will be presented at this meeting.

American Meteorological Society, District of Columbia Branch

President: Jack C. Thompson (WB). *Secretary:* Raymond McGough (USN Hydro. Off.)
Meetings at NAS-NRC, 2101 Constitution Ave., N.W. on 3rd Wednesday

The 184th National Meeting of the American Meteorological Society will be held in Washington, at the National Academy of Sciences building, April 27-30. The program will include a number of general sessions on satellite meteorology, wind stress over the oceans, spherics, and thunderstorm electricity, Fred D. White (NSF) is program chairman.

American Society For Metals, Washington Chapter

President: William L. Holshouser (NBS). *Secretary:* Glen W. Geil (NBS)

The Chapter conducted an educational course on "Metallurgical Applications of Electrochemistry", on five successive Wednesday evenings, January 27-February 24.

The Burgess Memorial Award was presented, February 8, to Russell W. Mebs, National Bureau of Standards.

April 18, Walter L. Finlay, Crucible Steel Company, will speak on "Titanium and Competitive Stainless Steels."

May 16, National Officers Night; National President Walter Crafts will speak on "Facing the Productivity Challenge; Men and Metals of the Next Decade." This meeting will be held at the Officers Mess, U. S. Naval Weapons Plant.

The chapter will provide 8-10 members for judging papers entered in the Science Achievement Awards Program of the American Society for Metals, conducted by the Future Scientists of America Foundation, NSTA. Judging will take place in April.

American Society of Civil Engineers, National Capital Section

President: W. Orme Hiltabidle. *Secretary:* Daniel P. Jenny

At the February 9 meeting, David Auld, Direc-

tor, D. C. Department of Sanitary Engineering, dealt with the water supply and sanitary problems of metropolitan Washington.

The Annual Dinner was held on March 1, at the Shoreham Hotel, where William L. Slayton, Webb and Knapp International, spoke on "The Redeveloper Looks at Redevelopment," from the background of his association with the Southwest Washington program.

American Society of Mechanical Engineers, Washington Section

Chairman: Alfred F. Bochenek. *Secretary:* Virgil L. Pence

March 24, Student Night, featured technical papers by four students in mechanical engineering from local universities, competing for section cash awards, and gaining experience toward regional and national ASME student competition.

April 7, Willard Fazar, Special Projects Office, U. S. Navy, presented the management technique developed and successfully employed for the Polaris weapon system.

April 20, Annual Banquet, Terrace Room, Arlington Towers.

May 12, "Air Pad Surface Vehicle."

May 26, Alfred Keil, "Response of Ships to Underwater Explosions."

Botanical Society of Washington

President: Harold T. Cook (USDA). *Corresponding Secretary:* Muriel J. O'Brien (USDA)

Meetings on first Tuesday, Powell Auditorium, 8:00 P.M.

April 5, Russell L. Steere (USDA), discussed "Recent Advances in Biology: Electron Microscopy and Nucleic Acid Studies."

May meeting, Annual Dinner.

Chemical Society of Washington

President: Allen L. Alexander (NRL). *Secretary.* John L. Torgesen (NBS).

The Board of Managers met on March 1 at the new ACS building, with President A. L. Alexander presiding. The minutes of the two previous meetings were corrected and approved.

Chairman Wilkins Reeve of the Awards Committee reported that about 20 members of the Society were eligible for various American Chemical Society and AAAS awards, and that efforts were being made to encourage their nomination by individual members.

A suggestion by several members, that the working name of the Society (Washington Section of the ACS) be changed to the National Capital Section, was referred to the Bylaws Committee for consideration.

Chairman P. K. Reily of the Professional Relations & Status Committee reported that the "PR&S Notes" column is expected to appear in THE CAPITAL CHEMIST regularly throughout the year; that the Committee would like to provide a PR&S subject and speaker for one of the general meetings during the coming year; that the Committee expects to compile a register of retired chemists in the area, many of whom may be available for consulting activities; and that chemistry departments of local universities are being invited to participate in PR&S seminars with senior students.

President-elect W. J. Bailey outlined plans for the Meeting-in-Miniature which is to be held at the University of Maryland on May 6, jointly with the ACS Maryland Section.

Chairman R. P. Maickel of the Public Relations Committee reported that the survey on use of academic titles by newspapers was to be published in a forthcoming issue of *C&E News*; and that efforts were being made to conduct a publicity program in the smaller newspapers of the Washington area, on civic and other activities of CSW members.

Letters were read from a CSW member, commenting on clannishness, lack of hospitality, and unfriendliness at CSW meetings, and from E. S. Pierce, on ways to increase attendance at meetings. After considerable discussion, the Board agreed to Dr. Pierce's suggestion that an *ad hoc* committee to make a thorough study of the problem of member interest and report back on possible solutions by next June.

Columbia Historical Society

President: Maj.-Gen. U. S. Grant, 3rd. *Executive Secretary:* John T. Gibbs

April 14, Heurich Mansion, Paul Oehser spoke on the "History of the Cosmos Club."

May 14, Heurich Mansion, Mrs. Frank P. Howard will discuss "The Friday Morning Music Club, a Record of 75 Years"

May 22, at Fort Myer Museum and Reviewing Area, a program on "History of Fort Myer," will be presented.

A group of five program planners seeking material on how various charitable enterprises were handled in the past as basis of a projected 1960 UGF television program have found much data in the Society records.

Entomological Society of Washington

President: Paul W. Oman (USDA). *Corresponding Secretary:* Paul Woke, *Recording Secretary:* Ernestine B. Thurman (NIH)

Meetings in Room 43, USNM, 10th and Constitution Avenue, N.W. on first Thursday.

April 7, "Nesting Habits of Some Southwestern Wasps and Bees," Karl Krombein (USDA); "Insect Survey and Detection Operation—Past and Present," Louis G. Davis, (USDA).

Insecticide Society of Washington

Chairman: Milton S. Schechter (Ag. Res. Center). *Secretary-Treasurer:* James F. Cooper (USDA)

March 16 meeting, Symons Hall at the University of Maryland, presented Roy J. Barker, Insect Physiology Laboratory, USDA, on "Isotope Effects as a Tool in Toxicology," and Hamilton

Laudani, Stored Product Insects Branch, USDA, on "Development of Insect Resistant Packages."

Institute of Radio Engineers, Washington Section

Chairman: John Durkovic. *Secretary:* Ben Melton

At the February 13 annual banquet of the Section, Ronald L. MacFarlan, 1960 IRE President, reviewed the award structure of the Institute. Three members of the Section, Stuart L. Bailey, Francis H. Engel, and Leland D. Whitelock, were presented with "Patron Awards" for distinguished service. John I. Bohnert for his "contributions to the field of microwave antennas," and Henry R. Reed, for his "contributions to engineering education," received "Fellow Awards." National and Section Awards were made to ten senior radio engineering students for outstanding academic records and IRE student branch activities, as follows: National Awards—Roger W. Bopp, Bernard Zempolich, Leon Sibul, Alvin R. Robinson, and Earl C. Channell; Section Awards—Robert W. Hamlin, John D. Watson, Richard L. Potterton, R. Alfred Whiting, and William L. Soper.

Medical Society of the District of Columbia

President: Dr. Victor Alfaro. *Secretary:* Theodore Wiprud

"Current Medical Events", published monthly by the Society, lists an impressive number of meetings of interest to medical persons and groups.

Philosophical Society of Washington

President: Louis R. Maxwell (Nav. Ord. Lab.). *Secretary:* F. N. Frenkiel (Taylor Mod. Basin) Meetings on alternate Fridays, Powell Auditorium, 8:15 P.M.

March 4, Ralph A. Alpher, G. E. Research Laboratory, spoke on "Experiments in Magneto-Fluid Dynamics."

March 18, Gordon M. Tomkins, NIH, presented a paper on "Principles of Molecular Biology."

April 8, Erwin M. Mueller, Pennsylvania State Univ., spoke about "Field Ion Microscopy."

April 22, Elmer Hutchisson, Amer. Institute of Physics, will discuss "Can We Merge Our Two Cultures?"

Society for Experimental Biology and Medicine, District of Columbia Section

President: George A. Hottle (NIH). *Secretary:* Edwin P. Laug (FDA)

April 7, Hall A, G.W.U. School of Medicine, 1335 G Street. Richard S. Yamamoto (NIH), "-Studies on Dietary Obese Rates"; James H. Rust, Jr., Walter Reed, "Effects of Radiation Injury on Plague Infection"; Marian Webster and J. V. Pierce (NIH), "Studies on the Hypotensive Enzyme, Callicrein"; and Eugene Streicher and Gilbert D. Press, NIH, "Measurement of Extracellular Space of Rat Brain."

Society of American Bacteriologists, Washington Branch

President: Mary L. Robbins (G.W.U.). *Secretary:* Eliz. J. Oswald (FDA)

March 22, a program of three technical papers, on microbial interactions (Eddie C. S. Chan and Michael J. Pelczar, Jr., Univ. of Maryland); virus-caused pancreatic necrosis of trout (Kenneth E. Wolf, S. F. Snieszko, and C. E. Dunbar, Fish and Wildlife Serv.) and studies on cholera in South-East Asia (Capt. Eugene Gangarosa, Walter Reed).

The 64th Annual Meeting of the national society will be held in Washington in 1964, with the Washington Branch as hosts; Roy C. Dawson, FAO, will serve as chairman of the Committee on Local Arrangements.

Society of American Foresters, Washington Section

President: James M. Owens (Commerce). *Secretary:* Matt C. Huppuch (Dept. of Army)

An Information Bulletin and folder, covering the Fifth World Forestry Congress is now available. Inquiries concerning the Congress should be addressed to I. T. Haig, c/o Office of International Conferences, Department of State.

The Section has established a Seed Certification Committee, under the chairmanship of Harry A. Fowells, U. S. Forest Service, assisted by Ralph Hodges, Nat. Lumber Manufacturers Assoc., and Roland Rotty, U. S. Forest Service.

The Section is also interested in cooperating with the National Arboretum in initiating and stocking a living repository for special and unusual trees, shrubs and other plants, and has formulated a suggested program leading to that objective.

ACADEMY ACTIVITIES

Board of Managers, March Meeting

These notes are intended to outline briefly, for the information of the membership, the principal actions taken at Board meetings. They are not the official Minutes as prepared by the Secretary.—Ed.

The Board of Managers held its 527th meeting on March 15 at NBS, with President Wood presiding. The Minutes of the 526th meeting were amended and approved.

Dr. Wood announced the appointment of Archie I. Mahan as chairman of the Committee on Awards for Scientific Achievement, and of Archibald T. McPherson as chairman of the Committee on Policy and Planning.

Chairman Stiehler of the Meetings Committee reported on speakers for the meetings of March 17 (Louis H. Bean, on "Science and the Art of Predicting"); April 21 (still open); and May 19 (Dr. Baker of the Bell Telephone Laboratories).

Chairman Hall of the Membership Committee gave the First Reading of three candidates for membership.

Chairman Schubert of the Committee on Encouragement of Science Talent reminded the Board that certificates of merit would be awarded at the meeting of March 17 to 25 students—members of the Junior Academy—and that special recognition would be given to the teachers who had most influenced these students to take up careers in science. He hoped that in future, the Committee or the Junior Academy might be able to do something more in recognition of the teachers.

Dr. Schubert next discussed the letter recently addressed to the Academy by the Society of American Bacteriologists, suggesting the development of improved rules for Science Fair exhibits, which had been referred at the last Board meeting to Dr. Schubert's Committee for comment. He indicated that the letter had been distributed to Committee members and would be given serious consideration; also, he felt that the Junior Academy and the Joint Board on Science Education likewise would be seriously concerned with the letter.

Dr. Wood asked Dr. Robbins to discuss the recent letter from the Society of American Bacteriologists, suggesting the development of improved rules for Science Fair exhibits. Dr. Robbins indicated that the same letter had been sent to various organizations, of which 10 had responded, for the most part indicating emphatic agreement with the position taken. This led to a lengthy discussion of Science Fair activities, in which most of the Board members participated. No decisions were reached.

Dr. Schubert then discussed plans for a national meeting of Junior Academies of Science proposed for next fall, indicating that financial support for the meeting, to the extent of about $35,000, may be forthcoming from HEW and NSF. The matter of who should sponsor the meeting has not been definitely decided. There was considerable discussion of the question as to whether the Academy's executive secretary (Mrs. Fell) would be available to oversee the paper work involved in the operation, or whether the Academy office could be used to house a director and clerical help for the national meeting. No definite conclusions were reached.

Chairman Hall of the Membership Committee presented for Second Reading the names of two candidates for membership previously proposed, as follows: Ross C. MacCardle and Russell L. Steers. These candidates were then elected to membership.

The secretary (Dr. Specht) reported for the treasurer, who was out of town. Dr. Specht then presented the recommendation of the Executive Committee, responding to a request for life membership by Archibald T. McPherson, that a charge of $25 be made for such membership. After discussion of the manner of arriving at this figure, the recommendation was approved by the Board.

On motion of the secretary, the Board approved the resignations of W. R. Wedel, John R. Magness, O. L. Cartwright, Lloyd G. Henbest, Theodore R. Gardner, George S. Switzer, Giles W. Mead, J. L. Cask, George A. Llano, Lyman B. Smith, Clifford Evans, C. V. Morton, Ernest Ambler, and Edwin B. Bartram.

The secretary reported for the custodian (Dr. Rehder) that the latter is leaving town for a protracted field trip; but that on his return the Academy publications heretofore stored at the National Museum would be moved to the Carnegie Building, and at that time an accurate count of publications would be made.

With reference to activities of the Special Committee on Bylaws and Standing Rules, Dr. Wood noted that the proposed revision of the Bylaws is now before the membership for approval by mail ballot, and that the Committee would expect next to consider a revision of the Standing Rules.

The secretary informed the Board concerning a contract with the National Institute of Mental Health, which has been approved by the Executive Committee acting for the Board. A group of retired scientists known as the "Fossils" had been approached by NIH to act as subjects in a study of mental abilities with respect to aging. (This is a companion project to one conducted by NIH at Baltimore City Hospital, on the physiological aspects of aging.) Customarily, NIH enters into contracts with organized groups in order to provide modest compensation to the subjects, who are nominally furnished through the officers of the organization. But since the Fossils were only informally organized and did not want to enter into contractual status with the Institute, it had been suggested that the Academy could act in this capacity. Arrangements have now been completed whereby the Academy will receive the compensation and pass it on to the subjects, and additionally will receive a payment for overhead.

In a discussion of the *Journal*, Mr. Johnson voiced the opinion that the publication in its new format was off to a good start. Mr. Scribner observed that for the first time since he has been a member, he is looking at the issues of the *Journal*, and actually reading some of the material. Dr. Wood felt that the most important function of the *Journal* involved informing the membership on local scientific happenings, particularly among the various affiliates. Dr. Wood also indicated his understanding that the *Journal* would continue to carry some articles of a descriptive nature, which would be paid for in part by page charges. He expressed the feeling that the examples set by the National Bureau of Stand-

ards and certain other Government agencies in underwriting the cost of journal publications by staff members, might lead to more widespread adoption of the policy.

In a discussion of membership activities, Dr. Wood pointed out that in the past it has been left largely to the Membership Committee to initiate nominations for new members. He felt that the Board and the Academy membership at large ought to assume a more prominent part in this connection. Dr. Specht reported that at the time the last directory was issued, he worked with Mrs. Fell to send a copy to each WAS member at NIH, together with an application blank and a note asking the member to consider nominating any eligible staff member at NIH, not already a member of the Academy. Dr. Wood observed that the Academy's lack of initiative in canvassing for new members has resulted in a number of criticisms over the past year. Dr. Shepard suggested that the Entomological Society might have as many as 50 eligibles who had not been approached concerning membership in the Academy. Dr. Specht reminded the Board that the prior status of prospective nominees could be determined through the Academy files—that is, whether an individual had been approached previously, and what his reaction had been.

Bylaws Revision Approved by Membership

The Academy membership has overwhelmingly endorsed the proposed revision of the Bylaws that was recently circulated for approval, according to WAS Secretary Heinz Specht.

Results of the mail balloting, which closed March 25, showed that of 349 votes cast, 335 were for the revision. Additionally, 3 votes were provisionally in favor, while 9 were against the revision, 1 was both for and against, and 1 was neither for nor against.

Dr. Specht noted that sundry typographical errors had inadvertently crept into the draft revision that was circulated to the membership, including omission of a line of copy from Article III, Section 4. He pointed out, however, that these errors did not appear in the portions subject to change, and hence had no influence on the vote.

The following members have been placed on the retired list at their request:

Emery C. Leonard, W. F. Swann, R. Clifford Hall, J. B. Umpleby, Martha S. Carr, Benjamin Schwartz

JOINT BOARD

The Joint Board has under preparation a source book for science projects which will be published in the late summer. Dr. Phoebe Knipling and Dr. John K. Taylor are the editors. A grant from the Eugene and Agnes E. Meyer Foundation will underwrite part of the publication costs.

The project book stems from the expressed need for such a reference source by local secondary school teachers. Consequently, several years ago, Dr. Knipling, Science Supervisor for Arlington schools called upon a number of local scientific institutions to enlist the cooperation of their scientific personnel for suggestions for student projects. The ideas submitted were compiled, duplicated and given wide distribution, locally, and have been stimulating not only for student projects but for class research projects as well.

Partly because the earlier booklet is out-of-print, and also to enlarge its scope, technical societies and individual scientists are being called upon again to submit suggestions to be incorporated into a new book. Response to date has been gratifying in the biological sciences area but only meager in the fields of physical sciences, mathematics, and engineering.

Accordingly, the request is being renewed for project ideas, especially in the shortage categories mentioned above. Short (one-paragraph) descriptions of activities that can be carried out by students with readily available equipment or with apparatus capable of being constructed by the student are desired. Each write-up should contain references to easily accessible sources where further information or background material can be found.

Suggestions should be sent to either editor: Dr. Phoebe Knipling, Arlington Schools, Arlington, Virginia; Dr. John K. Taylor, National Bureau of Standards, Washington 25, D.C.

SCIENCE AND DEVELOPMENT

The American Geophysical Union has formed a Planning Committee on Planetary Sciences, according to recent announcement. Purpose of the new committee will be to accommodate the increasing number of AGU members engaged in planetary and space research by expanding the Union's activities in this field. Its chairman is Homer E. Newell, Jr., of the Office of Space Flight Programs, National Aeronautics and Space Administration; its secretary is Robert Jastrow, of NASA's Goddard Space Flight Center. Other members of the 12-man committee include WAS members Philip H. Abelson, Allen H. Shapley, E. H. Vestine, Harry Wexler, and Charles A. Whitten.

American University has received a $17,800 grant from NSF for a summer conference on the stratigraphy and structure of the Appalachians. This program, scheduled for June 8-21, will be open to 40 professors of geology and earth science from institutions throughout the United States. The grant will

cover operational costs as well as a travel-subsistence allowance to each participant.

Georgetown University Medical Center officials started in late February to review 400 applications for 20 research scholarships in the Schools of Medicine and Dentistry next summer. They came from junior class students of high scholastic standing in 50 public and private schools of the Washington area. The awards, involving $100 plus facilities and research equipment and supplies, were to be announced on April 1.

A Space Education Institute was conducted at the University of Maryland, beginning February 29 and continuing through March. Sponsored by the University College and the Maryland Section of the American Rocket Society, the Institute presented a series of five lectures by authorities in the fields of space flight, rocket control guidance, and space propulsion systems.

Maryland's Microbiology Department has received a NAS grant of $8,428 for its work on classifying compounds effective in the destruction of molds. This is the twelfth consecutive year that such a grant has been given. Since the work began in 1948, more than 14,000 compounds have been sent to the University for screening and classification. The testing of compounds involves determinations not only of their destructive effect on molds, but also of their stability, boiling point, solvency, surface tension, and corrosion of metals. Results are reported to NAS for cataloging purposes.

Fifty-one chemicals that the Food & Drug Administration believes are safe for use in food have been listed as a proposal for consideration by the country's qualified experts; this recent action was taken in accordance with provisions of the Food Additives Amendment of the Federal Food, Drug, and Cosmetic Act. FDA said these chemicals would be an addition to the 182 covered by a regulation of November 20, 1959. They would be generally regarded as safe only when they were of food grade and used in accordance with good food manufacturing practice. If the proposal is adopted, no further proof of their safety would be required.

A new portable missile service tower has been developed by Army's Engineer R&D Laboratories at Fort Belvoir. It weights 175 tons and is 151 feet tall, and can handle missiles of the Redstone and Jupiter classes, or any other missile up to 136 feet tall. While previous missile towers have been either fixed or rail-mounted, the present structure is mounted on two base trailers each having six pneumatic-tired wheels.

Another recent ERDL development is an improved 5-kw, 60-cycle generator set that weighs 468 pounds, is powered by an air-cooled gasoline engine, and can operate at rated load under any environmental condition experienced by Army tactical units.

A hypothesis suggesting that the blue haze seen over the world's vegetated areas is actually petroleum in the process of formation has been advanced by F. W. Went of the Missouri Botanical Garden. Writing in the NAS *Proceedings*, Dr. Went attributes the blue haze to a layer of asphaltic and bituminous particles created by hundreds of millions of tons of volatile hydrocarbons and near-hydrocarbons expelled into the atmosphere annually by living plants. These particles eventually rain down on earth, and in time, form petroleum. Dr. Went further suggests that these smog-like particles influence the weather in a variety of ways, and also serve to regulate plant growth.

The sea otter of northwestern Pacific coasts, ruthlessly slaughtered for two centuries as one of the most valuable fur animals, has been saved from extermination by the rigorous protection of American and Canadian authorities over the last 50 years. So says Karl W. Kenyon, Fish and Wildlife Service biologist, in the latest annual report of the Smithsonian Institution. Dr. Kenyon, who annually visits the Service's sea otter reserve on Amchitka Island in the Aleutians, reports that there may be as many as 30,000 otters in Alaskan waters. A count two years ago indicated as many as 1,000 in California coastal waters, while individuals have been reported off Washington and British Columbia. In the heyday of the otter fur trade, a single pelt brought as much as $300.

"Private Research and Development Organizations in the Washington Metropolitan Area" is the title of a brochure recently compiled and published by the Economic Development Committee of the Washington Board of Trade. It lists about 130 such organizations, each with the address and name of the principal officer, number of employees, year of establishment, and fields of interest. The pamphlet is part of a kit that includes also leaflets on "The National Capital Area—Center for Research and Development" (reprint from *Career*); "Young Research Workers Sought for Washington Area Laboratories" (reprint from *Science*); and "Professionally, Intellectually, Geographically, the Climate is Perfect in the National Capital Area."

Two new durum wheat varieties, with better resistance to Race 15B stemrust than any variety presently available to growers, have been released by USDA in collaboration with the North Dakota Agricultural Experiment Station, for seed-increase next summer in Great Plains states. In addition to improved stemrust resistance, the new durums—Wells and Lakota—ripen earlier, have shorter and stronger straw, and yield as well or slightly better than varieties now in commercial use. Both display good characteristics for production of semolina flour, basic ingredient of macaroni.

Vice-Presidents of the Washington Academy of Sciences Representing the Affiliated Societies

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Institute of the Aeronautical Sciences	*Not Named.*
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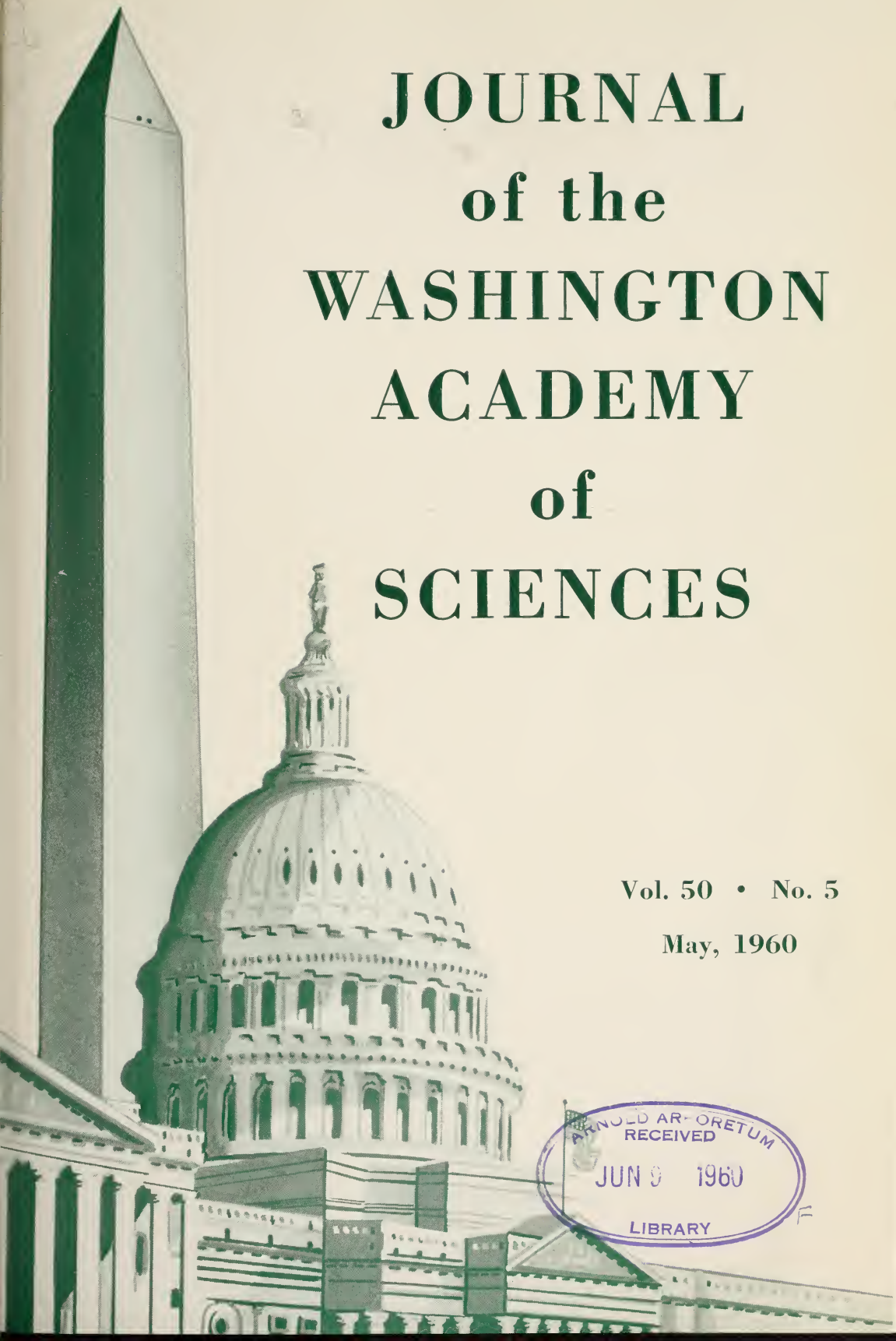

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May, 1960

JOURNAL OF THE WASHINGTON ACADEMY OF SCIENCES

Editor: Chester H. Page, National Bureau of Standards

Managing Editor: Ileen E. Stewart, National Science Foundation

This Journal, the official organ of the Washington Academy of Sciences, publishes: (1) historical articles, critical reviews, and scholarly scientific articles, (2) original research, if the paper, including illustrations, does not exceed 1500 words or the equivalent space, (3) notices of meetings and proceedings of meetings of the Academy and its affiliated societies, and (4) regional news items, including personal news, of interest to the entire membership. The Journal appears eight times a year in January to May and October to December.

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Oceanographic and Hydrographic Observations At Wilkes IGY Station, Antarctica

Willis L. Tressler *
U. S. Navy Hydrographic Office, Washington, D. C.

Wilkes IGY Station is located on one of the Windmill Islands on the Budd Coast of East Antarctica. Its exact geographic location is 66°15′24″ South and 110°31′39″ East. The station is situated at the Western end of what is still called Clark "Island", although the results of gravimetric and radio soundings give a profile which pretty definitely show it to be a peninsula extending out from the ice-covered Budd Coast. Commissioned on February 16, 1957, the IGY station has been in operation for over two consecutive years. Until Spring of 1959 it was part of the IGY program sponsored in this country by the National Academy of Science. It is at present being maintained by the Australians with three American scientists present.

During the year 1958-1959 when the author was Station Scientific Leader at Wilkes IGY Station, it was possible to accomplish a certain amount of oceanographic and hydrographic work, such as ice and current studies, tides, bottom sediments, and some hydrographic and topographic survey work. The condition and extent of fast ice and floes were observed daily from the aurora tower and on all except days of extremely poor visibility; movements of ice were photographed with a 16 mm time-lapse motion picture camera from the same location. A portable tide gage was established and continuously run for slightly longer than one complete lunar cycle in the fall and was again placed in operation in the spring for approximately two months. A series of ten bottom samples was obtained, extending from the shore to deep water in Newcomb Bay of the base. Survey work was accomplished in which the position and orientation of Clark and the northern islands were tied in with the astro station on Holl Island.

The first to enter Vincennes Bay, the large indentation of the east antarctic coast, on which this IGY station is situated, was Lieutenant Charles Wilkes in command of the U. S. Exploring Expedition in 1840. Wilkes' flagship, the *Vincennes*, sailed into the bay and traversed it at a point somewhat north of the present Wilkes Station site. In 1912 the *Aurora* entered these waters and again in 1931 the *Discovery* was here. In 1947 during Operation *Highjump*, two aerial photographic runs were made from carrier based planes. It is mainly from the photographs obtained on these flights that the present charts have been constructed by the Hydrographic Office. During Operation *Windmill*, in 1948, the two icebreakers USS *Burton Island* (AGB-1) and the USS *Edisto* (AGB-2) entered Vincennes Bay and Lieutenant Richard Holl, of the Navy Hydrographic Office established an astro station on what was later called Holl Island.

Not many vessels had visited the area until 1956 when the *Thala Dan* which had been chartered by the Australians with a party under the leadership of Phil Law, sailed in among the Windmill Islands and

* The opinions expressed in this paper are those of the author as an individual and are not to be construed as necessarily reflecting the official views of the Department of the Navy.

went as far as Cloyd Islet, where they erected a cairn and left a record. A number of aerial photographs were taken at a time when the area was unusually ice-free. In the same year and shortly after the Australian visit, the U. S. Navy icebreaker USS *Glacier* (AGB-4) nosed into the edge of the shelf ice at a point south of Cape Folger and some five miles north of Wilkes Station. The purpose of this visit was to make a reconnaissance of the area to locate a site for an IGY station to be established the following year. A survey of the area and adjacent water had just commenced when we were driven out by a sudden gravity wind which raged in excess of 50 knots for several hours. The next year, in late January 1957, the *Glacier* returned and Wilkes Station was constructed in about three weeks time. During this time, a reconnaissance sounding of the area was made by Lieutenant Newcomb, the *Glacier's* navigator and the author.

As in the case of the adjoining islands of the *Windmill* group, Bailey and Mitchell, Clark Island is composed of exposed, rocky areas in between which are large, permanent snow fields, the whole area finally merging into one extensive snow slope which, at an altitude of about 500 feet ends in a sinuous shear moraine. Beyond the shear moraine, the shelf ice extends uninterrupted to the pole, some 1400 miles south. According to Hollin [1] the glacial ice retreated from most of Clark Island approximately 12,000 years ago. Relieved of its load the land rose 100 feet and apparently is continuing to rise at the present time. Raised beaches in the area substantiate this fact. In winter much of the rocky area is snow covered, but during the summer months, considerable bare rock and rocky terrain is exposed. Several coves indent the south and southwest shores of the island, the base site being located between what provisionally have been called "Ramp" and "Tide Gage" coves. (Figure 1). The water in these coves averaged 7 fathoms but several pinnacles of rock are in evidence. Newcomb Bay does not appear, from the reconnaissance sounding made in 1957, to exceed a depth much greater than 45 fathoms. There are some shoal areas and at least two submerged pinnacles which do not uncover at low tide, but have been charted. Both of these obstructions are located away from the main anchoring area, which was wire dragged to 40 feet by the MSTS *Greenville Victory* in 1957. The greater part of Newcomb Bay offers a safe anchorage for large vessels and the bottom provides good holding ground. A prominent, permanently ice-covered rock (Fitzpatrick Rock) is located in the middle of the entrance to the bay; there is good water all around this rock at a distance of not more than 15 yards.

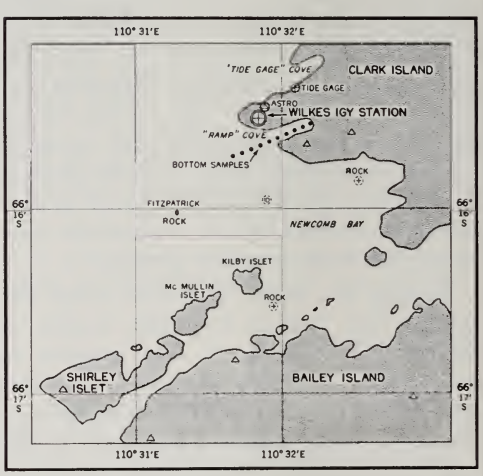

Figure 1. Outline chart of the Wilkes IGY Station area.

Weather Conditions

Situated along the coast of East Antarctica, Wilkes did not suffer the extreme antarctic weather experienced by other U. S. bases. At a latitude almost on the Antarctic Circle, which is true of all the bases along the east antarctic coast, the French in Adelie Land, the Russians at Bunger Oasis and Haswell Islet and the Australians at MacRobertson Coast and at the Vestfold Hills, Wilkes enjoyed a com-

[1] Information furnished by John Hollin, Head Glaciologist Wilkes Station 1958-1959.

paratively mild climate. When open water surrounded the base the temperatures remained in the upper 20's and lower 30's. Even in the matter of winds, for which Wilkes became famous during the first year, the average monthly wind velocity was often below that of the other U. S. bases. Frequency of winds exceeding 50 knots and high peak gusts, however, have earned for Wilkes the reputation of being a windy station. There were days at a time when no one who didn't absolutely have to, went out, but on the other hand, there were many long periods during which there was a complete absence of wind. There was nothing to approach Mawson's experience at Commonwealth Bay where the monthly average for the year was over 40 miles per hour.

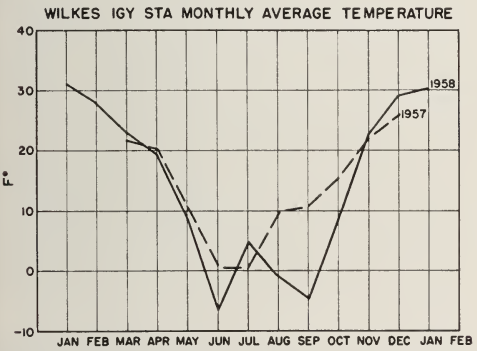

Figure 2. Monthly average air temperature for 1957-1958 and 1958-1959 at Wilkes Station.

An examination of Figure 2, which shows monthly average temperatures for the two years, shows that while the general temperature trend is similar in both years, there are some marked differences in the two-year record. In 1957 average temperature reached a low in June and July, following which there was a gradual upward trend. In 1958, however, the low reached in June was followed by a sharp increase in July and then a downward trend in August which reached a point almost as low in September as had been recorded in June. September was certainly our most unpleasant month, with low temperatures, windy and generally unfavorable conditions the rule, day after day.

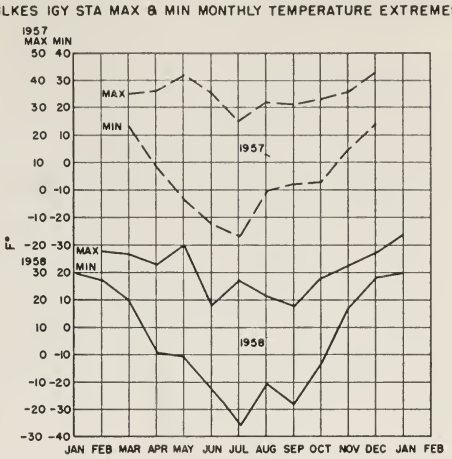

Figure 3. Monthly air temperature extremes for 1957-1958 and 1958-1959 at Wilkes Station.

Figure 3 gives the monthly temperature extreme for 1957 and 1958. Our lowest temperature of −37° F. occurred in July, with −29° registered in September. At the Satellite Station, located 50 miles out on the shelf ice and at an elevation of something over 3700 feet, the lowest temperature recorded was −53° F. Comparing the two years, it will be noted that in 1957 the lowest temperature recorded fell in July, while in the following year the two lowest temperatures occurred in June and September. The maximum temperature observed at Wilkes Station was 44° F. which occurred on 6 January 1958; the higest temperature recorded during the previous year was 43°, observed on 20 December 1957.

Figure 4 shows average wind velocities and peak gusts recorded at Wilkes Station during the first two years of operation. During both years April had the highest average wind velocity, whereas in 1957 there was a second high average in September, this was not repeated in 1958. April 1958 averaged 16 knots and September 1958 only 8 knots. Peak gusts were also somewhat lower during the late winter of the second year. The maximum recorded gust occurred on the night of April 24, 1958 when 116 knots (133 miles per hour) was officially recorded before the

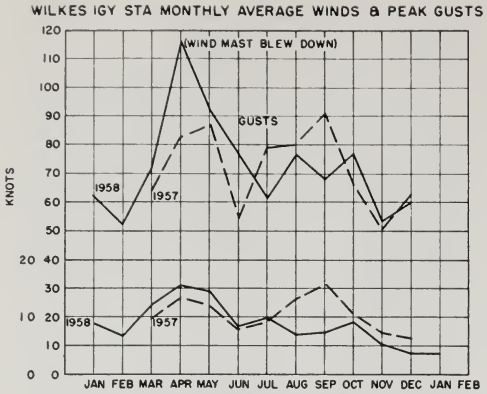

Figure 4. Average monthly wind velocities and peak gusts for 1957-1958 and 1958-1959 at Wilkes Station.

aerovane mast blew down. This was a rather trying experience and there were several times when we feared the roofs would be blown off. Later on we learned that the Clements buildings were designed to withstand winds of 100 miles per hour. In May 1958 the maximum gust reported was 92 knots (105 miles per hour) while gusts of over 70 knots (80 miles per hour) were recorded during the months of March, June, August and October. In May 1958 there were 12 days with gusts of over 50 knots (59 miles per hour).

Monthly precipitation in hundredths of an inch is shown in Figure 5. The two years are quite dissimilar. In 1957 precipitation showed a gradual and irregular drop from March through December while in 1958, the maximum precipitation rose in May and again in July. Rain was actually observed twice; a trace was reported on 5 January 1958 and on 17 May 1958 0.25 inches fell, causing heavy leaking in all the buildings. The maximum sea level barometric pressure occurred on 26 June 1958 when the barometer read 1019.5 MBS. The minimum barometric pressure observed occurred during the storm of 24 April and was 947.9 MBS.

[2] The weather data from which this summary has been prepared were furnished by John Zimmerman, Meteorologist USWB, at Wilkes Station 1958-1959.

Ice Studies

Daily observations of the ice conditions in the portion of Vincennes Bay surrounding the base were made from the aurora tower or from nearby hills. The Hydrographic Office Shore Observers Ice Log was filled in each day. Open water persisted around the base and in Newcomb Bay between Clark and Bailey islands until late in the fall. Rocks along the shores of the coves gradually became ice covered from spray of breaking waves but fast ice did not finally form in the coves and for several miles seaward until late May. Repeatedly, young ice would form, remain for a few days and then be broken up and blown out to sea by high winds, of which there were record numbers in May. Finally on May 27 the adjacent waters froze over for the last time and on June 9, 1958, 14-inch thick ice was measured at a regular ice measuring station established in the Ramp Cove. At this time holes cut in the ice farther offshore and in the center of Newcomb Bay showed a uniform thickness throughout. On June 11 the ice thickness had increased 1 inch, while by June 21, the thickness was 21 inches. Increase in ice thickness progressed as follows:

June 25	24 inches	Aug. 8	42 inches
July 8	30 inches	Aug. 25	42 inches
July 11	31 inches	Sept. 16	50 inches

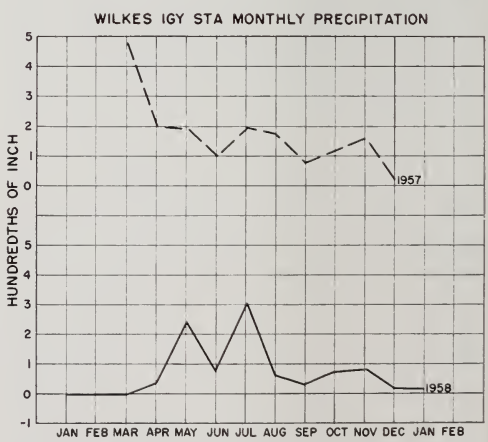

Figure 5. Monthly average precipitation for 1957-1958 and 1958-1959 at Wilkes Station.

From September 16 on, although the ice thickness was measured regularly until just before the fast ice went out, no greater thickness than 50 inches was observed. Snow blew in around the shore lines making a smooth approach to the rocky hills and snow fields adjoining the coves. At the head of "Ramp" Cove, on June 25, a 1-ton sled with mounted hand winch was hauled up on a wind-swept snow surface about 30 feet back from the former shoreline. Within a few days the sled was covered and when we finally dug it out on July 19, it was buried under 4 feet of hard-packed snow which had blown in from the land surface.

In ice holes which had been chopped to measure ice thickness, ice formed again rather rapidly during the colder months. In one hole which was chopped on June 20, 14 inches of ice had formed five days later. Conductivity of fast ice *in situ* was measured at the time of each ice thickness measurement by obtaining a clean ice sample 4 to 6 inches beneath the surface, melting it and determining the conductivity with a Surface Conductivity Bridge. Conductivity and hence salinity of the samples varied throughout the time of observation and showed no trend whatsoever. Conductivity was at about the same level when last measured in December as it had been when first measured on June 11. Salinities varied between 5 and 8°/oo. Brine apparently seeps upwards in the ice. In samples taken from hummocked ice above submerged rocks in the Ramp Cove, however, the salinity steadily decreased until on December 4, 1958, six months after the formation of the ice, the conductivity was around 1,000 micromhos (less than 1% salinity). This is perfectly good water for drinking although it is a little saline to most tastes. On the USS *Arneb* (AK-56) coming down to Wilkes Station, evaporator trouble caused the drinking water to vary between around 300- and over 4,000-micromhos conductivity. Good distilled water should not run much over 10 micromhos and this figure is easily attained when the evaporators are functioning properly.

Once the fast ice had formed in Vincennes Bay, it slowly extended its seaward range to what appeared to be a line about two or three miles east of the Frazier Islets which were some 10 miles out from shore. Fast ice never reached these islets during the winter of 1958-1959. The fast ice extended out to and considerably beyond the Chappel Islets which were about 5 miles west of the base and continued north along the shore as far as we could see. This ice along the shore to the north of the base remained in position until late in the summer and was still in place when the staff departed Wilkes on 6 February.

Break-up of the ice in southern Vincennes Bay and in Newcomb Bay occurred in late August in 1957 but was delayed until early November in 1958. The ice finally started breaking out on 6 November 1958 and in a few hours had broken out half way into Newcomb Bay on a line from the end of the "Ramp" Cove to McMullin Islet and northwest to the northernmost of the Chappel Islets. Fast ice remained in the "Tide Gage" and "Ramp" coves until well into December; blasting was finally resorted to in "Ramp" Cove to free it of ice to enable the dory to be launched. In "Tide Gage" cove the ice edge had receded just past the tide gage site and with a little blasting to free the rocks of ice, the tide gage was reactivated on November 28, 1958.

Before the formation of the fast ice and after the spring break-up, open water surrounded the base and extended as far as one could see toward the Frazier Islets. On some days a line of pack ice with numerous bergs could be seen near the horizon in this direction, having apparently been blown in from farther north or west. Small block and brash and occasional small floes of fairly thin ice would be carried past the base by wind and currents from time to time. This ice movement is illustrated nicely in a number of time-lapse movie films taken throughout

the year from the aurora tower. During the last two days while Wilkes Station was being built in February 1957, large masses of pack ice moved into Newcomb Bay from the north and seriously interfered with small boat movements in the area. The head of Newcomb Bay remained closed by fast ice and served as a source of supply for brash and block which was carried out of the bay by wind and currents. In 1958-1959 the strait between Shirley and Bailey Islands also remained frozen much longer than it had in previous years.

South of Wilkes Station, fast ice remained in position to the east of the outer islands such as Midgley, O'Brien, Warrington and Ardery, so that weasel traffic over the ice was possible as far as Browning Island until well into December. On December 17 we made a weasel trip to Browning, Peterson, O'Conner, Holl and Cloyd Islands over the ice. At that time only a narrow strip of ice connected O'Conner Island with the ice north of Browning Island.

Studies of the movement of Cape Folger, an ice point 9 miles to the north of the base, were made commencing on March 25, 1958 and continuing for nine months until December 23, 1958. A signal pipe was set in bedrock on the ridge across from the tide gage and a point of observation with bench mark was established on the rock ridge just to the south of the recreation hall. By obtaining the angle between the signal and the face of Cape Folger at intervals, using a Wild T-2 theodolite, the rate of seaward movement of Cape Folger was determined. Commencing on March 25 with an angle of 1°29′26″, by December 23 this angle had decreased to 1°20′50″ and by knowing the distance to Cape Folger from the point of observation—obtained by triangulation with a long base line—it was determined that a change in angle of 1 second arc was equivalent to a movement of 0.253 feet. During the 9 months of observation Cape Folger had moved 130 feet to the westward at an average daily rate of 0.48 or approximately one-half foot per day. This rate was not at all constant but varied from 0.17 to 1.42 feet per day. Compared with the Vanderford Glacier, which the glaciologists determined to be moving at the rate of nine feet per day,[3] Cape Folger's rate is comparatively slow. Because it was thought that the face of the tip of Cape Folger might break off sooner or later and also to establish more certain signals, a trip was made on 26 August to Cape Folger, where two ten-foot tripod signals were frozen into the ice on top of the cape. We found the surface of Cape Folger criss-crossed with crevasses, varying in width from a foot to 12 or more feet and mostly bridged over. Starting on September 6, observations were made on these two signals as well as on the face of Cape Folger. The outer signal, located about 75 yards from the tip of the Cape, seemed to be moving westward more slowly than the inner signal which was placed a half mile inland. By November 20 the outer signal was moving faster than the inner and at a rate of 0.35 feet a day. The distance to Cape Folger from the point of observation was determined by finding the distance from the point of observation (F-1) to G-3 as a base line and obtaining angles from each of these points. The base line was 4883 feet and the distance from F-1 to Cape Folger was 9.94 statute or 8.63 nautical miles. Up until the time we left Wilkes Station, the tip of Cape Folger had not broken off and fast ice still sealed it in to westward.

Tide Records

A portable tide gage furnished by the Navy Hydrographic Office, was installed on the rocky shores of what came to be referred to as "Tide Gage" Cove. A large rounded rock, the top of which was some 15 feet above the surface of the water, served as a base and firm mount for the recording drum, while the plastic pipe containing the float, was secured alongside

[3] Information determined by John Hollin Head Glaciologist, Richard Robertson and Caspar Cronk, Glaciologists, Wilkes Station 1958-1959.

a 2-inch iron pipe. This pipe was placed at the end of a steel bridge, which was suspended out over the water by steel cables, and firmly anchored from sidesway by other cables at the sides. The cables were fastened to steel rods driven into holes drilled in the rock. The fine wire from the float was run up over a pulley and through a 1-inch diameter pipe, to prevent interference from the wind, and to the recording mechanism on the rock. This arrangement was used during the fall operation of the tide gage to prevent total loss of equipment should the ice carry away the plastic pipe. In the spring when the tide gage was reactivated, the recording mechanism was placed directly on top of the plastic pipe. A tide staff was permanently mounted by steel braces fastened to pins in the rock, with the zero levelled in to a brass bench mark set in the top of the rock near the recording mechanism. In late April ice took out the plastic pipe and damaged the staff, which was replaced in the spring and relevelled. Although the tide gage was first installed in mid-February, it was not until early March that we were able to obtain continuous and relatively uninterrupted records. Even then we had trouble with the wire breaking and later on with freezing around the float. The latter condition was remedied by pouring hot water and then diesel fuel into the plastic pipe.

A more or less continuous record was obtained from March 5 through April 19, 1958, and again in the spring from December 15, 1958 through February 2, 1959. During the fall operating period, the maximum high tide level, based upon an arbitrary datum, was 8.2 feet, the lowest 1.7 feet, giving an extreme range of 6.5 feet. The maximum daily range was 5.8 feet, the minimum 0.7 feet. It was observed on several occasions that at neap tides between the time of full or new moon, there was considerable slack water with consequent lessening of tidal currents. The average daily range for the fall period of operation was 3.3 feet. In the spring and summer operating period, the maximum high tide level was 7.9 feet, and minimum low tide level 1.6 feet, which gives an extreme range of 6.3 feet compared with 6.5 feet in the fall period. The maximum daily range was 6.0 feet. the minimum daily range was 1.6 feet and the average daily tidal range was 3.5 feet (3.3 feet during the fall period).

Although the period of time over which tidal observations were recorded was not of sufficient length to establish a true mean sea level, the averages were taken as a base for topographic survey work and other work at Wilkes Station which required at least a tentative mean sea level approximation. If the average for the fall period of observation of the height above our zero datum (4.59 feet) is compared with the same figure for the spring and summer (4.13 feet), we find a drop of 0.46 feet occurring in "mean sea level" in the spring. This phenomenon has recently been pointed out by Munk (1958) and was shown for the North Atlantic Ocean by Patullo and others (1955), although in the northern hemisphere the months are reversed, with high sea level occurring in the month of September, rather than in March. Munk (1958) gives a figure of 20 cm (0.66 feet) difference at Baltimore and this difference, while greater than the amount noted at Wilkes Station, is of the same order of magnitude and probably is greater because the readings were taken in September and March rather than in March-April and December-January. Munk ascribed the cause of this difference in sea level at different seasons to actual transport of water to and from the polar regions, rather then being the effect of heating and cooling of the water by solar radiation, back radiation, evaporation, or other means, as seems to be the case in lower latitudes.

Strong tidal currents were produced in and out of the coves, and these will be discussed in the next section of this report. After the fast ice closed the coves and extended for several miles out to sea, a tidal crack developed along the shore. At high tides water was extruded through

this crack out onto the ice. There seemed to be little vertical movement of the ice, although this fact was difficult to determine. Other wintering-over expeditions have made tidal observations of limited extent by following the vertical movement of the ice and recording this to show tidal fluctuations. These results must be correlated with actual vertical rise and fall of open water, and the actual figures obtained can be only approximate. Establishment of such a tide gage on the ice at Wilkes Station was considered but the idea was abandoned after observing the apparently minute vertical movement of the ice near the tide gage. Operation of a tide gage was not continued by the Australians because of lack of manpower at the base.

Currents

Approximately 3,000 feet of 16 mm movie film was obtained from time-lapse photography of ice movements made from the aurora tower at Wilkes Station. Commencing in February 1958, these studies were made on all clear days when the camera and equipment were functional and there was open water with ice to photograph. Exposures were made at 30 second intervals at first, and later at 20 seconds. The resulting film will be subjected to careful examination by experts to determine current patterns and trends. At the present time, only a few general statements can be made. It is readily apparent that there are strong currents of tidal origin running into and out of the coves and into Newcomb Bay. In "Tide Cage" Cove the current is strongest near shore on the base side of the cove. A reversal in direction follows change in tide. Currents in Newcomb Bay appear strongest near shore but there is also considerable current flowing in the mid-bay area. Currents flowing out of "Tide Gage" Cove meet currents flowing out around "Base" Point and cause a large eddy at certain stages of the tide. In one instance it was noted that two blocks of ice which were travelling in opposite directions collided with each other. A counter current runs in opposite direction to the inshore current at a distance of a few hundred yards offshore. Far out on the horizon large blocks of ice and small bergs could be seen moving down southeast toward the Midgley Island group. In some instances ice movement near shore followed the direction of low cloud formations, whereas in most cases there was no correlation between direction of ice movement and wind direction, as indicated by low cloud movement, showing the currents to be of tidal origin. It would be interesting and perhaps might yield valuable information, if a wind direction indicator could be placed in the foreground when ice movement pictures are taken in the future. In the "Ramp" Cove there is an oscillatory motion of ice blocks seen at certain stages of the tide. When the *Magga Dan,* the Danish ship chartered by the Australians, anchored off the south side of "Base" Point, time-lapse movies were made of her motions while riding at anchor. It was hoped that some indication of current direction and shift might be obtained by following her motions. However, the *Magga Dan* seemed to switch about with little or no regularity of change of direction. The picture obtained when run at 16 frames a second reminded one of the lashing of a cat's tail and bore no resemblance to what might be expected from orderly tidal changes.

Survey Work

The first astronomical position for this area of the East Antarctica coast was accomplished by Lieutenant Richard Holl of the U. S. Navy Hydrographic Office while serving as hydrographic surveyor on Operation *Windmill* in 1948. A brass marker was permanently placed on a prominent peak on Holl Island, while two other positions on the island were occupied; South Base and East Base. In 1956 the Australians under the leadership of Phil Law established astros on Nelly Islet of the Frazier Islets group and on Thompson Islet in the Balaana Islets to the north of Wilkes

Station. Richard Berkley, geomagnetist at Wilkes during its first year of operation, established a position on the base from a number of star sights taken with a transit. Lieutenant (jg) Donald Burnett, OIC during the first year at Wilkes, had set up a number of signals on prominent high points on Clark Island and had tied them in among themselves with a transit. A start on the topography of Clark Island had also been made by Lieutenant Burnett and his men. Our task during the second year at Wilkes Station, was to tie in Holl's astro and Burnett's star sights with easily identified positions on islands shown on the existing charts of the Windmill group, bring the survey up to Clark Island and if possible tie in the small northern islands. We wished also to complete the topographic survey of Clark Island and fill in holiday areas on the charts, notably in the Midgley Island group and Herring Island.

In preparation for the survey work, permanent signals consisting of 1-inch iron pipe inserted into drilled holes in solid rock were placed on some 20 prominent positions on Clark, Bailey, Mitchell, O'Brien, Beal, Midgley, "West Midgley", Holl, Shirley and Ardery islands and the Chappel Islets. Using a portable Swedish rock drill, foot-deep holes were easily drilled and the pipe with flag inserted in the hole.[4] In most cases the pipe could be removed from the hole so that the theodolite could be centered directly over the hole; where this was impossible the pipe was bent down. Two large cairns had already been erected by Lieutenant Robert Newcomb and the author in early 1957 on a prominent ridge east of the base and formed a part of Lieutenant Burnett's system. Permanent signals were erected at these sites. A half-mile base line was chained out on a fairly level snow field between two low rocky prominences on which permanent signals had been erected. This was remeasured in the opposite direction a few weeks later, and tied into the triangulation system. Some survey work with a Wild T-2 theodolite was accomplished in the fall of 1958, occasional warm days permitting some work as late as May, but most of the work was accomplished in late spring and summer. when almost all signals on the nearby islands were occupied and all signals erected were tied into the net. Dean Denison and Sebastian Borrello, Aurora and Cosmic Ray physicist and geomagnetist respectively, made a trip to Holl Island and placed a permanent signal at the astro site, also taking sights on all signals visible to the north with the theodolite. They also placed a signal on Ardery Island, the highest point in the Windmill Group. Later Lieutenant (jg) David Eyres CEC who did all the remaining work with the theodolite, was able to cut in the astro signal on Holl Island from Midgley and West Midgley islands. While the ice was still in place, a second base line was chained off on the ice between O'Brien and Mitchell islands and tied in to signals on these islands. Star sights with the Wild T-2 theodolite were taken by Borrello and Eyres to more accurately fix the geographical location of Wilkes Station. The final best position, 66°15′24″ S. and 110°31′39″ E., is believed to be plus or minus 3 seconds in error. In the case of latitude the error is estimated, while with longitude it is the standard error of the mean. The point of actual observation was the old seismic hut located 176 yards east of Berkeley's B_2 station. For latitude, B Crucis and A Centauri at lower transit were used; 11 sets of data on the stars Sirius, Rigel, and Betelguese rising were used for the determination of longitude.

A topographic survey with plane table and telescopic alidade was completed for the northernmost of the small islands to the north of Clark Island by Robertson and Borrello, and these two men with help from others at the base covered the great-

[4]Audun Ommundsen, mechanic at Wilkes Station 1958-1959 greatly assisted Lieutenant (jg) Eyres and the author in preparing and establishing the signals used in triangulation.

er portion of Clark Island in a similar survey. Supplementing the topographic survey, a series of aerial photographs was taken by Caspar Cronk from the little Auster plane of the Australians, piloted by Lcdr Leckie of the RAAF. For these surveys a hole was cut in the floor of the plane so that verticals with the F-56 aerial camera could be taken. The elevation was approximately 8,000 feet. The Australians were also kind enough to furnish the author with copies of two dozen trimetrogon photos which had been taken over Herring and Midgley islands in 1956 when the area was unusually ice free. With these aids, it is believed that the Hydrographic Office may be enabled to complete the charting of the Windmill Island group.

Bottom Sediments

In February 1957, while the station was being established under the critical supervision of Carl R. Eklund, Wilkes first Station Scientific Leader, the present author was able to obtain several short cores and bottom sediment samples in the deeper waters of Newcomb Bay. These were obtained from the deck of the USS *Glacier* (AGB-4), while she was at anchor. The results of these bottom samplings were reported on in the Hydrographic Office Technical Report No. 29 (1957). Because of a considerable variation in the nature of the samples taken, it was believed that a series of samples taken from the shoreline out to the deeper waters of Newcomb Bay, might prove of interest. Accordingly, as soon as the ice had formed in "Ramp" Cove in June, a series of ten samples was commenced, starting at a spot about 30 feet from the shoreline at the head of the cove where the water was 1 fathom deep and ending out in Newcomb Bay proper at 37½ fathoms depth. The first few holes were chopped out by hand, but as the ice became thicker, it was found much easier to blow them with 2 to 3 pounds of C-4 plastic. This made a blackened mess on the ice and a jagged hole which was unsuitable for ice thickness measurements but which served admirably for obtaining bottom samples with an orange peel sampler. A hand winch mounted on a 1-ton sled was towed by the Rat vehicle or weasel and when in deeper water the sampler was hauled up by running the vehicle out on the ice away from the hole rather than by laborious hand winding of the winch. The results of the series of bottom samples, together with those obtained from samples taken on the *Glacier*, are given in Table 1. Location of the samples are shown in Figure 1. Station GL-27 was an orange peel sample taken off the Frazier Islets and is included for comparison of the cove samples with the deeper bottom sediments of Vincennes Bay. Station 1 is located about 30 feet from the edge of the shoreline at the head of "Ramp" Cove, station 6 about 30 yards out in the cove from station 1. The other stations in succession were 60 yards apart as far as station 5, and 120 yards apart from then on into Newcomb Bay. CL-16 was taken from the Glacier off the entrance to "Ramp" Cove.

Table 1 summarizes some of the results obtained from field inspection of the fresh samples and laboratory analysis of the sediments, particularly in regard to size analysis and statistical measures. It will be noted that within the cove the sediments are coarse and relatively well sorted, while out in Newcomb Bay the sediment becomes much finer and sorting is poor. None of the pebbles examined appeared to be freshly deposited but gave indications of long residence in the area. Most quartz grains exhibited a glassy surface texture. Frosted grains in samples 2, 3, 4 and 7 possibly suggest the existence of old beach lines. Most of the pebbles were composed of gneissic or banded quartzite, with biotite the most abundant accessory mineral. Some garnet was present but this mineral was not nearly as abundant as its common and wide-spread occurence on the exposed rocks of the area would appear to indicate. Sand grains were almost all of medium sphericity with angular or subangular configurations. Quartz was the

TABLE 1

Bottom samples taken in "Ramp" Cove, Newcomb Bay and Vincennes Bay. Abbreviations; F = fathoms; M D G = medium dark gray; Gr Ol = grayish olive; L OG = light olive gray: M O B = medium olive brown; L O B = light olive brown; Veget = vegetable like odor.

Station No.	1	6	4	3	2	5	7	8	9	10	GL-17	GL-27
Depth (F)	1	1	1.75	2.5	3.5	3.75	7.5	9.0	31.5	37.5	40	166
Color	—	MDG	Gr Ol	Gr Ol	Gr Ol	Gr Ol	LOG	—	MOB	MOB	MOB	LOB
Odor	—	Fishy	Fishy	Fishy	H^2S	Fishy	H^2S	—	None	Slight	Foul	Veget
Plasticity	—	Med High	—	High	High	High	Med	—	Low	High	—	—
Pebbles %	100	52	3	6	18	3	3	100	—	0	0	57
Sand %	—	48	96	93	81	96	96	—	—	52	44	31
Silt %	—	Tr	Tr	Tr	1	1	Tr	—	—	34	34	7
Clay %	—	Tr	Tr	Tr			Tr	—	—	13	23	5
Quarterly Deviation ϕ	—	3.64	0.22	0.45	0.62	0.33	0.34	—	—	2.23	2.30	4.38
Skewness ϕ	—	+0.21	+0.02	−0.05	−0.18	−0.01	−0.03	—	—	+1.42	+0.95	+2.87
Median Diameter ϕ	—	−2.45	1.05	1.90	2.10	2.04	1.99	—	—	3.85	4.50	−4.10
First Quarter ϕ	—	5.88	0.85	1.40	1.30	1.70	1.62	—	—	3.04	—	—
Third Quarter ϕ	—	1.40	1.29	2.30	2.53	2.36	2.30	—	—	7.50	—	—
Sediment Type	Gravel	Sand/ Pebbles	Sand	Sand	Sand	Sand	Sand	Pebbles	—	Silty Sand	Sand	Glacial Till

dominant mineral with feldspar, biotite, hornblende and garnet subdominant minerals.

Organic remains in the samples varied considerably from station to station depending upon the nature of the bottom sediment. The bottom of "Ramp" Cove is pretty well covered with both brown colored and bright red colored algae which are attached to rocks on the substratum and have long kelp-like fronds. At station 1, the bottom was entirely gravel and bare of organic material while at the next station out in the cove some annelid worms were recovered. The third station also showed in addition to annelids, some clam shell fragments. Although repeated attempts were made with various devices to obtain some of the living clams, which could clearly be seen on the bottom, it appeared that the clams were able to burrow down into the sediment faster than they could be scooped up by dredge or other sampling device. The shells were extremely thin and fragile. Some razor clam type shells had been obtained in Newcomb Bay two years earlier on the *Glacier*. Clam shell fragments and annelids appeared to be the only organic remains in the cove proper and it was not until the deeper water of the bay was reached at station 9 in 31½ fathoms that other organisms such as sea cucumbers, brittle stars and sea urchins were recovered.

No sponge spicules such as abound in the sediments of the McMurdo Sound region were noted in the bottom sediments of the cove nor in Newcomb Bay. Diatoms were not observed until well out in the bay at station 10. A general scarcity of diatoms in the waters of the area around Wilkes may possibly be explained by the following comments. With the spring break up of the ice at Wilkes, the water was of unusual clarity, making photographs of the bottom possible through several meters of water. It was expected, from experience gained at McMurdo Sound, that by December the planktonic growth would be dense enough to greatly reduce the transparency, but this never happened and the water remained very clear until we left Wilkes in early February. At McMurdo Sound, on the other hand, the water was very clear on 4 November 1956 when the *Glacier* made an early visit, and a transparency of 47 meters was obtained. By 21 December 1956 the transparency had been reduced to 5 meters and a ½-meter net haul produced a quart jar full of a thick mass of plankton which smelled like a freshly opened can of raw oysters. Apparently the volcanic nature of the exposed rocks at McMurdo Sound offer more easily soluble nutrients, especially silica, in the spring turnover period thus causing the dense crop of diatoms, and also probably contributing to the abundance of silicious sponges, which feed on the diatoms. Both of these organisms are very much less abundant at Wilkes, where granitic types of rock formations provide little in the way of nutrient materials, despite considerable runoff during the summer months.

This same condition was noted by Lisitzin (1959) in reporting on bottom sediments of the Indian and Pacific sectors of the Antarctic. Lisitzin commented upon the scarcity of diatoms near the antarctic continent with its predominance of glacial material composing the sediments, while farther north the glacial material decreased and diatoms took the leading role in sedimentation. Lisitzin also pointed out that in regions of the Indian and Pacific sectors submarine volcanoes were associated with zones of diatom oozes.

In conclusion it may well be said that despite the enormous amount of information on various phrases of Antarctica contributed during the International Geophysical Year, in the fields of oceanography and hydrography, much remains to be accomplished, the surface having, so far, barely been scratched. Our year at Wilkes Station was certainly one of the most enjoyable periods of my life, but our oceanographic accomplishments were negligible and we are looking forward to a year at

McMurdo Sound where full-time, shore-based oceanography will be carried out during 1959-1960. Since the voyage of the *Atka* in 1954-1955, icebreakers with a single oceanographer from the Navy Hydrographic Office aboard, have been contributing a certain amount of scattered oceanographic observations in the Antarctic. However, a real and worthwhile approach to antarctic oceanography will only be made when it becomes possible to send a specially constructed oceanographic survey vessel with a single mission, oceanographic research, into the area for an extended period.

REFERENCES

Munk, Walter. 1958. The Seasonal Budget of water. Geophysical Monograph No. 2 Am. Geo. Un. p. 175-176.

Patullo, June, Walter Munk, Roger R. Revelle and Elizabeth Strong. 1955. The Seasonal Oscillation in Sea Level. J. Marine Res., *14*, p. 88-155.

U. S. Navy Hydrographic Office. 1957. Operation DEEP FREEZE II, 1956-1957. Oceanographic Survey Results. Technical Report No. 29. p. 58, 135-140.

Lisitzin, A. P. 1959. Bottom Sediments of the Antarctic. Abstracted in Reprints, International Oceanographic Congress, A.A.A.S. Washington, D. C. p. 468-469

Pioneering Research in the Department of Agriculture

William E. Carnahan

Information Division, Agricultural Research Service

"Basic research is the starting point for the imaginative processes that lead to new things and new ways of doing things . . . the thought, observation, experimentation, and analysis that give us new scientific facts and principles."

This is how Byron T. Shaw, administrator of the Department of Agriculture's Agricultural Research Service, has defined the kind of work done at the new ARS Pioneering Research Laboratories. The first of these special laboratories to explore beyond the known in science was established in the summer of 1957, and a total of 15 are now in existence. Seven are at ARS Agricultural Research Center, Beltsville, Md., two are in Washington, D. C., two in New Orleans, La., and four others are at Lafayette, Ind.; Albany, Calif.; Peoria, Ill.; and Wyndmoor, Pa.

Scientists engaged in pioneering research are not required to justify their work with respect to its practical results but only from the standpoint of its contribution to basic knowledge. Also, pioneering research scientists are freed from routine administrative duties. And there are no supervisors in the new laboratories, only scientists working together.

The first pioneering laboratory was established in August 1957, at Beltsville to study the mineral nutrition of plants. Sterling B. Hendricks, principal scientist of this unit, and six associates are involved with a long-range study of the process of nutrient uptake in plants. Scientists know that the transfer of nutrient elements from the soil to the interior of plant roots is controlled by the respiration of the root and is limited by cellular barrier. The exact location and character of the barrier are unknown.

Radioisotopes are used in this work to measure rates of nutrient uptake. What plants do with the nutrients is one of many questions workers in the laboratory hope to answer.

Also established at Beltsville very early in the history of pioneering research was the Blood Antigens Laboratory under the

Figure 1. Discovery by a team of scientists at the Plant Physiology Laboratory headed by Dr. Harry A. Borthwick of a light-sensitive pigment that acts as the triggering mechanism for plant development may eventually enable man to control all stages of plant growth. Dr. Borthwick showed some of the light pigment work to Russia's Premier Nikita Khrushchev during the Khrushchev visit to the U. S.

leadership of Sam L. Scheinberg. Currently, Dr. Scheinberg and his associates, who concern themselves with blood chemistry and immunogenetics, are studying the somatic variation of red cell antigens. Variants have been found among red cells which lack antigens found in most blood cells. In man, A-negative cells have been found to occur spontaneously at a frequency of one per 1000. Similar and higher frequencies of inagglutinable cells have been found in pigeons and are thought, perhaps, to be due to spontaneously occurring mutations. To support this hypothesis, it was recently found that, following irradiation in both man and pigeons, an increase in inagglutinable cells occurs.

Perhaps the most important single find made so far in pioneering research efforts was the discovery of a pigment in plants that acts as a triggering mechanism for all plant development. The discovery was made at the Plant Physiology Laboratory at Beltsville where the principal scientist is Harry A. Borthwick. The finding may open the way eventually to man's complete control of plant growth from germination through flowering and fruiting.

The pigment, named phytochrome, is present in plants in very minute quantities, and pioneering research workers have found out much about it. For example, they know that it is blue because it absorbs red light. They also know that it takes two reversible forms—one that absorbs red light, and the other that absorbs far-red light. Experiments show that, when the red-absorbing form is exposed to red light, it reverts to the form that absorbs far-red light. Far-red light, in turn, causes the pigment to revert to the red-absorbing form.

The scientists have removed the pigment from corn seedlings and are now attempting to purify it and identify it chemically.

Dr. Borthwick and his associates are thus seeking to learn more about the ways in which plants are influenced by their environment with special emphasis on their response to light.

The Cellular Metabolism Laboratory, in the ARS Institute of Home Economics at Beltsville, is under the leadership of Howard Reynolds. Scientists in this group are developing new basic information on cellular nutrition, physiology, and biochemistry, using microorganisms such as algae, bacteria, protozoa, yeasts, and molds as experimental tools. The use of microorganisms in this way is based on recognition that all organisms have much in common and that a new understanding of one often leads to a new understanding of others. For example, vitamins that function in the metabolism of microorganisms also play essential roles in human and animal nutrition and, as far as is known, the enzymatic functions of individual vitamins are identical in all organisms.

The Insect Pathology and the Insect Physiology pioneering laboratories are in the ARS Entomology Research Division at Beltsville. Clarence G. Thompson is leader of the Insect Pathology group. He and his

associates are seeking to gain a fundamental understanding of the nature of microorganisms that cause diseases of insects. Environments in which microorganisms are capable of causing disease outbreaks in insect populations are being analyzed, and the scientists are trying also to determine how insect diseases start and spread in nature in hope that their findings will be useful in controlling insect populations. What happens to insect cells when they are invaded by a virus is also being investigated as well as how the viruses invade the cells, and how they multiply within the insect.

The Insect Physiology group, under the leadership of William E. Robbins, studies the normal life processes of insects, including endocrine systems, development, sensory perception, and reproduction. In addition to increasing man's knowledge of insect physiology and biochemistry, this work may provide clues to insect responses to chemicals and the development of insect resistance to insecticides.

Russell L. Steere heads a group working in the Plant Virology Laboratory at Beltsville. Here, the scientists are attempting to learn what happens after a virus enters a plant and how the virus reproduces within the plant cells. They are also studying the relationship between various plant viruses and plant response to them. Viruses are being purified to study their chemical and physical properties, and new serological techniques for identifying plant viruses are being developed.

Dr. Steere is also developing new techniques for preparing biological specimens for electron microscopy. By modification of the frozen replica technique that he recently developed, he hopes to be able to follow the course of virus reproduction within infected cells.

Two pioneering laboratories are located in New Orleans at the ARS Southern Utilization Research and Development Division. One is the Seed Protein Laboratory, under the direction of Aaron M. Altschul. Dr. Altschul's group is seeking basic knowledge

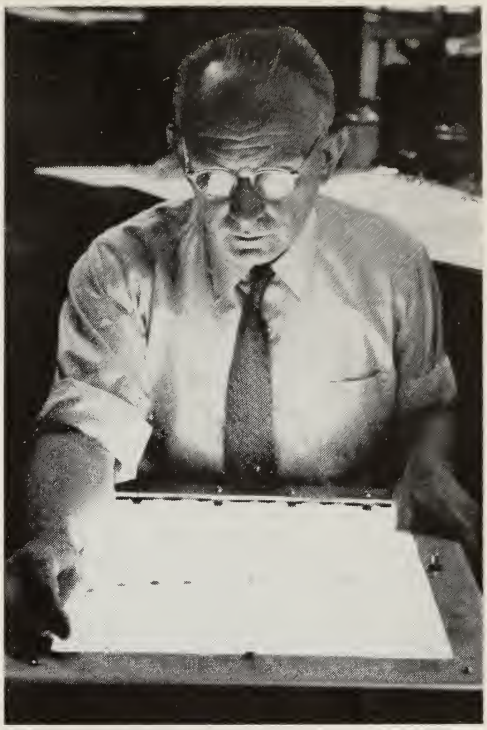

Figure 2. Dr. Sterling B. Hendricks, principal scientist at the Laboratory for Mineral Nutrition of Plants, examines chromatograph negative of barley root extract. Such photomaterial helps in the study of translocation of plant nutrients.

of the proteins, fats, and other components of seed as they occur naturally in the seed before processing treatments have changed the nature of the constituents. Homogenizing the oilseed and separation of individual subcellular particles by gentle physical means, are among the techniques used. Purification of individual proteins furnishes materials that can be studied to determine the amino-acid sequence and other structural factors of plant proteins. It is hoped that this information will permit comparison of the fundamental structure of seed protein with other plant and animal proteins.

The Plant Fibers Laboratory, also at New Orleans, is designed to develop basic information on the structure of plant fibers (with special emphasis on cotton), and the relationship of this structure to fiber properties. The information gained in this research may assist in predicting

effects of chemical and physical treatments on fibers. Knowing these effects in advance may help other scientists eliminate or minimize the need to conduct experiments on a trial-and-error basis. Carl Conrad is principal scientist of this group.

At the Laboratory for Microbiological Chemistry in the ARS Northern Utilization Research and Development Division at Peoria, a group under Frank H. Stodola seeks to discover fundamental principles underlying metabolic synthesis in microorganisms. Recently, they investigated the mechanisms by which yeast converts glucose into more complex chemicals. A thorough knowledge of these processes may help to control them for beneficial purposes.

A group at the regional utilization research laboratory in Albany, Calif., called the Plant Enzyme Laboratory, is developing basic knowledge to advance the utilization of plants and plant products. Here, Eugene F. Jansen, biochemist, and three associates are currently working on two problems: One of these is concerned with the biosynthesis of ascorbic acid in fruit and the discovery and characterization of the specific enzymes involved in the reaction chain of this synthesis. The other is concerned with the biochemistry involved in speeding up the post-harvest ripening of fruit by ethylene gas.

Milk proteins are being analyzed at the Laboratory for the Chemistry of Animal Proteins at Wyndmoor, Pa., under the leadership of T. L. McMeekin. Studies there have already shown that the caseins, albumins, and globulins making up these proteins are not pure substances, but similar fractions of slightly differing properties. As the fractions are separated, isolated, and identified, information is obtained that may have profound effects on the future science and technology of milk and milk products.

A pioneering laboratory in animal genetics has been organized at Lafayette, Ind., under the leadership of Wendell H. Kyle who is working on quantitative genetics. The group is associated with the Population Genetics Research Institute at Purdue University.

Inheritance, gene behavior, mutations, mating systems, selection, and environmental factors affecting genetic traits of animals are under study at this laboratory. The scientists use laboratory animals, such as mice and fruit flies, for theoretical and mathematical studies of genetic problems, where gene actions, mating systems, and selection systems are described. New methods of selection and new systems of breeding are evaluated, and new mutations that might be produced are investigated.

Henry Stevens is principal scientist in the Laboratory on Allergens in Agricultural Products in Washington. He and his associates are conducting basic research on the chemistry and immunology of allergens. They are concerned with finding out just how these materials produce allergic responses. The principles they establish will be useful in the processing of agricultural products to reduce or eliminate allergic effects. This laboratory is contributing to the little-known science of immunochemistry and thus to human health.

The 15th, and newest, of the pioneering research groups has been organized for the study of interfirm integration in farming and is under the leadership of Ronald L. Mighell, agricultural economist.

Interfirm integration in farming refers to the ways by which production decisions, services, and risks are linked between farmers and related businesses. Dr. Mighell's group is analyzing the basic economic principles and related social and technological forces underlying the development of the various forms of integration and coordination in farm production. They are working toward improved understanding of the economic reasons for true production coordination.

All the ARS pioneering research laboratories together serve as a training ground for future U. S. scientific leaders and offer new and expanding opportunities for young scientists to grow and develop.

Science in Washington

SCIENTISTS IN THE NEWS

This column will present brief items concerning the activities of members of the Academy. Such items may include notices of talks given, important conferences or visits, promotions, awards, election to membership or office in scientific and technical societies, appointment to technical committees, civic activities, and marriages, births, and other family news. Formal contributors are being assigned for the systematic collection of news at institutions employing considerable numbers of Academy members (see list on masthead). However, for the bulk of the membership, we must rely on individuals to send us news concerning themselves and their friends. Contributions may be addressed to **S. B. Detwiler, Jr., Associate Editor, 2605 S. 8th St., Arlington, Va.**

Coast and Geodetic Survey

Dean S. Carder served on a panel of seismologists and physicists that met April 21 before the Joint Congressional Committee on Atomic Energy. The panel was concerned with possibilities of detecting underground nuclear explosions.

Geological Survey

Francis R. Fosberg attended a conference on tropical botanical problems of concern to the United States, held May 5-7 at the Fairchild Tropical Gardens, Coconut Grove, Fla.

Louis W. Currier, a member of the Geological Survey since 1930, retired from the staff on May 31.

George Washington University

H. George Mandel attended the recent 51st Annual Meeting of the American Association for Cancer Research and the 44th Annual Meeting of the Federation of American Societies for Experimental Biology, both held in Chicago.

Harris Research Laboratories

Alfred E. Brown attended a meeting of the Scientific Research Advisory Committee of the Washington Board of Trade on March 14, and discussed the Committee's recommendations on how to foster research and development in Washington. On March 24-25, he attended the 30th Annual Meeting of the Textile Research Institute in New York City, and was chairman of the session on new textile fibers.

Dr. Brown and **John Menkart** attended the Second Quinquennial Wool Textile Research Conference at Harrogate, England, on May 18-28, where Dr. Brown presented a paper entitled "Development of Wash-and-Wear Wool Fabrics for Modern Home Laundering."

National Bureau of Standards

Irwin H. Fullmer, chief of the Engineering Metrology Section, has received a certificate from the Board of Codes and Standards in appreciation of his outstanding leadership in the development of standards and codes.

Allen V. Astin, director of the Bureau, was one of 35 scientists elected to membership in the National Academy of Sciences at the Academy's 97th annual meeting here, on April 26.

John K. Taylor, Director of Science Projects under the NSF grant to the Wash. Academy, has been elected to membership on the Board of Directors of the Metallurgy-Ceramics Foundation, Inc. which was established as an outgrowth of a study by a Special Committee on Manpower for the Metallurgical and Ceramics Professions. The Foundation, which has headquarters in Latrobe, Pa., is dedicated to "the advancement of learning in the fields of metallurgy, metallurgical engineering, ceramics, ceramic engineering, and allied fields of science, and to encourage the study of the same by more and better qualified students . . .".

To illustrate the role of scientific meetings in today's research, our contributor has compiled the following list of papers presented by WAS members at NBS during late March and April:

Samuel N. Alexander, "Data Reduction and Computation in Relation to Space Instrumentation"—American Institute of Electrical Engineering in Space Technology, Dallas, April 13.

Vincent E. Bower, "The Dissociation Constants of Three Ethanolamines" — American Chemical Society, Cleveland, April 12.

Lewis M. Branscomb, "The Determination of Temperatures in Gases by Spectroscopy"—Symposium on Optical Spectrometric Measurements of High Temperatures, University of Chicago, March 25.

Abner Brenner, "A Visit to a Scientific Conference in Moscow"—American Electroplater's Society, Pittsburgh Branch, April 13, and Tri-state Annual Meeting of American Electroplater's Society, Cincinnati, April 23.

Frank R. Caldwell, "Intercomparison of Thermocouple Response Data"—Society of Automotive Engineers, New York, April 5.

Forest K. Harris, "Basis of Electrical Standards"—New York Section of the American Institute of Electrical Engineers, Hicksville, Long Island, April 27.

Charles M. Herzfeld, "The Evaluation of Modern Physics"—University of Maryland Chapter of Sigma Pi Sigma, Physics Honor Society, Washington, April 12.

John D. Hoffman, "Theory of Chain Folding of Polymer Molecules in Dilute Solution"—American Physical Society, Detroit, March 23.

Julius L. Jackson, "Electric Field Distribution in a Dense Plasma"—American Physical Society, Washington, April 25-28.

Deane B. Judd, "Color-vision Theory, Implications and Applications"—Armed Forces NRC Committee on Vision, Cleveland, April 5.

Lewis V. Judson, "Can You Measure It?"—Metrology Seminar, AAAS, Chicago, April 21-28.

Harry J. Keegan, "Spectrophotometry 190 to 2500 Millimicrons"—Optical Society of America, Washington, April 7-9.

Carl C. Kiess, "Evidence for Oxides of Nitrogen in the Atmosphere of Mars"—National Academy of Sciences, Washington, April 25-27.

Lawrence M. Kushner, "The Growth of Crystals from the Vapor; Recent Experiments at NBS with Zinc"—Southeastern Section of the American Physical Society, Gatlinburg, Tenn., April 7-9.

Samuel L. Madorsky, "Thermal Degradation of Polymers"—Brooklyn Polytechnic Institute, Brooklyn, April 23.

Ladislaus Morton, "Some Aspects of Electron Physics"—Local Chapter of Sigma Phi Sigma, Washington, April 13.

Robert S. Marvin, "J. D. Ferry as a Scientist and Teacher"—American Chemical Society, Cleveland, April 12.

Alvin G. McNish, "The Twentieth Part of One Poor Scruple" — Annual Conference of Technical Societies, Council of New Jersey, Newark, March 29.

Archibald T. McPherson, "Standards—Good and Bad"—Allentown-Bethlehem Section, American Society for Quality Control, Allentown, Pa., April 13.

Sanford B. Newman, "Microscopy with Electrons and X-rays"—Carnegie Institution, Geophysical Laboratory, Washington, April 28.

Irwin Oppenheim, "Solvent Effect on Internal Rotations of Linear Polymer Molecules"—American Chemical Society, Cleveland, April 6.

George C. Paffenbarger, "Dimensional Changes Occurring in Artificial Dentures During Processing and in Service"—Odontographic Society of Chicago, April 4, and "Evaluation of Available Materials for Dental Impressions, Dental Restorations, and Denture Base Materials"—11th Mid-Atlantic States Conference on Dentistry, Hershey, Pa., April 25-28.

Aaron S. Posner, "X-ray Diffraction Studies on Contraction in High Polymers"—Harvard Medical School, Biophysics Colloquium, Boston, March 31, and "The Crystal Chemistry of Calcified Tissue"—Section on Pathodontia, First District Dental Society of New York, April 11.

James B. Saunders, Sr., "Measurement of Wave Fronts Without a Reference Standard"—Optical Society of America, Washington, April 7.

Hubert R. Snoke, "Roofing Research"—Asphalt Roofing Industry Bureau, Chicago, March 24.

Robert D. Stiehler, "Developments in Rubber Laboratory Testing"—Quality Control Conference for Rubber Companies, White Sulphur Springs, Pa., April 28.

Lauriston S. Taylor, "Radiation Protection Standards"—PHS Radio Nuclides in Foods Course, Taft Engineering Center, Cincinnati, April 19, and "Historical Development of Radiation Protection Standards"—Cincinnati Radiation Society, Cincinnati, April 19.

Edward Wichers, "The Work of the National Bureau of Standards"—Lorain County Society of Professional Engineers, Lorain, O., April 13.

William J. Youden, "What's in Measurement"—Mathematics Club, Roosevelt High School, Washington, March 31, and "Everyday Application of Statistics"—Montgomery County Mathematics Teacher's Association, Bethesda, Md., April 6.

Naval Research Laboratory

William A. Zisman was the principal speaker at the "Frontiers of Chemistry" lectures held March 25, under the sponsorship of Western Reserve University. His subject was "Surface Activity in Non-aqueous Liquids." On the same day he spoke before the staff of the Standard Oil Company of Ohio. Dr. Zisman also recently addressed the members of the Chicago Section of the American Chemical Society.

Herbert Friedman delivered an invited paper on "Optical Experiments in Rockets and Satellites" before the Optical Society of America at its spring meeting, held here in early April. On April 11, Dr. Friedman spoke on "Instrumentation for Space Science" at the AIEE 1960 Conference on Electrical Engineering in Space Technology, held in Dallas. He also presented an invited paper on April 28 at the annual meting of the National Academy of Sciences, on the subject, "Survey of Observations of Solar Ultraviolet and X-Rays."

USDA, Beltsville

C. H. Hoffmann of the Entomology Research Division presented a paper, "Relation of Insecticides to Fish and Wildlife," before a meeting of the North Central States Branch of the Entomological Society of America, held March 24 in Milwaukee.

USDA, Washington

Robert W. Webb is now rounding out 40 years of continuous service on the Department's scientific staff, the last 33 years of which have been devoted to cotton fiber technology. He is generally referred to by his professional associates as being the "father of cotton fiber technology in America." During the next several

years before his retirement from active service, Dr. Webb will be engaged in evaluating some complex relationships of importance to both present and future cotton fiber technology. These statistical investigations are of a highly exploratory nature; and as a consequence, Dr. Webb continues today to be a pioneer in his final plateau of official work, no less than he was during the early days of his program for the development of cotton fiber technology in the United States, over 30 years ago.

National Academy of Sciences

The 97th Annual Meeting of the National Academy of Sciences, held April 25-27, 1960, elected 35 new members. Five of these were members of the Washington Academy of Sciences: **Allen V. Astin,** director of the National Bureau of Standards; **Herbert Friedman,** U.S. Naval Research Laboratory; **Karl F. Herzfeld,** professor of physics and head of department, Catholic University; **Richard N. Tousey,** U.S. Naval Research Laboratory; and **Robert J. Huebner,** chief, Laboratory of Infectious Diseases, Nat. Inst. of Allergy and Infectious Diseases, NIH (resigned WAS, 1959).

Four WAS members presented papers during the National Academy meetings: **C. G. Abbot,** Smithsonian Institution, "A Forecast of United States Precipitation Through 1967"; **Edward V. Evarts,** NIH, "Effects of Sleep and Waking on Single Cortical Neurons"; **C. B. Anfinsen, Jr.,** NIH, "Topology and Topography of the Genetic Fine Structure"; **Herbert Friedman,** Naval Research Laboratory, "Survey of Observations of Solar Ultraviolet and X-rays". **David McK. Rioch,** Walter Reed, lead a symposium discussion; **Leonard Carmichael,** Smithsonian Institution, was chairman of a Symposium on Current Investigations on the Brain and Behavior.

Alan T. Waterman, director, National Science Foundation, received the Academy's Public Welfare Medal for "eminence in the application of science to the public welfare". The honor medal is unique in recognizing public service in the uses of science rather than achievement in any particular scientific discipline.

DEATHS

Beno Gutenberg, geophysicist, died in Pasadena, Calif., on January 25, at the age of 70. A native of Darmstadt, Germany, Dr. Gutenberg studied under Emil Wiechert at the University of Göttingen, where he received the Ph.D. degree in 1911. He remained at Göttingen for some years, later serving with the International Seismological Central Station in Strasbourg, and as professor at the University of Frankfort. In 1930 he was called to California Institute of Technology as professor of geophysics and meteorology. Later he was appointed first director of the Seismological Laboratory, a position which he occupied until his retirement in 1957.

Among his many outstanding accomplishments, Dr. Gutenberg was especially recognized for his computation of the depth of the earth's core—2900 km, a value that still stands—and his publication with Richter of the several editions of "Seismicity of the Earth." His particular discovery, according to Perry Byerly (*Science*, April 1), was the low-velocity layer in the earth just below the Mohorovic discontinuity.

Paul Bartsch, internationally-known biologist, died April 24 at "Lebanon," his 458-acre home and wildlife preserve on the Potomac near Mount Vernon. He was 89.

A native of Silesia, Dr. Bartsch was brought to the United States at the age of 11 and raised in Iowa. He received the master's and Ph.D. degrees from the University of Iowa.

Dr. Bartsch retired in 1941 from his post as curator of mollusks at the National Museum, but remained active as a consultant until his death. In 1945 he retired as professor emeritus of George Washington University's Zoology Department, which he established in 1900 with a class of four students. He introduced botany and biology into the University's curriculum, and started graduate work in the natural sciences.

Dr. Bartsch also taught for 37 years at Howard University's Medical School, directing the historical and Physiological laboratory. He was elected to the Washington Academy in 1906, and retired in 1948.

Peter Chrzanowski, 49, a physicist and expert on acoustics at the National Bureau of Standards, died April 11 of a heart attack, at his home in Chevy Chase. Born in New Britain, Conn., Mr. Chrzanowski joined the Bureau staff in 1929; he graduated in physics from George Washington University in 1937.

In 1941, Mr. Chrzanowski worked with Paul Heyl in their classic determination of the gravitational constant. He was awarded the Department of Commerce silver medal for meritorious service in 1952. At the time of his death he was head of the NBS Infrasonics Group, which last year received the Department's gold medal for exceptional service in classified defense work.

AFFILIATED SOCIETIES

Acoustical Society of America, Washington Chapter

April 26, colloquium on "Architecture, Acoustics, and Electronics in Modern Architectural Acoustics," with Harold Burris-Meyer, John W. Mcleod, Horace Trent, and Albert Preisman: a joint meeting with the Washington Chapter of the American Institute of Architects, the Washington Audio Society, and the Professional Group on Audio of the Washington Chapter of IRE—8 P.M., in the Pan American Room of the Stat-

ler, preceded by the usual informal dinner at Alfonso's, 1403 L Street, N.W.

American Institute of Electrical Engineers, Washington Section

April 26, Technical Meeting, "Design Theory of Dulles International Airport," Herbert H. Howell, Federal Aviation Agency.

American Meteorological Society, District of Columbia Branch

May 18, "Current Problems in Synoptic Meteorology," Harlin Saylor, U. S. Weather Bureau.

American Society of Mechanical Engineers, Washington Section

May 12, "Ground Effect Machines," Major J. J. Wosser, 8 P.M., PEPCO Auditorium.

May 26, "Response of Ships to Underwater Explosions," Alfred Keil.

Botanical Society of Washington

May 5, Annual Dinner, University Methodist Church, College Park, Md., featuring an address by Justice William O. Douglas.

Chemical Society of Washington

The Society held its 698th meeting on April 14 in the John Wesley Powell Auditorium of the Cosmos Club. Sir Eric K. Rideal, professor emeritus of King's College, University of London, addressed the group on "Chemical Reactions in Adsorbed Monolayers." Prior to the general meeting, the Board of Managers entertained Sir Eric at dinner, but transacted no business.

The Society held its 699th meeting on May 6 at the University of Maryland. This was a "meeting-in-miniature," conducted jointly with the Maryland Section of the American Chemical Society. In afternoon and evening sessions, over 50 technical papers were presented in the divisions of analytical, bio-, industrial and engineering, inorganic, organic, and physical chemistry.

In addition to the technical papers, a general program featured tours of the Maryland Chemistry Department; a popular lecture on "Science and Magic" by Samuel Shapiro of the Engineer Research & Development Laboratories at Ft. Belvoir; presentation of awards to the chemistry winners at the recent area science fairs, and to their chemistry teachers; and a dinner at which the principal speaker was Richard L. Kenyon, editorial director of ACS applied journals, who discussed "The Future of the American Chemical Society Publications."

A special women's program was highlighted by a lecture, "How the Food and Drug Administration Protects Your Health," by Daniel Banes of FDA's Bureau of Biological and Physical Sciences.

Columbia Historical Society

May 14, Heurich Mansion, Mrs. Frank P. Howard on "The Friday Morning Music Club, a Record of 75 Years."

May 22, Fort Myer Museum and Reviewing Area, program on the "History of Fort Myer."

Geological Society of Washington

April 25-28, The Geological Society of Washington acted as host society for the annual meetings of the American Association of Petroleum Geologists and the Society of Economic Mineralogists and Paleontologists, Atlantic City. The President, Harry S. Ladd, served as General Chairman for the convention.

Society awards for the earth sciences at the D. C. Science Fair this year were as follows: Senior High—Leonard Vacher (mineral content of the sediments of the Rock Creek tributaries); 9th Grade—Antoinette Bonanno (identification of gemstones); 8th Grade—Adele Ichilian (evolution of the horse); 7th Grade—Louis Lawwill (craters of the moon).

Entomological Society of Washington

May 5, "The Work of the Plant Quarantine Division," M. H. Sartor, USDA, "The Hidden Menace," a movie, and Science Fair winners and their entomological exhibits.

Insecticide Society of Washington

April 20, "Control of Pests on Ornamentals in Home Gardens," by Floyd F. Smith, USDA, and "Application Equipment and Gadgets for Applying Pesticides," Robert V. Travis, Garden Pest Control, Greenbelt, Md.

May 18, symposium on pesticide residues, featuring a panel of specialists from various agencies dealing with these problems.

Institute of Radio Engineers, Washington Section

Section meetings held first Monday of each month, Perpetual Building Auditorium.

International Association for Dental Research, Washington Section

May 2, Guest Night, dinner at Walter Reed Army Medical Center Officers Club, 6:00 P.M.; meeting Room 276, Institute of Research, "The National Health Service in England—its Advantages and Disadvantages," Alexander B. MacGregor, The Medical School, Birmingham, Eng.

Society for Experimental Biology and Medicine, District of Columbia Section

June 2, Annual Dinner Meeting. Program on Advances in Tumor Virus Research: "Host Response," Sarah E. Stewart, NIH; "Characteristics of Tumor Viruses," Bernice Eddy, NIH.

ACADEMY ACTIVITIES

Board of Managers, April Meeting

These notes are intended to outline briefly, for the information of the membership, the principal

actions taken at Board meetings. They are not the official Minutes as prepared by the Secretary.—Ed.

The Board of Managers held its 528th meeting on April 19 at NBS, with President Wood presiding.

The minutes of the 527th meeting was approved as previously circulated, without correction.

Dr. Wood reported that the Executive Committee had agreed on a price of $1.00 for copies of the Directory and back issues of the *Journal;* also, that the end of March had been set as a cutoff date for the receipt of requests for emeritus status.

Chairman Stiehler of the Meetings Committee announced that at the May meeting, Dr. Baker of the Bell Telephone Laboratories would speak on analogies between solid state and biological systems.

Chairman Hall of the Membership Committee presented, for first reading, the names of eight candidates for membership. He announced that 59 additional proposals for membership were being processed by the Committee.

In the absence of Chairman Van Evera of the Committee on Grants-in-Aid, Dr. Wood reported that no student applications for aid were currently on file. Dr. Specht mentioned receipt of a reminder from AAAS, to the effect that the $900 still available from 1959 and 1960 grants to the Academy would be lost if not spent within two years.

Leo Schubert reported for the Committee on Encouragement of Science Talent that (1) he had responded favorably to a questionnaire from the St. Louis Academy, asking whether a national meeting of junior academies of science would be desirable; (2) the Washington Junior Academy is now publishing its own journal, in mimeographed form; and (3) concerning the problem raised at a previous Board meeting by Dr. Robbins for the Society of American Bacteriologists, on improved rules for the development of Science Fair exhibits, the problem was under study by a committee of the Joint Board.

Dr. Wood reported receipt of a letter from the AAAS Academy Conference, asking our views on whether a strong National Junior Academy of Science should be formed; whether each local junior academy should remain under the sponsorship of the corresponding senior academy, where there is one; whether the national junior academy should be sponsored by the AAAS Academy Conference; and whether the national junior academy would interfere with the operations of any existing youth science group. After some discussion, the Board agreed that the first three questions should be answered affirmatively, and the last one negatively.

Dr. Stiehler presented for second reading the names of three candidates previously proposed for Academy membership, as follows: Basil deB. Darwent, Ellsworth S. Obourn, and David Rosenblatt. These candidates were then elected to membership.

In the absence of Chairman Shepard of the Committee on Bylaws, Dr. Wood reported that the Committee is continuing work on a revision of the Standing Rules.

Dr. Specht reported the following figures on Academy membership: Local active, 761; local emeritus, 65; non-resident active, 185; non-resident emeritus, 60; honorary, 6; total, 1077.

Treasurer Aslakson reported that for the quarter ended March 31, receipts were $6,267 and disbursements were $6,976.

Announcement was made that the Philosophical Society expects to publish important talks in *Physics Today.* It is hoped that reprints of these papers can be bound with other material and issued at intervals as the *Bulletin of the Philosophical Society of Washington,* Series 2.

Elected to Academy Membership

The following scientists have been elected to membership in the Washington Academy of Science:

Roy J. Barker, Agr. Res. Service, USDA
Robert F. Blunt, Nat. Bur. Standards
Richard F. Davis, Univ. of Maryland
Lafe R. Edmunds, Nat. Sc. Foundation
Robert B. Fox, Naval Res. Lab.
Alan D. Franklin, Nat. Bur. Standards
S. L. Friess, Naval Med. Center
Sydney Geltman, Nat. Bur. Standards
William A. Geyger, Naval Ordnance Lab.
Stanley A. Hall, Agr. Res. Service, USDA
Ronald E. Kagarise, Naval Res. Lab.
Arnold H. Kahn, Nat. Bur. Standards
Gunnar Kullerud, Geophys. Lab.
George S. Langford, Univ. of Maryland
S. Kenneth Love, Geological Survey
Raymond L. Nace, Geological Survey
H. Steffen Peiser, Nat. Bur. Standards
Homer W. Schamp,, Jr., Univ. of Maryland
Milton M. Slawsky, USAF, Off. Sc. Res.
Bertram Stiller, Naval Res. Lab.
Joseph T. Vanderslice, Univ. of Md.
John B. Wachman, Jr., Nat. Bur. Standards
Madelyn Womack, U. S. Dept. Agric.

JOINT BOARD

The Washington Academy of Sciences is the recipient of a grant from the National Science Foundation in the amount of $34,990 for the purpose of conducting a science education program during 1960-61. The Joint Board on Science Education has been designated by the Academy to administer the grant and the program that it supports.

The objectives of the science education program are defined as follows: (a) to bring about a more vigorous effort in science education at the community level; (b) to encourage experimental approaches to the improvement of education in which scientists work in close cooperation with secondary schools. Four projects are planned to implement the program.

Project I involves the development of a roster of scientists and engineers willing to assist in educational activities and making it available to the schools of the area. A start was made in this direction during the current year when members of the Academy and other interested scientists were contacted to indicate their willingness to participate. An all-out effort will be made in the coming school year to publicize the roster, and develop the procedure by which it might be most effectively used. Members of the Academy who wish to add their names to the roster are invited to do so.

Projects II and III are concerned with the support of experimental courses being developed by several schools in the area with the purpose of getting better correlation between science and mathematics instruction. Advisory committees of scientists assist in the planning and evaluation of course content and actively aid local programs in various ways. Project I is concerned with junior high school courses while Project III relates to the upper elementary school level. An allocation of $22,000 has been made for these projects.

A series of round-table discussions on the teaching of science and mathematics is designated as Project IV. As in the past year, it is planned to sponsor conferences in each of the neighboring areas of Maryland, Virginia, and the District of Columbia for each of the disciplines of biology, chemistry, mathematics, and physics, in which scientists, teachers, and university instructors will discuss both course content and teaching problems. Additionally, a new feature will be a series of conferences on junior high school mathematics and science in which junior high school and senior high school teachers will meet with scientists to discuss educational matters.

Dr. John K. Taylor of the National Bureau of Standards continues to serve as Director of the program. The grant provides for retaining a full-time secretary and a part-time executive secretary who are concerned with the administrative details. Both are located in the Academy office, 1530 P Street, N.W., Washington 5, D. C. The telephone number is NO 7-3661.

In view of the objective of the program—to bring about a closer cooperation between the scientific community and the schools—members of the Academy are invited to make known the ways in which they are willing to participate.

SCIENCE AND DEVELOPMENT

Once a bat flew more than 2,000 miles across the ocean from the Pacific Coast to Hawaii. This is dscribed as perhaps the most remarkable mammalian flight of all time by David H. Johnson, Smithsonian curator of mammals, in a report on the present-day mammals of the Pacific Islands. The animal was a hoary bat, fairly common in western North America. It has been in Hawaii for thousands of years. and has undergone various changes, but is unmistakably related to the mainland variety. Probably the original Hawaiian immigrant was a pregnant female that had lost her way in a northward spring migration.

The world's most accurate yardstick of radio frequency has been established by NBS at Sunset Canyon, west of Boulder, Colo. The radio station, with call letters WWVL, will transmit on the very low frequency of 20 kilocycles; its range may extend as far as Hawaii. Currently, the Bureau's Station WWV at Beltsville, which transmits on such short-wave frequencies as 15 *mega*cycles, can be used to measure frequency to a few parts in ten million. In contrast, users of the WWVL Sunset station will be able to make measurements to one part in 10 thousand million.

The 10th Annual Instrument Symposium and Research Equipment Exhibit will be held October 4-7 at the National Institutes of Health. Chairman of the Symposium Committee is Herman C. Ellinghausen of USDA, who is developing a scientific program in the fields of fluorescence, infrared, activation analysis, ultracentrifuge, microscopy, and electrodes. In addition, manufacturers and distributors of scientific equipment will present extensive displays of modern analytical instruments.

An electronic survey system that may provide rapid, accurate means of measuring distances and establishing positions is being evaluated by the Army's Engineer Research & Development Laboratories at Fort Belvoir. Called "Lorac," the system can be used where line-of-sight conditions do not exist, and for establishing positions of boats, aircraft, and land vehicles. Using a continuous-wave unmodulated radio transmission sent out from each end of the line to be measured, the system can measure distances up to 100 miles over mountains with minimum accuracy of 1:10,000; over salt water, the maximum range is 200 miles and the minimum accuracy, 1:45,000. To establish positions, the system employs two baselines extended from a central transmitting station, and a transmitter at each end of the two baselines.

The distressing disappearance of valuable scientific documents is one of the concerns of

a group of scientists, historians, and other specialists who met in Washington May 5-6 at the Cosmos Club. The specific problem is not one affecting national security but scientific scholarship: how to locate and save the original papers of great American scientists whose personal memorabilia may otherwise be lost to mankind forever. The Library of Congress, Smithsonian Institution, and NAS-NRC were among the organizations represented on the conference organizing committee. Funds for the conference were supplied by NSF.

Twenty Washington area high school juniors—15 boys and 5 girls—have been awarded summer research scholarships at Georgetown University Medical Center. Picked from 325 applicants, all with high qualifications and recommendations, these young people will participate during July and August as members of actual research teams, working on research projects in basic or clinical science.

The American Geophysical Union has formed a Planning Committee on Planetary Sciences, according to recent announcement. Purpose of the new committee will be to accommodate the increasing number of AGU members engaged in planetary and space research by expanding the Union's activities in this field. Its chairman is Homer E. Newell, Jr., of the Office of Space Flight Programs, National Aeronautics and Space Administration; its secretary is Robert Jastrow, of NASA's Goddard Space Flight Center. Other members of the 12-man committee include WAS members Philip H. Abelson, Allen H. Shapley, E. H. Vestine, Harry Wexler, and Charles A. Whitten.

Pre-white Kansas was not always a region of roving, rather hostile Indian hunters. According to Waldo R. Wedel in a recent report of the Bureau of American Ethnology, this stage was preceded by one of farming peoples having some contacts with the Pueblos of the Southwest. Basically, he says, the story is one of several millennia of hunting-gathering subsistence economies, followed by several centuries of horticulture, with hunting again coming into the ascendancy in the last century or two, this time with the horse as an important adjunct. The original hunters were living perhaps 10,000 years ago, when large game animals of species now extinct roamed the Kansas grasslands. Farming was probably introduced within the Christian Era; its subsequent intensification gave rise about 1000 AD to small village cultures, from which developed larger communities. Just before the white man arrived, the farmers were replaced by wandering bison hunters; drought possibly played a major factor in this change.

Experimental "artificial recharge" of water-bearing rocks a few miles east of Walla Walla, Wash., has shown the practicability of using this means of backstopping the municipal water supply, according to a recent Geological Survey report. About 70 acre-feet of creek water were injected, at an average rate of 650 gallons per minute, into a 1200-foot municipal well penetrating the water-bearing rock formation known as the Columbia River basalt. The study area is one in which the structure of the rocks limits natural recharge, and there has been concern over the persistent lowering of water level caused by years of pumping. With a carefully controlled schedule of alternating recharge and pumping, it is believed that as much as 1000 gpm can be injected into the well during the 9 months of the year when creek water is available.

Dairy heifers eat sparingly and grow slowly when fed silage made from freshly-chopped unwilted grass-legume mixtures, presumably because some unidentified organic compound formed during fermentation of silage decreases the appetite of the animals. Lane A. Moore and J. William Thomas of USDA's Agricultural Research Center are working to identify the compound responsible. Until more information is obtained, they suggest that farmers wilt their crop a few hours before ensiling, even though this involves mowing before chopping. The scientists found that heifers consumed about twice as much dry matter eating wilted silage as they did eating unwilted silage. In fact, there was little difference between consumption of heavily wilted silage and hay.

A new electrochemical determination of the faraday has been accomplished at the National Bureau of Standards by D. N. Craig and W. J. Hamer, in collaboration with Catherine Law and James I. Hoffman. This constant—the quantity of electricity associated with a change of one equivalent weight of the reacting substance in any electrolytic process—was redetermined by measuring the electrochemical equivalent of silver *dissolved* by one coulomb of electricity. This, together with the atomic weight of the silver used, gives the new value—96,516.4 $\pm$ 2.0 coulombs per gm equivalent on the physical scale or 96,489.9 $\pm$ 2.0 coulombs on the chemical scale. The increased accuracy in the faraday afforded by this new evaluation is of major importance in both physics and chemistry, where the faraday enters into the determination of other fundamental constants.

The first edition of Small-craft Chart Series 140, Fort Pierce to Miami, Fla., has just been published by the Coast & Geodetic Survey. This is the second chart published in Series 140, which was designed to suit the needs of small boat owners. Prior to the adoption of the small craft series, C&GS presented four experimental formats, Series A, B, C, and D, to thousands of small craft operators throughout the country. Upon the basis of

the comments received, Series B was the format chosen as most suitable for the small craft series. A re-examination of the comments received from individuals in Florida also indicated their preference for format B plus a number of suggested changes. This series, folio size 8-1/2 by 15-1/2 inches, consists of four sheets at the scale of 1:40,000 and insets of active boating areas at 1:24,000.

An all-aluminum sea water distillation unit, the first known application of aluminum for this purpose, is being developed by the Engineer Research & Development Laboratories at Fort Belvoir. Equipment currently supplied to troops for desalting sea water is fabricated of cupro-nickel. The new equipment will be lighter, have greater capacity, and better fuel economy, and will eliminate the need for large amounts of nickel which may not be available in the event of mobilization. It is currently undergoing engineer tests near Daytona Beach.

The Geological Survey is engaged in a terrain study of the surface of the moon which may prove highly valuable in the selection of a landing site for initial scientific investigation of the moon. The study, when completed this year, also may have an effect on the design of surface vehicles for use on the moon, for geologic moon investigations, and for further space exploration. First phase of the work involved use of modern stereoscopic methods to plot the relationships of surface features of the moon. With this phase completed, Survey personnel will interpret the moon's surface constituents, textures, and bearing power.

A new instrument—the universal orthophotoscope, a photogrammetric machine that "flattens the mountains" to the satisfaction of the mapmakers—was exhibited by the Geological Survey at a recent meeting in Washington. In the new instrument, advantage is taken of the stereophotogrammetric principle to produce photographs that are free from image displacement due to camera tilt or topographic relief. The instrument represents the culmination of nearly a decade of research and development in the field of uniform-scale photography. In the present model of the orthophotoscope, two overlapping aerial photographs are projected to form a three-dimensional image on a moving screen, which has in its center a small slit through which light passes to strike a photographic film. The operator views the images on the screen and causes the screen and film to raise or lower so that the slit skims the surface of the ground as it appears to the three-dimensional image. Thus, objects farther from the camera are enlarged more, and those closer to the camera are enlarged less, so that the entire image pattern is brought to one uniform scale.

The lady mosquito's "love song" is the beat of her wings in flight. This is what attracts males of the species, although actually they cannot be credited with any true sense of hearing comparable to that of birds or mammals. In some way, however, the male, by means of a highly developed and complex organ—the so-called organ of Johnston in the antenna—is extremely sensitive to certain ranges of vibrations coming through the air. Discussing this subject in a recent Smithsonian Institution report, R. E. Snodgrass cites experiments reported elsewhere which show that males, when subjected to the sound of a tuning fork at 480 cps held behind a suspended piece of cloth, fly at once to the source of the sound where they exhibit typical mating activities although no females are present. On complete removal of the organ, however, they have no such reaction.

Weather predictions through 1967 for 32 cities of the United States were recently released by the Smithsonian Institution. They cover precipitation for each month and are also broken down into four-month seasonal averages for the use of farmers. This is apparently the first time that anyone has ventured to forecast the monthly rainfall eight years in advance for definite cities, stating the exact expected percentage departures from the normal values. The predictions were prepared by Charles G. Abbot, the Smithsonian's secretary from 1928 to 1944, and are based upon his studies of harmonic periods in solar variations.

Coast and Geodetic Survey continues active in its program of charting obstructions to air traffic around major transport-category airports in the United States. During a recent two-week period, survey parties were sent out to cover eight airports—in the vicinity of Tuscaloosa, Ala.; Lufkin, Tex.; Moultrie, Ga.; Modesto, Calif.; Alexandria, La.; Vicksburg, Miss.; Burbank, Calif.; and Beaumont, Tex. Each party will determine the location and elevation of any obstructions to air traffic in an area of about 50 square miles around its airport, and the horizontal position of all aids to air navigation. The Airport Obstruction chart series was inaugurated in 1945 at the request of CAA (now FAA); to date, C&GS has on issue about 450 charts, including all of the more important airports in the United States.

Another continuing C&GS program, instituted in 1878, is illustrated by the activities of a 10-man leveling party that was recently sent out to determine elevations of selected points in various directions from Augusta, Ga. The party will determine the elevation of bench marks—bronze discs set in concrete by an advance party, about each mile along the route. This is called a *geodetic* survey. Data are referred to mean sea level as observed at 26 tide stations in the United States and Canada.

Vice-Presidents of the Washington Academy of Sciences Representing the Affiliated Societies

Acoustical Society of America	Richard Cook
Institute of the Aeronautical Sciences	*Not Named.*
Anthropological Society of Washington	Regina Flannery
Society of American Bacteriologists	Mary Louise Robbins
Biological Society of Washington	Herbert Friedman
Society for Experimental Biology and Medicine	Kathryn Knowlton
Botanical Society of Washington	Herbert C. Hanson
Chemical Society of Washington	William J. Bailey
American Society of Civil Engineers	*Not Named.*
International Assn. for Dental Research	Gerhard Brauer
American Inst. of Electrical Engineers	Robert D. Elbourn
Washington Society of Engineers	Howard S. Rappleye
Entomological Society of Washington	Harold H. Shepard
Society of American Foresters	*Not Named.*
National Geographic Society	Alexander Wetmore
Geological Society of Washington	Carle Dane
Helminthological Society of Washington	Carlton M. Herman
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Insecticide Society of Washington	Joseph Yuill
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American Society for Metals	John A. Bennett
American Meteorological Society	Morris Tepper
Institute of Radio Engineers	Robert Huntoon
American Nuclear Society, Washington Section	Urner Liddel
Philosophical Society of Washington	Louis R. Maxwell
Society of American Military Engineers	*Not Named.*

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Membership	Wayne C. Hall, *Naval Research Laboratory*
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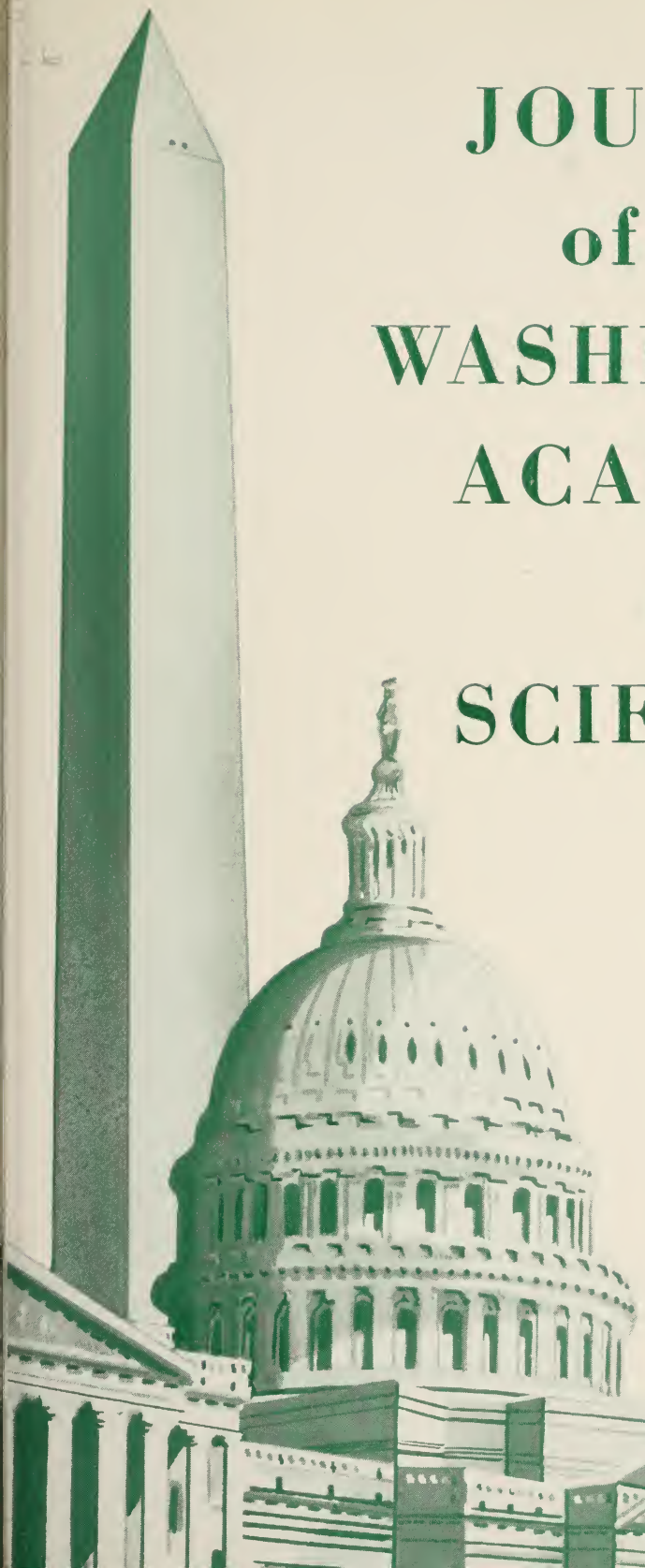

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OCTOBER 1960

JOURNAL OF THE WASHINGTON ACADEMY OF SCIENCES

Editor: Chester H. Page, National Bureau of Standards

Managing Editor: Ileen E. Stewart, National Science Foundation

This Journal, the official organ of the Washington Academy of Sciences, publishes: (1) historical articles, critical reviews, and scholarly scientific articles, (2) original research, if the paper, including illustrations, does not exceed 1500 words or the equivalent space, (3) notices of meetings and proceedings of meetings of the Academy and its affiliated societies, and (4) regional news items, including personal news, of interest to the entire membership. The Journal appears eight times a year in January to May and October to December.

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The Magnetic Field Accompanying Neuronal Activity A New Method for The Study of The Nervous System

John H. Seipel * and Robert D. Morrow * *

Introduction

From the time of Galvani and Volta it has been accepted that electrical activity is associated with the transmission of information by the nervous system; in its ultimate form this activity consists of separate electrical impulses conducted by neurons. The neurophysiological literature, reflecting currently accepted methods and procedures for research in this field, describes much work measuring neuronal activity by direct electrode implantation and other procedures. While these methods have been highly developed they carry certain inherent limitations and inaccuracies; the most advanced of these methods carry additionally a high degree of technical difficulty precluding their use in many laboratories. Further, as is true for any experimental method, information may be obtained only within the scope of the quantities measureable; extension of a method to the investigation of other parameters is rarely accomplished without great difficulty. In discussing the various methods of neurophysiological research the authors concluded that a new approach to the investigation of neuronal activity was indicated. It was hoped that a method might be found that would be technically simple, accessible to all investigators, and capable of extension to the determination of quantities hitherto measured indirectly.

* Laboratory of Experimental Neurology, Dept. of Neurology, Georgetown University Medical School, Washington, D. C.

** 6324 Hazelwood Ave., Baltimore 6, Md.

Since the time of Maxwell it is a recognized physical fact that an inductive field having both electromagnetic and electrostatic components is associated with the movement of charged particles, i.e., electrical activity. These fields are directly and rigorously dependent upon the underlying electrical activity; measurement of such magnetic fields gives a precise and complete determination of the quantity and direction of the underlying activity.

Hitherto overlooked as a possible approach to the investigation of neuronal electrical activity, intuitively such a field should be present and, with proper apparatus, be measureable (Figure 1).

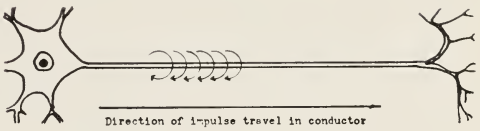

Fig. 1. The magnetic field surrounding a conductor

In an extensive search of the literature many publications were found that discussed various bioelectric fields and their effects, but only one, that of Burr and Mauro,[1] draws the important and basic distinction between an electrical field, such as exists in a potential gradient between two electrodes in a conducting solution or surrounding a conductor in an ionic medium, and the inductive field generated by elec-

[1] Burr, H. S., and Mauro, A., Yale J. Biol. Med., *21*, 457-462 (1949)

trical activity. In this paper the authors detected and measured the electrostatic field about a stimulated frog sciatic nerve and found it extended to at least 12 mm. in air from the nerve, varying from 550 microvolts at the nerve to 150 microvolts at 12 mm. These observations were then compared with values calculated using the equations of Lorente de No[2] and were found to be in close agreement. It is apparent, however, that Lorente de No in his derivation used the Maxwellian equations transformed for fields in volume conductors rather than for general inductive fields.

Neither in the above cited papers or elsewhere in the literature is there a reference to the magnetic component of the field accompanying the electrical activity of the neuron.

Theoretical considerations indicate that a magnetic field is relatively unaffected by its surroundings and is shielded only by ferromagnetic materials; a method of detection of neuronal activity based upon magnetic methods would be almost independent of the tissues surrounding the nerve and, with proper instrumentation, the ionic properties of the tissue fluids. In short, the magnetoneuronal activity should be detectable at a distance, perhaps even beyond the skin of an intact subject.

Experimental

Apparatus

For these qualitative attempts at detection of the neuronal field a DuMont Model 304A oscilloscope was modified by use of carefully selected high-gain vertical amplifier tubes and metallic shielding of its input terminals: both chassis and case were grounded directly to an earth ground. An unmodified Weston Model 983 oscilloscope was used when simultaneous direct recording of the electrical impulse was necessary.

A Grass Model 3C stimulator was used with carefully shielded leads and was calibrated against the DuMont oscilloscope. This unit was connected to earth ground.

Because of stray fields and their interfering noise it was found necessary to place a direct ground post through the floor extending 6′ below the lowest level of the building; *all* electrical equipment in the room, including lights, refrigerator, soldering irons, and the various units of the apparatus described in this paper were connected by heavy soldered ground straps to this post.

Detection of the magnetic field was accomplished using detector heads of various designs. Basically these heads consisted of one or more highly compact series-wound coils of ultra-fine copper wire and differed only in the presence or absence of steel or other metallic shielding and in the presence or absence of ferrite cores within the coils. The steel shielding was most effective in blanking extraneous noise: in this case the coil protruded slightly less than half of its diameter in the direction of the nerve. The ferrite made no measureable difference in the sensitivity of the coil. The coils measured 2mm. x 3 mm. x 6 mm. and contained approximately 3000 turns of copper wire; they were completely insulated in plastic tape and potted. The heads were mounted on a rack and pinion arm graduated in millimeters and could be positioned at various distances from the nerve and at various axis positions relative to the nerve. When used, shielding was carefully connected to earth grounding.

Signals from the detector were amplified by a self-contained battery-operated two-stage resistance-coupled preamplifier using a selected noise-free 6SC7 tube. The entire preamplifier was contained with the experimental subject in a specially constructed electrostatically shielded aluminum apparatus. The output from this amp-

[2] Lorente de No, R., Stud. Rockefeller Inst. Med. Res., #131 and 132 (1947)

lifier was led directly to the DuMont oscilloscope.

All connecting leads within the above apparatus were doubly shielded; all other leads were singly shielded.

Permanent recordings were taken by Polaroid land camera, on tape using a specially designed Product Development Associates Mark I dual channel medical tape recorder, and on 16 mm. motion picture film.

Synchronization was run to the AC line to give as stable a base line as could be obtained.

Procedure

The sciatic nerve of the American bullfrog. R. catesbiana, was chosen for study as it is easily obtained and has been exhaustively studied by classical methods.[2] Selected jumbo bullfrogs were pithed and their sciatic nerves freed from the spinal column to the gastrocnemius muscle, ligating vessels and severing twigs where necessary; other nerves to the thigh muscles were severed to prevent as much movement as possible during stimulation. Isolated nerves were prepared according to the method of Lorente de No.[2] The frog was mounted on a dissecting tray with the copper screen ground electrode for the electrical readout between the frog and the wax; the thigh muscles were pinned back exposing the nerve. The tray was inserted in the apparatus case and connected to ground within the case. The nerve was suspended between the stimulator electrode hooks and the copper wire electrode for electrical impulse detection. The magnetic detector was placed at various distances from the stimulator electrodes and before the electrical readout electrode with approximately ½ to 1 mm. air gap from the coil to the nerve. The nerve was moistened as necessary with Ringer's solution.

Stimulus was applied at a level sufficient to give a maximum electrical action pulse but was not increased above this level. This stimulus varied with each nerve but was usually initially about .7-.9 volts for 1 millisecond at a frequency of 50-70 per second.

Isolated nerves were suspended in a plexiglass constant humidity chamber containing Ringer's solution. These nerves were stimulated electrically or by mechanical crushing. In the latter case determinations were made both with the electrical pickup electrodes contacting the nerve and with no connections of any sort in the apparatus except the electromagnetic detector coil.

Results

The directly recorded electrical action potentials are equivalent to those in the literature.[2, 3]

A composite tracing typical of the electromagnetic component of the action pulse is shown in Figure 2.

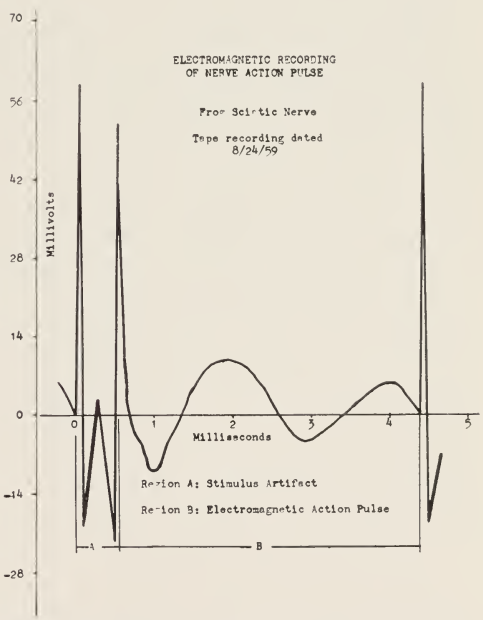

Fig. 2. Composite tracing of the electromagnetic action pulse

[3] Erlanger, J., and Gasser, H. S., "Electrical Signs of Nervous Activity," University of Pennsylvania Press, Philadelphia, 1937

The scale in millivolts is the value observed on the oscilloscope; since the detection and amplification equipment were uncalibrated the relationship of these values to the input signal is unknown.

Placement of the magnetic detector at varying distances from the stimulator electrodes gave the expected variable delay of the electromagnetic trace following the stimulus artifact and showed the same time lag as the electrical pulse when the electrical pickup was in the same position.

As the nerves gradually died or became refractory to stimulation the decrease in amplitude of the electrically observed pulse paralleled that of the electromagnetically observed pulse, both disappearing simultaneously. Disappearance of muscle contraction in those experiments where the nerve was not removed from the animal also occurred simultaneously with the disappearance of both pulses. With the use of stimulus voltages below that required to give a maximum electrical action pulse the percentage decrease below the maximum impulse detected electrically exactly paralleled the decrease in the electromagnetically detected impulse. Continued stimulation of inactive nerves gave only the stimulus artifact; no neuron action pulse could be observed electrically or electromagnetically.

Finally, mechanical stimulation by crushing an intact portion of an isolated nerve in the ungrounded plastic container gave single transient electromagnetic impulses visually equivalent to those obtained by electrical stimulation. These transient pulses could not be photographed because of the rapid trace decay of the oscilloscope phosphor.

Discussion

There can be no doubt that this field exists, is an inescapable component of neuron activity, and must be of sufficient magnitude to be readily measureable since it could be detectable using relatively simple equipment. The experiments of Burr and Mauro [1] demonstrating the existence of an electrostatic field about an isolated frog sciatic nerve immediately confirms the existence of the electromagnetic field. Both fields are component vectors of the inductive field surrounding the actively conducting nerve, arise simultaneously, and are interdependent. Thus neuron impulses fellow the same laws applicable to moving charges as other phenomena and have the same inductive fields as those accompanying moving charges in general.

Detailed discussion of the theoretical and practical implications of the existence of these fields will be held for future publications. However, it should be noted that by proper measurement of these fields a method of localizing and mapping central nervous system activity is feasible without direct contact with the structure investigated, thus avoiding the trauma and artifact caused by the present contact methods.

Summary

The electromagnetic field associated with neuronal activity is demonstrated for the first time and affords a new method for the study of the nervous system that avoids direct instrumentation.

Educational Activities of Washington Scientists

John K. Taylor
Director, Science Projects
Joint Board on Science Education

One of the distinguishing characteristics of a learned profession is the desire of its members to perpetuate it by fostering high educational standards and by attracting talented young people into its ranks. Washington area scientists as individuals have long been aware of this professional responsibility. Collective action in this respect has been of recent origin, however.

The first major cooperation of the scientific community with local educational programs was brought about by the advent of the science fair activities in 1947. Local educators found that they needed scientists and engineers in considerable numbers to serve as judges and counselors for student projects and appealed to the technical societies for assistance. In serving in these capacities, scientists became keenly aware of the part that they could play in cooperation with the schools to improve and strengthen science education, particularly at the secondary level.

As a result of these experiences, scientists and engineers reported back to their technical societies the need and opportunity for service. Apparently, their selling was effective for there was a sudden mushrooming of society-sponsored educational activities. Indeed the uncoordinated efforts that followed bordered on the side of chaotic in extreme cases. Accordingly, it became clear that some mechanism must be found for better utilization of these community resources. The D. C. Council of Engineering and Architectural Societies took positive action by establishing a school contacts committee with a member designated for each school to serve as liaison between it and the scientific community. The wisdom of this procedure has been proven by the fact that the school contacts program is today a major factor in science-education activities.

Joint Board Established

As a result of the success of the above program, the need was estabished for a permanent organization to administer cooperative educational activities. After careful study by science education leaders of the D. C. Council and the Academy, the Joint Board on Science Education for the Greater Washington Area was formed in 1955 under joint sponsorship of the two groups for the purpose of "assisting and counseling the faculties of schools and related organizations, with power to initiate action, where desirable, and to raise funds to carry out the various activities of the Board."

The Board's program has evolved and expanded from the original school contacts activity to include a number of endeavors with an annual combined budget of about $7,500. One of the first of these was the project in which some 1000 scientists and engineers replaced class-room teachers to permit them to attend the annual meeting of the National Science Teachers Association which convened in Washington during March, 1956. This is the first known instance of a major cooperative effort between schools and scientists of the community and it aroused national attention. This activity has been repeated several times in this area, however on a smaller scale.

The science fair movement has grown to such an extent in this locality that most

of the schools now participate. As a result, the one area-wide fair has been replaced by five local area fairs, each affiliated with the National Science Fair-International. The Joint Board assists each of these by providing publicity material, entrance blanks, and other printed matter. (The Junior Academy of Sciences which is also a co-sponsor provides the major awards for each fair). The Joint Board also provides the transportation and expenses of the student-finalists and their teacher escorts to participate in the annual National Science Fair-International.

On becoming aware of the need for better communication between the educational and scientific communities, the Joint Board established a newsletter in 1958. This 8-page publication, known as THE REPORTER, appears monthly during the school year and is sent without charge to every teacher of science and mathematics in each of the junior and senior high schools of the Greater Washington Area. School contact persons and others interested in science education are also included in the monthly circulation of over 2000 copies.

A recent project of the Joint Board has been the publication of a book containing many suggestions for science projects. Scientists and engineers of this area were invited to outline projects, particularly those involving research or investigation on the part of the student. These contributions were edited by the writer, in collaboration with Dr. Phoebe Knipling and Dr. Falconer Smith and the resulting "Project Ideas for Young Scientists" was published in September 1960. a grant from the Eugene and Agnes E. Meyer Foundation made it possible to place a free copy of this book in the library of each secondary school in the area and to sell copies at a nominal price.*

National Science Foundation Projects

In 1959, the Washington Academy of Sciences received a grant of $35,000 from the National Science Foundation to make its science-education program more effective. The Joint Board became the logical body to administer this activity. With the writer as Director and Dr. William T. Read as Executive Secretary, four projects were developed and carried on. These may be summarized as follows:

Project I. To establish a community consultation service, including a roster of scientists and engineers willing to assist in educational activities.

Project II. To sponsor and participate in experimental educational programs concerned with better coordination of science and mathematics teaching in secondary schools.

Project III. To sponsor and participate in experimental educational programs concerned with better coordination of science and mathematics teaching in elementary schools.

Project IV. To sponsor conferences of school teachers and officials, university and college instructors, and scientists and engineers to consider problems concerned with science and mathematics teaching.

Details of the first year of this program and an evaluation of the results obtained are contained in the annual report submitted to the National Science Foundation on July 15, 1960. A limited number of copies are available for distribution and may be obtained by request to the office of the Joint Board on Science Education. 1530 P Street, N.W., Washington 5, D. C.

The National Science Foundation has made another grant of $35,000 to the Academy to continue this program during 1960-61. Administrative details will be the

* Copies are available from the office of the Joint Board on Science Education, 1530 P Street, N.W., Washington 5, D. C., at $1.25 per copy.

same as during the previous year except that Mr. G. Gravatt Coleman, an engineer with the Chesapeake and Potomac Telephone Company, has replaced Dr. Read as Executive Secretary.

In addition to continuing the projects of the previous year, a special effort will be made to increase the usefulness of the roster of the scientists and engineers. Under the title, "Visiting Scientists and Engineers," a brochure has been published which lists over 100 lectures, many illustrated and containing demonstrations, that local scientists and engineers are willing to present to school groups. It is expected that school contacts will assist teachers in selecting subjects from this list that would be most helpful in a given situation. The office of the Joint Board will assist in making arrangements.

More Help Needed

Although several hundred persons are engaged in some phase of these educational activities, there is a need for more participants. The Joint Board serves the counties of Calvert, Charles, Montgomery, Prince Georges, and St. Mary's in Maryland and the counties of Arlington, Fairfax, and Prince William, and the cities of Alexandria and Falls Church in Virginia, as well as the District of Columbia. Private and parochial schools are included in the approximately 170 junior and senior high schools in this territory. Accordingly, the roster of scientists and engineers must be extensive and represent a large geographical area to be useful. Interested scientists are invited to register with the office of the Joint Board.

There is a special need for persons willing to assist in the administrative details of the program and also with editorial assignments.

Science in Washington

SCIENTISTS IN THE NEWS

This column will present brief items concerning the activities of members of the Academy. Such items may include notices of talks given, important conferences or visits, promotions, awards, election to membership or office in scientific and technical societies, appointment to technical committees, civic activities, and marriages, births, and other family news. Formal contributors are being assigned for the systematic collection of news at institutions employing considerable numbers of Academy members (see list on masthead). However, for the bulk of the membership, we must rely on individuals to send us news concerning themselves, and their friends. Contributions may be addressed to **S. B. Detwiler, Jr., Associate Editor, 2605 S. 8th St., Arlington, Va.**

APPLIED PHYSICS LABORATORY

Albert M. Stone, technical assistant to the directory, represented APL at the Twelfth General Assembly of the International Union of Geodesy and Geophysics, held July 25-August 6 in Helsinki.

Archie I. Mahan served as program chairman for the annual meeting of the Optical Society of America, held in Washington last spring. Dr. Mahan has been elected to a six-year term as associate editor of the Society's *Journal.*

CARNEGIE INSTITUTION OF WASHINGTON

Philip H. Abelson, director of the Institution's Geophysical Laboratory and president-elect of the Washington Academy of Sciences, has been made a member of the General Advisory Committee of the Atomic Energy Commission. The appointment was approved by President Eisenhower as of June 29. Dr. Abelson, an early pioneer in atomic energy, was the first scientist in this country to identify uranium fission products; with Edwin MacMillan he discovered neptunium. During World War II he designed and developed a method for uranium isotope separation that was used at Oak Ridge; subsequently he was involved in the first report indicating the feasibility of an atomic submarine.

COAST AND GEODETIC SURVEY

Norman F. Braaten, Donald A. Rice, El-

liott B. Roberts, and **Charles A. Whitten** attended the Twelfth General Assembly of the International Union of Geodesy and Geophysics, held July 25-August 6 in Helsinki. Mr. Whitten was elected president of the International Association of Geodesy, to serve for the three-year period 1960-63. Mr. Rice was elected chairman of the IAG's Gravimetry Section.

Thomas J. Hickley, chief of the Instrument Division, recently returned from a six-week trip to Europe, where he inspected hydrographic, oceanographic, and geophysical instruments at institutions in England, Germany, and Sweden.

Barry G. Knapp, son of David G. Knapp and a 1960 graduate of Montgomery-Blair High School, has been awarded a scholarship at Johns Hopkins University for studies in the physical sciences and engineering.

GEORGETOWN UNIVERSITY

The promotion of **Walter C. Hess** to associate dean of the Georgetown University Medical Center Schools of Medicine and Dentistry was announced September 10 by the Very Reverend Edward B. Bunn, S.J., president of the University. Previously, Dr. Hess had served as professor of biochemistry and assistant dean for research at the Medical Center.

NAS-NRC

On June 1, **George A. Llano** left his position with the Commission on Polar Research to become science specialist in biology in the Science and Technology Division, Library of Congress.

Effective July 1, **W. H. Larrimer** has been appointed executive secretary of a new NAS-NRC Committee on Pest Control and Wildlife Relationships in the Division of Biology and Agriculture.

Linn Hoover, on a year's leave of absence from Geological Survey, has been named executive secretary of the Division of Earth Sciences, effective July 1. The last permanent appointee to this post was William R. Thurston, who transferred to Geological Survey in May 1959, but continued to assist the Division until March 1960, when Adrian Richards was temporarily detailed to the position from the Navy's Hydrographic Office.

At the end of August, **Frank L. Campbell,** executive secretary of the Division of Biology and Agriculture, attended the annual meetings of the American Institute of Biological Sciences, held at Stillwater, Okla.

NATIONAL BUREAU OF STANDARDS

Fred L. Mohler retired August 1 as chief of the Mass Spectrometry Section, after 43 years with the Bureau. Dr. Mohler joined the Atomic Physics Section in 1917, just after receiving the Ph.D. degree in physics from Johns Hopkins, and was made chief of the Section in 1928; during this period, he worked on fundamental phenomena in atomic physics, including electrical discharges in gases, the study of ionization potentials, and ionization of liquids. After service in World War II with the Ninth Air Force in Europe, and a year with the Manhattan Project, Dr. Mohler was appointed to head the Mass Spectrometry Section, where he has been engaged in the development of mass spectrometric methods as applied to chemical and isotope analysis and molecular physics.

Harold F. Stimson, a senior physicist in the Temperature Physics Section, retired April 30 after more than 42 years with the Bureau. Dr. Stimson joined the staff in 1916 after receiving the Ph.D. degree from Clark University. He has pioneered many scientific advances in the field of heat measurement, and is recognized as one of the world's foremost authorities on the International Temperature Scale. His activities have included important research on the accurate determination of the thermal properties of water and steam, as part of an international program for the production of steam tables to be used as a basis for engineering and power plant design. As a member of the Advisory Committee on Thermometry, he played a major role in drafting the International Temperature Scale of 1948; and he has recently completed work on a text revision which may be adopted at the 1960 meeting of the General Conference on Weights and Measures.

Hubert R. Snoke retired July 31 as assistant chief of the Building Technology Division, after over 40 years of service. A graduate of Lebanon Valley College, Dr. Snoke joined the staff as a chemist in the Chemistry Division's Paint Laboratory. Since 1929 he has specialized in bituminous and other roofing materials, and is an internationally-recognized authority in the field. When the Building Technology Division was formed in 1947, Dr. Snoke was named to head the Floor, Roof, and Wall Coverings Section; and in 1956 he was assigned concurrent duties as assistant chief of Division. Lebanon Valley awarded him the honorary D.Sc degree in 1952.

Archibald T. McPherson was guest of honor at a reception and dinner held May 24 at the Army-Navy Club by the Washington Chapter, American Institute of Chemists. Dr. McPherson was awarded the Chapter's 1960 Honor Scroll.

Kurt E. Shuler, an authority in the fields of chemical kinetics, statistical mechanics, energy transfer, and molecular spectroscopy, has been appointed consultant to the director. In this capacity he will advise on the Bureau's continuing efforts to strengthen its basic science program. Dr. Shuler will at the same time continue his own research in chemical physics.

The following Academy members are among the Bureau scientists who recently received Department of Commerce awards for outstanding accomplishment: Gold Medal for Exceptional Service, to **Chester H. Page,** consultant to the director and chief of the Electricity Division, for

contributions in electronics, ordnance, and physical research and measurement; **Herbert P. Broida,** technical coordinator of free radicals research, and **Arnold M. Bass,** chief of the Free Radicals Section, for leadership in the direction of the Bureau's free radicals program; and **Charlotte Moore-Sitterly** of the Spectroscopy Section, for research in spectroscopy and astrophysics. Silver Medal for Meritorious Service, to **John K. Taylor,** for contributions to accurate electrochemical methods of analysis; and **Hugh L. Logan** of the Corrosion Section, for research on stress-corrosion cracking of metals.

NATIONAL INSTITUTES OF HEALTH

Kenneth S. Cole, chief of the Biophysics Laboratory, National Institute of Neurological Diseases and Blindness, recently returned from a five-week visit to European laboratories that are conducting research on electrical potentials in nerve fibers. He discussed results of continuing work on ionic membrane currents with authorities in Paris, Stockholm, Uppsala, London, and Cambridge. Dr. Cole spent most of his time at Uppsala University, where he discussed comparative results of analogue computer studies of clamped nerve fibers with Torsten Teorell.

NAVAL RESEARCH LABORATORY

Peter King, associate director of research for materials, was awarded the Navy's Distinguished Civilian Service award in ceremonies on May 31. Dr. King was honored for outstanding achievement in contributing to the development and direction of a Long Range Detection Program which led to conclusive evidence of the first atomic explosion by a foreign power. The analytical system developed by Dr. King identified the bomb material and fixed the approximate time of the explosion. His final chemical analysis for the fissionable material revealed the advanced state of technology of the foreign power concerned.

George R. Irwin, superintendent of the Mechanics Division, received the Charles B. Dudley Medal of the American Society for Testing Materials on June 29, at the Society's annual meeting in Atlantic City. This award is "presented for a paper of outstanding merit constituting an original contribution on research in engineering materials." The paper, entitled "Fracture Strengths Relative to Onset and Arrest of Crack Propagation," was published in *ASTM Proceedings 58,* 640 (1958).

Dr. Irwin also has received the NRL-RESA Award for Applied Science for 1960, which was presented in ceremonies on May 10. The award was given for his studies in the theory of fracture failure in metals.

USDA, BELTSVILLE

Kermit W. Kreitlow, Crops Research Division, was chairman of the Herbage Disease Section at the Eighth International Grassland Congress, held July 11-21 at Reading, England. In conjunction with the Congress, Dr. Kreitlow visited a number of European laboratories where diseases of forage grasses and legumes are being investigated.

Erwin L. LeClerg, director of Biometrical Services, Agricultural Research Service, was a recent honor guest at ceremonies on the Colorado State University campus, where he received the Honor Alumnus Professional Achievement Award.

Edward F. Knipling, director of the Entomology Research Division, ARS, was a co-winner of this year's Hoblitzelle National Award in the Agricultural Sciences for his part in developing a new method of fighting insect pests with atomic energy. The other recipient was **Raymond C. Bushland** of the Department's entomology laboratory at Kerryville, Tex. The two scientists received the award—$10,000 and a gold medal—for their part in developing the use of male screwworm flies, made sterile by exposure to radioactive cobalt-60, to eradicate the screwworm, a serious pest of cattle.

Dr. Knipling also received a Distinguished Service Award at the USDA Honor Awards Ceremony on May 17.

USDA, WASHINGTON

Kenneth W. Parker attended the Eighth International Grassland Congress at Reading, England, July 11-21, as a representative of USDA; he subsequently traveled in Bavaria, France, and Spain to observe range and wildlife habitat management on high mountain rangelands. Dr. Parker was scheduled to present an invited paper, "Principles of Grazing Management as Related to Vegetation Condition and Soil Stability," at the Fifth World Forestry Congress, held at Seattle on the University of Washington campus, August 29-September 10.

Harold H. Shepard last June led a Soviet exchange team of six specialists in fertilizers, insecticides, and other agricultural chemicals on a 20-day tour of United States facilities conducting research in the field. The group met with Federal, state, and industrial workers in six states as well as the Washington, D. C., area.

Justus C. Ward spoke on "Federal Pesticide Laws and Sanitation" before the Indiana Association of Sanitarians, meeting June 9 at Indianapolis. On August 14 he spoke on "Toxicology and Federal Pesticide Control" before the American College of Veterinary Toxicology at Denver.

Harold T. Cook attended the Institute of Food Technology's Pacific Rim Food Conference, held May 19-29 in Hawaii. Dr. Cook was chairman of the Section on Tropical Fruit and Spice Products.

At the USDA Honor Awards Ceremony on May 17, **Herbert L. J. Haller** received the Distinguished Service Award, while **Elbert L. Little** and **Harold H. Shepard** received Superior Service Awards.

Hazel K. Stiebeling was a member of the organizing committee and chairman of the publications subcommittee for the Fifth International Congress on Nutrition, meeting in Washington September 1-7. She also was co-chairman of one of the sessions at which original research papers relating to human nutrition were presented.

UNCLASSIFIED

Ward Pigman has been appointed professor and chairman of the Department of Biochemistry at New York Medical College, effective September 1. Dr. Pigman was formerly associate professor of biochemistry at the University of Alabama Medical College.

Six Academy members attended the 21st International Geological Congress, held August 15-25 at Copenhagen. They are **George T. Faust, Edwin W. Rodder,** and **Clarence S. Ross,** of the Geological Survey: **Waldmar T. Schaller,** retired; **William W. Rubey,** former WAS president, now located at the Institute of Geophysics, UCLA; and **James Gilluly,** who is currently retiring from a Geological Survey post at Denver.

DEATHS

Ernest L. Jackson, retired former chemist at the National Institutes of Health who was noted for his contributions to the chemistry of carbohydrates, died of cancer on June 14 at the NIH Clinical Center, after a long illness. He was 68.

Dr. Jackson received his doctorate at Harvard University. After teaching at Western Reserve and Emory Universities, he joined the staff of the Public Health Service in 1928. His early work included the discovery and pioneer development of a technique for the periodic acid oxidation of sugars, considered one of the most valuable tools for structure determination ever devised in sugar chemistry. He also worked on the development of chemo-therapeutic agents for use against tuberculosis, and on the synthesis and structure of antibacterial agents. During recent years, Dr. Jackson investigated various approaches to the synthesis of an analogue of thyroxine in which the ether bridge is in the meta position to the alanine side chain. He retired from NIH two years ago, but remained active by writing articles for professional journals.

Howard A. Edson, a resident member of the Academy, died February 29, 1960. Dr. Edson was elected to the Academy in 1921 from the field of plant pathology, and retired in 1946.

Carroll E. Cox of the Botany Department, University of Maryland, died June 24. In 1959, Dr. Cox represented the Botanical Society of Washington on the Academy's Board of Managers.

AFFILIATED SOCIETIES

Chemical Society of Washington

President: Allen L. Alexander (NRL). *Secretary:* John L. Torgesen (NBS).

The Board of Managers met on May 3 at the American Chemical Society Building, with President Alexander presiding. The minutes of the March 1 meeting were read and approved. The treasurer's report for the period January 4-May 2 was distributed.

A proposal that the Society's working name be changed from "Washington Section" (of the American Chemical Society) to "National Capital Section" was considered by the Board and defeated.

Frank S. Grimaldi reported for the Education Committee that ten chemistry winners in the recent Science Fairs, and their teachers, would be dinner guests of the Society at its May 6 "meeting-in-miniature." John M. Leonard reported that a total of $1600 had been provided by the Society, the Washington Academy of Sciences, and the Junior Academy, for use as lunch money and carfare for high school students working in Washington-area laboratories during the summer. Up to the time of the meeting, 21 student applications had been received.

John K. Taylor reported for the Professional Relations and Status Committee, that plans were under way to devote one of the regular meetings of the Society to a panel discussion of such a topic as "Improving the Status of Chemists." He also reported that the Committee was exploring the establishment of an employment service for local chemists.

William J. Bailey of the Programs Committee circulated the program for the May 6 "meeting-in-miniature" to be held jointly with the Maryland Section of ACS; this showed a total of 53 papers to be presented at afternoon and evening sessions of six divisions.

Chairman Andrew F. Freeman of the Membership Committee reported on collaboration with THE CAPITAL CHEMIST in preparation of the classified membership list for the annual Directory. Mr. Freeman also urged that membership applications originating in the area be sent to the ACS through the Membership Committee, so that commissions might be properly credited to the local Society.

An *ad hoc* Committee on Member Interest, appointed at the Board's March 1 meeting, reported on a study of annual reports of other ACS local sections, with the findings that (1) the number of people who help to govern the affairs of the sections is in direct proportion to the number of active members, and (2) the proportion of committee members is greater in the more active sections than in the Chemical Society of Washington. At the Committee's recommendation, the Board agreed to the appointment of a new *ad hoc* Committee on Member Participation, charged with making a survey of special talents among the membership, and with determining the members' interest in participating in ACS activities.

THE BROWNSTONE TOWER

Frank L. Campbell

In the issue of June 1948 of the late *Scientific Monthly* appeared the last column called "The Brownstone Tower." It had run through 42 issues of the *Monthly* and terminated only because we moved on to other work. As a memento we took with us the cut of the Smithsonian's principal tower, the brownstone tower, on the eighth floor of which behind the clock face we had written the earlier columns. We had never expected to use it again, but here it is and it seems even more appropriate in this journal about science and scientists in Washington than it did in the old *Scientific Monthly*.

And now we are off again on our observational rambles, promising nothing, but hoping that the new Brownstone Tower will help to broaden the view of professional and amateur scientists in Washington.

We have just returned from the 11th annual meeting of the American Institute of Biological Sciences at the Oklahoma State University in Stillwater. The AIBS is a federation of national biological societies, some of which hold their annual meetings under the auspices of the Institute, always on a university campus. These societies are affiliated not only with AIBS but with the National Academy of Sciences—National Research Council and the American Association for the Advancement of Science. We represent NAS-NRC at the AIBS meetings and Raymond Taylor the AAAS. Thus we are interested both in the individual socieities and in the AIBS itself.

Our experience in Stillwater and at seven previous meetings of AIBS leads us to reflect on organizational differences between biology and chemistry, to the advantage of the latter. Chemistry is unified in its nomenclature, and in its educational and organizational arrangements. Every scientist who deals with transformations of non-living matter can and usually does call himself a chemist. If he is a pure chemist, he may think of himself as an inorganic chemist, organic chemist, analytical chemist, electrochemist, etc. If he works in applied chemistry he may be a rubber chemist, petroleum chemist, textile chemist, insecticide chemist, etc.—the name is always "chemist" with suitable modification. In institutions of higher education he prepares for his profession in departments of chemistry and when he is ready for membership in a professional society, he becomes a member of the American Chemical Society. All along the line "chemist," "chemistry," and "chemical" prevail and the chemical chorus before other scientists and the lay public is clear and strong.

What a contrast is found among scientists who study living and dead organisms, excluding man! They all could be called biologists with suitable modifiers to express the area of biology in which they work, but unfortunately they did not provide for the unity so characteristic of and helpful to the chemical profession. There is no harmonious chorus as yet and there may never be anything like the chemical chorus among those who would call themselves biologists but do not. Specialists in biology use many names; e.g., botanist, ecologist, embryologist, entomologist, geneticist, mycologist, physiologist, zoologist, etc., etc. In applied biology we have agronomist, animal husbandman, forester, horticulturalist, plant breeder, plant pathologist, poultry scientist, veterinarian, etc., etc. Furthermore, we have university departments of agronomy, animal husbandry, bacteriology, botany, entomology, physiology, plant pathology, zoology, etc., and various combinations of these. And when majors in these departments are ready for membership in professional society they join one or more of the societies concerned with or related to the field of their specialization. For example, a man who takes his degree in agronomy does not become an agronomical biologist and join an American Biological Society; he becomes an agronomist and joins the American Society of Agronomy. Thereafter, he thinks of himself only as an agronomist and if he is a loyal member of his society, he thinks only in terms of the advancement of agronomy through his society. Although quite aware of soil science and less conscious of other branches of biology round about, such as horticulture, plant physiology and plant patholgy, to him agronomy alone is really important. This narrow outlook is not restricted to agronomists; it is prevalent among foresters, horticulturalists, entomologists, plant pathologists and other applied biological scientists. To a lesser extent it is found among botanists, geneticists, zoologists, etc.

The interphase between biology and mathematics, physics, and chemistry has been delivered to the last three disciplines through the currently accepted nomenclature, biometrics, biophysics biochemistry—never statistical biology, or physical biology, or chemical biology. And as between chemistry and physics, chemistry wins with "physical chemistry."

And so it is that biology next to mathematics, physics, and chemistry has become "et cetera." But through AIBS biology is moving toward useful unification through the federation of existing biological societies.

ACADEMY ACTIVITIES

Board of Managers, May Meeting

These notes are intended to outline briefly, for the information of the membership, the principal actions taken at Board meetings. They are not the official Minutes as prepared by the Secretary. —Ed.

The Board of Managers held its 529th meeting on May 17 at NBS, with President Wood presiding.

The minutes of the 528th meeting, previously circulated, were approved with minor changes.

Dr. Wood announced the appointment of new members of the Committee on Policy and Planning. The complete roster of the Committee is: Through 1960, F. M. Setzler and J. E. P. Morrison; through 1961, W. Schmidt and P. D. Foote; through 1962, A T. McPherson (chairman) and A. M. Sookne.

Dr. Wood also announced the complete roster of the Committee on Science Education, as follows: Through mid-1961, R. J. Seeger (chairman) and F. Smith; through mid-1962, H. A. Meyerhoff and J. K. Taylor; through mid-1963, J. A. Sanderson and L. Schubert. Dr. Wood observed that the Committee members are also the Academy representatives on the Joint Board on Science Education, and that its business largely concerns the Joint Board; however, as a Committee it may bring before the Academy other matters considered germane to science education.

Dr. Stiehler, reporting for the Meetings Committee, initiated a general discussion concerned with the development of programs that would stimulate increased attendance at the Academy's general meetings. It was noted that the Philosophical Society has had excellent attendance at its meetings, despite the fact that its membership is no larger than that of the Academy. The desirability of holding joint meetings with the Academy's affiliates was discussed at length, with an essentially negative reaction. Dr. Wood suggested that the Academy membership at large might very desirably assist the Meetings Committee by offering ideas on speakers for future programs.

Chairman Hall of the Membership Committee presented, for first reading, the names of 11 candidates for membership. Dr. Wood indicated that these nominations would be voted upon at the June meeting.

Mrs. Fell reported on sales by Pergamon Press of the Academy's monograph on microsomal particles. She indicated that as of April 30 about 500 copies had been sold in New York and 400 in London, and that 1061 copies in all could be accounted for. According to the contract with Pergamon, royalties will accrue to the Academy only after 1500 copies have been sold.

Chairman McPherson of the Policy and Planning Committee called attention to the Board's request in November 1959, that the Committee should study the current relationship between the Academy and its affiliated societies, with a view to determining whether some societies might wish to sever relations. Dr. McPherson asked permission to expand this instruction, as follows: "The Policy and Planning Committee is requested to study the relations of the Academy with its affiliated societies to determine ways and means whereby (1) these relations can be extended and made closer to the mutual benefit of the affiliated societies and the Academy; (2) the Academy can provide a larger measure of leadership in the activities of the scientific community; (3) the affiliated societies whose aims, objectives, and interests are no longer consistent with those of the Academy can be tactfully induced to sever relations with the Academy." The Board agreed to this language.

Chairman Schubert of the Committee on Encouragement of Science Talent reported that he had met with Watson Davis and others concerned with national science fairs, concerning the criticisms of these fairs that had been raised at previous meetings of the WAS Board. Dr. Davis appeared to be in agreement with the concept of state science fairs, and to feel that national science fairs are giving inadequate returns on the expense involved; also, he felt that it is necessary to develop new rules for the conduct of local science fairs.

Dr. Schubert also reported that the Joint Board has carefully considered, and was preparing a response to, the letter transmitted some months ago by Dr. Robbins for the Society of American Bacteriologists, on improved rules for the development of science fair exhibits.

Dr. Hall presented for second reading the names of eight candidates previously proposed for Academy membership, as follows: G. Robert Coatney, Helen L. Garstens, Warren W. Hastings, Jack C. Jones, Robert C. Likins, Geoffrey S. S. Ludford, Meyer Rubin, and Emma Shelton. These candidates were then elected to membership.

SCIENCE AND DEVELOPMENT

The tornado is one of the most dangerous of all storms. The deadly funnel dips suddenly from a cumulo-nimbus cloud to spread its destruction, often over a very small area. The possibility that a meteorological satellite orbiting some 400 miles above the earth would photograph an isolated mass of tornado-producing clouds seems remote; yet Weather Bureau scientists believe that NASA's satellite TIROS I did just that, last

May 19. During a painstaking analysis of over 20,000 photograpns taken by TIROS, the Bureau's satellite meteorologists discovered a striking and unusual picture that showed an isolated group of clouds appearing in the photograph as a very bright square in an otherwise cloudless part of the sky. A subsequent analysis showed that the "square" cloud mass was precisely in the area of heavy thunderstorm activity reported by the Texas cities of Hobart, Childress, and Wichita Falls at the exact time the TIROS wide-angle camera snapped the picture. The analysis also produced strong evidence that this cloud mass later expanded and spread northeastward, spawning tornadoes and hail in central Oklahoma.

The NIH *Record* has provided the following idea of the relative pain-killing power of analgesic drugs by rating them, on the basis of equivalent doses, on a numerical scale, assigning to morphine the value of 100: 500-1,000—phenazocine (NIH-7519) and 14-hydroxydihydromorphinone (Numorphan); 500—levophan (Dromoran); 300-400 — dihydromorphinone (Dilaudid) and metopon; 300—heroin; 100-morphine and methadone (Dolophine); 80-90—dihydrohydroxycodeinone (Eucodal); 30-50—anileridine (Leritine) and diethylthiambutene (Themalon); 20-30—meperidine (Demerol); 15—codeine; and 1-2—aspirin. Aspirin actually does not belong with the other drugs, but is inserted for comparison. All of the drugs are addicting to some degree with the exception of aspirin, which definitely is not. Heroin, although listed above, is not used in medical practice in the United States; it has been banned because of its high rate of abuse as an addicting drug.

A marvel in fish obstetrics—a pregnant female shark containing 114 embryos each about 10 inches long—has been reported by the Division of Fishes of the Smithsonian Institution. The total mass of embryos amounted to about 5 gallons, probably a record for fish. The specimen, belonging to a species of bramble shark, was received from the Hawaiian Islands in connection with a world-wide census of shark attacks now being conducted under Institution auspices. Although formidable in appearance—the body is covered with short, sharp spines—this shark is not considered dangerous to humans, since it is a bottom dweller in deep water and seldom comes near the surface.

NBS has developed an improved scanning photometer to determine wavelengths of spectral lines on a spectrographic plate easily, rapidly, and accurately. The instrument, devised by M. L. Kuder of the Bureau's Electronic Instrumentation Laboratory, optically scans a 0.5-mm-wide portion of the plate and then presents, on an oscilloscope tube, a curve of spectral line density versus wavelength. The instrument was developed for the Bureau's Spectroscopic Laboratory to help automate the processing of a large volume of spectrographic plates.

The Coast and Geodetic Survey issues regular press releases to report the activities of its numerous triangulation survey parties that range the country, establishing accurate base points that are used in mapmaking, engineering projects, local surveying, etc. Each press release contains an interesting stock statement that appears intended to quash superstitious rumors before they can get started. The statement generally reads as follows:

> "Someday you may suddenly notice a slender steel tower silhouetted against the skyline, or at night the blinking of lights in Morse code may catch your eye. These strange sights coupled with the busy movement of men and trucks may cause some of the local residents particular concern. Though unfamiliar to the area, these sights are actually part of one of the oldest operations carried on by the Federal Government, that is, to survey accurately all of the land area within our borders. The towers are not used in drilling for oil, and the strange lights are not some mysterious secret code.
>
> "The activities are merely the work of a Coast and Geodetic Survey field party. This party is one of several similar parties that methodically roam the country, in a nomadic way of life, from the Great Lakes to the Gulf and from the Atlantic to the Pacific. Their summer schedule finds them working the northern states and gradually moving south with the sun. Thus these men perform the geodetic work of the Survey."

The Geological Survey has completed a terrain study of the moon for the Army Engineer Corps, to provide lunar surface information for selecting landing sites, and as an aid in designing telemetering instruments and a lunar surface vehicle. The study consists of three diagrams, all of which show the visible face of the moon at a diameter of 36 inches, and an accompanying brief text. One diagram shows the physiographic regions of the moon; the second diagram is a general photogeologic map of the moon, showing relative ages of the various craters and maria; and the third diagram depicts the prominent lunar rays, which are interpreted as splashes of crushed rock derived from the impact of large fragments thrown out at times of meteoric impact.

A program for the reporting of unusual or adverse reactions to drugs was announced in May by the Food and Drug Administration. To be conducted initially with a limited number of hospitals selected to represent a cross-section of medical specialties, the program is designed to develop information promptly on the untoward effects of drugs, especially the newer

drugs; the information will be used by FDA in the resolution of medical and administrative problems under the Food, Drug, and Cosmetic Act. The project is an outgrowth of a voluntary pilot study carried out during the past four years in cooperation with the American Association of Medical Record Librarians, the American Society of Hospital Pharmacists, the American Medical Association, and the American Hospital Association.

Federal support to the nation's leading oceanographers in an international expedition to the Indian Ocean was announced last June by the White House. The expedition, a scientific project of extraordinary scope and magnitude, will begin late this year and extend through 1964. Like the recent International Geophysical Year, the International Indian Ocean Expedition will incorporate a many-sided scientific attack on a single area of interest under the leadership of a special committee of the International Council of Scientific Unions. Scientific responsibility for U. S. participation is vested in NAS-NRC. Key financial contributions will be made by the Navy Department and the National Science Foundation.

Vast, isolated islands in the sky, the largest about 2,500 square miles in area, are the flat, green tops of the sandstone massifs which constitute the Guayana Highlands of northeastern South America. An account of these islands was recently presented at a Smithsonian staff seminar by John J. Wurdack, who explored them for the New York Botanical Garden. He reports that some of them are almost two miles high, and are cold, rainy, desolate regions, swept constantly by penetrating, wet winds; they are almost devoid of animal life, except for birds. The canyon of one mountain, Cerro Neblina, is deeper than any gorge in the United States. Man, except for a few hardy explorers, has never attained most of the summits. Seen from above, large portions of the surfaces appear to be level, treeless green plains; actually these are peat bogs in which one may sink to the ankles. One flyer who landed safely enough was forced to abandon his plane, which is still there, sinking slowly into the bog.

The Coast and Geodetic Survey in July began a 1500-mile shoreline survey of Chesapeake Bay, in cooperation with the Maryland Department of Tidewater Fisheries. The project will provide 37 special shoreline maps for the Maryland agency in its study and development of seafood resources, especially oyster cultivation. In addition, C&GS will revise about 80 of its own large scale base maps of the Bay with the aerial photography and field data thus acquired. Both State and Federal governments will share the expense of this project, expected to cost about $120,000.

A new index map of the United States has been published by the Geological Survey covering small-scale maps in the 1:250,000-scale topographic map series. When completed, this series, covering all 50 States, will contain 626 maps, 437 of which are now available. Five show the eight principal islands in Hawaii. Alaska is covered by 153. Ninety-five have been completed during the past 15 months and 32 are in progress. All are expected to be available by late 1962 or early 1963.

NBS has found that its parallel-testing interferometer, developed a few years ago by J. B. Saunders for measuring the parallelism of the opposite faces of gage blocks, can be used without modification to compare the lengths of such blocks. This method has the advantage of not requiring wringing which, when repeatedly applied, can injure the surfaces of gage blocks to the extent that reworking is often necessary. Further, as blocks are measured in a horizontal position, use of the parallelism interferometer eliminates corrections for gravitational distortion in length measurements. Faster testing is another consequence of the technique, which makes it possible to measure blocks without handling, thus doing away with a major source of thermal disturbance.

More than 5,000 "shooting stars" a year have been recorded authentically by competent observers over much of the world during the past half century. Some 294,000 of these luminous bodies reported over the years 1901-1959 have been catalogued by Charles P. Oliver, director of the American Meteorological Society; results of this laborious task have just been published by Smithsonian's Astrophysical Observatory. The figures have been broken down into averages for months and hours of each night when reliable observations were possible. With a few notable exceptions, the monthly rates remained fairly constant throughout the 50-year period, but showed a tendency to increase in autumn and early winter, possibly because of better observing conditions. There also was a tendency to increase rather markedly toward the middle of each month and, in general, in hours just after midnight.

The Optical Society of America now has an executive office in the new American Chemical Society Building at 1155 16th St., N.W. Its publication, *Optics and Spectroscopy*, is a cover-to-cover translation of the Russian journal, *Optikaispektroskopiya;* OSA initiated this translation journal with the January 1959 issue (Vol. 6, No. 1).

Studies made by the Geological Survey in the vicinity of Dulles International Airport at Chantilly, indicate ample water for construction needs but show it to be moderately

mineralized, very hard, and in need of treatment to make it suitable for domestic and some industrial uses. Pumping tests of two wells drilled to 860 and 955 feet by contractors in the spring of 1959 indicate yields of 327 and 600 gallons per minute, which are very high for the red shale water-bearing formation penetrated. Previously no known well in the immediate vicinity was more than 180 feet deep or produced more than 12 gallons per minute.

Continued belief in old wives' tales, magic potions, and old-fashioned home remedies in the 20th century, enabled an enterprising promoter to stock more than a hundred herbs and offer them in packages labeled as specific "cures" for practically every human ailment. In July, Food and Drug Administration announced seizure of his "teas" and "tonics" for conditions including arthritis, asthma, change of life, diabetes, epilepsy, external cataracts, hardening of the arteries, heart trouble, kidney stones, overweight, tapeworms, and varicose veins. Also taken into custody were raw materials such as cramp bark, devil shoe string, dog grass, figwort, skunk cabbage, queen of the meadow, and turtlebloom. Misbranding charges were filed, based on false and misleading curative claims in the labeling.

NAS-NRC has announced the formation of a new Committee on Pest Control—Wildlife Relationships, to investigate the relationship between chemical control of agricultural pests and conservation of America's wildlife populations. Creation of the Committee, which will function within the Division of Biology and Agriculture, is most recent of several steps taken by the Academy-Research Council during the past few years in response to concern expressed in several quarters over use of chemicals to control agricultural pests. Committee chairman is Ira L. Baldwin, special assistant to the president of the University of Wisconsin.

Three methods of removing radioactive contaminants from drinking water supplies have been successfully tested by the Army Engineer R&D Laboratories at Fort Belvoir. These methods involve a standard purification unit consisting of chemical coagulation and diatomite filtration that the Engineers call an "Erdlator," a mobile ion exchange unit, and an electrodialysis demineralization process. In one of the tests, conducted at the Nevada Test Site, radioactive soil ground to simulate fallout was added to a water source to give a contamination level of 660,000 units (micro microcuries per liter). After treatment in the "Erdlator," the contamination was reduced to 5,000 units (300,000 units is considered a safe emergency drinking water tolerance).

Chysanthemum stems can be greatly shortened by a new and relatively inexpensive plant-growth regulator, according to USDA scientists at Beltsville. Growers may be able to use this chemical—"phosfon"—to advantage because short chrysanthemum plants require no staking. Flower size is not noticeably affected by phosfon. The flowers of treated plants last longer, and their leaves are dark green, as compared with the medium- to light-green leaf color of untreated plants.

Vice-Presidents of the Washington Academy of Sciences Representing the Affiliated Societies

Acoustical Society of America	Richard Cook
Institute of the Aeronautical Sciences	*Not Named.*
Anthropological Society of Washington	Regina Flannery
Society of American Bacteriologists	Mary Louise Robbins
Biological Society of Washington	Herbert Friedman
Society for Experimental Biology and Medicine	Kathryn Knowlton
Botanical Society of Washington	Herbert C. Hanson
Chemical Society of Washington	William J. Bailey
American Society of Civil Engineers	*Not Named.*
International Assn. for Dental Research	Gerhard Brauer
American Inst. of Electrical Engineers	Robert D. Elbourn
Washington Society of Engineers	Howard S. Rappleye
Entomological Society of Washington	Harold H. Shepard
Society of American Foresters	*Not Named.*
National Geographic Society	Alexander Wetmore
Geological Society of Washington	Carle Dane
Helminthological Society of Washington	Carlton M. Herman
Columbia Historical Society	U. S. Grant, III
Insecticide Society of Washington	Joseph Yuill
Amer. Society of Mechanical Engineers	William G. Allen
Medical Society of the Dist. of Columbia	Fred O. Coe
American Society for Metals	John A. Bennett
American Meteorological Society	Morris Tepper
Institute of Radio Engineers	Robert Huntoon
American Nuclear Society, Washington Section	Urner Liddel
Philosophical Society of Washington	Louis R. Maxwell
Society of American Military Engineers	*Not Named.*

Chairmen of Committees

Standing Committees

Executive	Lawrence A. Wood, *Nat. Bureau of Standards*
Meetings	Robert D. Stiehler, *Nat. Bureau of Standards*
Membership	Wayne C. Hall, *Naval Research Laboratory*
Monographs	Dean B. Cowie, *Dept. of Terrestrial Magnetism*
Awards for Scientific Achievement	Archie I. Mahan, *Applied Physics Laboratory*
Grants-in-Aid for Research	B. D. van Evera, *George Washington University*
Policy and Planning	A. T. McPherson, *Nat. Bureau of Standards*
Encouragement of Science Talent	Raymond J. Seeger, *Nat. Science Foundation*

Special Committees

By Laws	Harold H. Shepard, *Dept. of Agriculture*
Library of Congress	John A. O'Keefe, *Nat. Aeronautics & Space Admin.*
Repres. on AAAS Council	Howard A. Meyerhoff, *Scientific Manpower Commission*

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Proceedings of the Geological Society of Washington

794th Meeting

The 794th meeting of the Society was held in the John Wesley Powell Auditorium, January 14, 1959, President Joseph W. Greig presiding.

Program—DEAN S. CARDER: March 5-7, 1958 eruptions of Manam Volcano off the north coast of New Guinea. See published abstract in Geol. Soc. Amer. Bull., v. 70, no. 12, p. 1711, 1959.

WALLACE DE WITT, JR. and G. W. COLTON: Stratigraphy of the Upper Devonian rocks in the Finger Lakes District of New York. See published abstract in Geol. Soc. Amer. Bull., v. 70, no. 12, p. 1761, 1959.

GEORGE W. COLTON: Sedimentary structures in some Upper Devonian rocks in western New York. See published abstract in Geol. Soc. Amer. Bull., v. 70, no. 12, p. 1759, 1959.

795th Meeting

The 795th meeting of the Society was held in the John Wesley Powell Auditorium, January 28, 1959, President Joseph W. Greig presiding.

Program—MARTIN F. KANE: Gravity study of the Rowe-Mora Basin, New Mexico.

A regional gravity survey of the Rowe-Mora area in northeastern New Mexico was made in May, 1957. The area surveyed is bounded by the Rio Grande on the west, extends to Raton on the north, to Logan and Gladstone on the east, and to Vaughn and Fort Sumner on the south. Most of the gravity anomalies that were outlined by the survey seem to be caused by density changes within the Precambrian basement rocks. A few of the anomalies are probably related to relief on the surface of the basement.

A gravity anomaly of -50 milligals is present in the Sangre de Cristo Mountains which occupy the western part of the area. The anomaly may be caused by a granitic core underlying the mountains, a thick section of clastic sedimentary rocks of Pennsylvanian age, or a thick wedge of younger and less dense sedimentary rocks presumably overlain by the Precambrian and Pennsylvanian thrust sheets exposed at the surface. Calculations indicate that the maximum depth to the mass deficiency is less than 15 kilometers, thus seeming to rule out a subcrustal root as the source.

In the plains-plateau area to the east, a positive gravity nose indicates the presence of dense basement rock, probably a mafic intrusive, which may mark an extension of the Wichita uplift of Oklahoma and Texas. A gravity low is present over the Sierra Grande uplift indicating that the rock forming the uplift has a relatively low density. The rock is probably felsic, a conclusion that is supported by the available drill-hole data. In the area around Las Vegas and Santa Rosa the gravity anomalies seem to be related to relief of the basement.

North of the town of Wagon Mound, both aeromagnetic and gravity data indicate the presence of a deep sedimentary basin, probably bounded on the east and south by faults.

EUGENE S. SIMPSON: A ground water mechanism for the deposition of glacial till.

An hypothesis is presented to explain erosion, deposition, and compaction of till by continental glaciers in temperate regions. Except for a relatively narrow zone at the periphery and at the surface of a continental glacier, ice is at the pressure-melting temperature and meltwater is produced by heat flow due to thermal gradients. Near the periphery meltwater escapes as fast as produced. This together with reduced ice pressure

(because of thinning) results in "cold" ice, i.e., ice whose temperature is below the pressure-melting point. This ice erodes, incorporates, crushes, and mixes rock debris. However, average ice velocity is greater than ice velocity near the base, and debris lags farther and farther behind the glacial toe. Eventually, debris is in a zone where ice is at the pressure-melting temperature and where meltwater is accumulating. This ice has no shear strength and consequently the incorporated debris is deposited. Meltwater escaping from the ice and moving down through the debris into the subjacent rock aquifer (from whence it discharges outward toward the toe) causes compaction.

GERMAINE A. JOPLIN: The origin of the calc-alkaline rocks.

796th Meeting

The 796th meeting of the Society was held in the John Wesley Powell Auditorium, February 11, 1959, President Joseph W. Greig presiding.

Program—T. C. HOERING and P. L. PARKER: Abundance of chlorine isotopes in nature.

A procedure for measuring small differences in the Cl^{37}—Cl^{35} ratio was developed. It consisted of transforming precipitates of silver chloride quantitatively to hydrogen chloride gas and the measurement of the isotope ratio in the mass spectrometer. This technique was applied to a large number of chlorine samples from a wide variety of geological origins. No detectable difference in the chlorine isotope ratio was found. These observations are discussed in terms of the reactions in the geochemical cycle of chlorine. Since the geochemistry of chlorine is that of a chloride ion, few chances for isotope fractionation in equilibrium and kinetic processes exist. In the few cases where an isotope fractionation may exist, the temperature was high enough to make the effect small.

ROBERT B. NEUMAN: Sedimentation in the Ocoee series, Great Smoky Mountains.

Detritus derived from both eastern and western quadrants can be inferred from stratigraphy and sedimentary structures of the Ocoee series (late Precambrian) in western North Carolina and eastern Tennessee. The lowest part, the Snowbird group, has coarse-grained sandstone at its base that grades upward through quartzite and silty sandstone to siltstone. This sequence records a transgression toward the southeast, confirmed by crossbedding in the quartzite that indicates currents moving westward.

Rocks overlying the Snowbird form two contrasting sequences: on the southeast the Great Smoky group (and three formations not assigned to groups) is characterized by feldspathic sandstones with pronounced graded bedding; to the northwest the Walden Creek group is dominantly siltstone with lenses of coarse sandstone and pebble conglomerate. Transportation and deposition of sandstones of the southeastern sequence was probably largely by turbidity currents. Furrows at the base of some sandstone beds have a NW-SE orientation, indicating that currents came from one or the other of these directions. That these currents came from the southeast is suggested by the contrasting composition of the Walden Creek group for which a northwesterly source is inferred. The northwestern source of detritus persisted in the Appalachians through Early Ordovician time.

STANISLAW DZULYNSKI: Evolution of the Carpathian Geosyncline during the Oligocene. See published abstract in Geol. Soc. Amer. Bull., v. 69, no. 12, p. 1556, 1958.

797th Meeting

The 797th meeting of the Society was held in the John Wesley Powell Auditorium, February 25, 1959, President Joseph W. Greig presiding.

Informal communication—HENRY FAUL: On carbonitites and other, seemingly related, subjects.

Program—W. GARY ERNST: Glauco-

phane stability and the glaucophane schist problem.

Glaucophane, $Na_2Mg_3Al_2Si_8O_{22}(OH)_2$, has been hydrothermally synthesized and its stability field determined up to 2000 bars vapor pressure. The experimental investigation shows that high pressure is not required for the stable existence of glaucophane.

Consideration of laboratory and field evidence leads to the conclusion that glaucophane schists can form under a variety of conditions.

(a) Since glaucophane is not a high-pressure mineral, it may occur over a wide P-T range in rocks of unusual chemistry; bulk compositions (rock + pore fluid) deficient in CaO, and rich in Na_2O (and MgO + FeO) relative to Al_2O_3 would favor the development of glaucophane. Moreover, bulk compositions with soda in excess of alumina would promote crystallization of intermediate members of the glaucophane-riebeckite series.

(b) Those alkali amphibole-bearing schists which are compositionally identical to greenschists and epidote amphibolites must belong to a separate metamorphic facies. Since reactions involved in converting greenschists and epidote amphibolites into glaucophane schists are favored by elevated pressures (or diminished temperatures), the glaucophane schist facies represents a relatively high pressure (or low temperature) equivalent of these two more common facies. The glaucophane schist facies may be defined by the diagnostic assemblages (1) glaucophane + calcium-aluminum-silicate, (2) glaucophane + white mica, and (3) jadeite + quartz. Assemblage (1) occurs in rocks of roughly basaltic composition; assemblage (2) is typical of aluminous bulk compositions; and assemblage (3) is obtained in rocks relatively enriched in Na_2O.

E-AN ZEN: Mineral assemblages in slate in western Vermont.

JOHN C. REED, JR. and BRUCE H. BRYANT: Lower Cambrian and Late Precambrian rocks in the Grandfather Mountain window, North Carolina.

Sedimentary and volcanic rocks of low metamorphic grade in the Grandfather Mountain area, well within the Blue Ridge province of western North Carolina, were recognized by Arthur Keith during his survey of the Cranberry, Morganton, and Mt. Mitchell quadrangles in the 1890's. He correlated these rocks with the Chilhowee group of the Valley and Ridge province to the west, and believed they occurred in a complex syncline in the crystalline rocks of the Blue Ridge province. Subsequent workers have suggested that these rocks are exposed in a window beneath a major overthrust along which early Precambrian gneisses, schists, and granites of the Blue Ridge have been carried many miles northwestward. This later interpretation has been confirmed by recent detailed mapping in the Linville and Table Rock quadrangles.

All sedimentary rocks within the Grandfather Mountain window have been progressively metamorphosed to a grade at which albite and sericite have developed. New biotite has formed in rocks of appropriate composition. Basement rocks within the window have been retrogressively metamorphosed to a similar grade. In the coarse-grained clastic rocks, sedimentary textures and structures are well preserved; in the fine-grained rocks, clastic original textures have been destroyed by recrystallization.

Two structurally separate sequences of sedimentary rocks are present in the western part of the window: an autochthonous sequence which rests unconformably on a basement of cataclastic granitic gneisses and phyllonites; and an allochthonous sequence which occurs in a thrust sheet that has overridden the autochthonous rocks and has in turn been overridden by the Precambrian rocks in the main overthrust sheet west of the window.

Arkose overlain by phyllite forms a thick basal unit of the autochthonous sequence. In the west-central part of the

window, arkose also overlies the phyllite of the basal unit, but to the south the upper arkose appears to finger out into phyllite. In the upper part of the autochthonous section is a widespread unit of amygdaloidal greenschist derived from basaltic flows (Montezuma schist).

The arkose of the autochthonous sequence is coarse- to fine-grained and contains minor interbeds of light-gray to green sericite phyllite. The lower part of the basal arkose member is generally fine-grained; the upper part of the member contains very coarse-grained units in which individual feldspar clasts reach more than one centimeter in diameter. Conglomerates are most common in the upper part of the basal arkose; they occur as channel fillings and contain quartz, arkose, phyllite, rhyolite, and granitic pebbles. A local conglomerate consists only of rhyolite cobbles.

The large feldspar clasts in the arkoses are predominantly microcline. Plagioclase, in subordinate amounts, occurs in small grains, most of which retain their clastic shapes. Quartz has been recrystallized except for some large clastic grains. Chlorite and biotite are absent, but the rock contains abundant green iron-rich sericite. The heavy mineral suite in the arkose consists of abundant zircon, magnetite, and leucoxene. Tourmaline is rare.

Dark biotite phyllite and phyllitic siltstone comprise the bulk of the phyllitic portion of the autochthonous sequence. Locally, thin beds of calcareous phyllite and rare lenses of sandy marble are pressent. The uppermost beds exposed adjacent to the window boundary in the Linville quadrangle are metagraywackes and conglomeratic metagraywacke containing abundant pebbles of andesite, phyllite, arkose, granitic rocks, and occasional pebbles of limestone and rhyolite. Typically, the phyllite contains biotite and chlorite in addition to sericite. The proportion of feldspar is quite variable, but plagioclase is predominant.

Structural complexity has precluded an accurate estimate of the stratigraphic thickness of these units, but the total may be as much as 50,000 feet.

The allochthonous sequence differs from the autochthonous sedimentary sequence in lithology, is more uniform stratigraphically, and is structurally simpler. The lowest unit of the allochthonous sequence consists of well-bedded sericitic arkose, arkosic quartzite, and some clean quartzite with much interlayered dark-green and gray sericite phyllite. This unit is at least a thousand feet thick, but its total thickness is unknown because of its position in the thrust sheet.

Overlying this unit is 30 to 100 feet of steel-blue to dark-gray lustrous phyllite which passes upward into thick-bedded to massive white sugary quartzite and arkosic quartzite, commonly with minor interbeds of blue phyllite. The upper quartzite unit is approximately 800 feet thick.

Near the western edge of the window, massive blue-gray dolomite conformably overlies the upper quartzite. This unit is almost certainly the equivalent of the Lower Cambrian Shady dolomite of the Valley and Ridge province.

In general, rocks of the allochthonous sequence contain less feldspar than the arkoses of the autochthonous sequence. Texturally, however, rocks of comparable grain size in the two sequences are quite similar. Green sericite is abundant, especially in the lower part of the allochthonous rocks. Biotite and chlorite are absent in the phyllites of this sequence, apparently because the original composition was inappropriate. The heavy mineral suite from the allochthonous sequence is characterized by abundant tourmaline, together with zircon, magnetite, and leucoxene.

No fossils have been found in any of the rocks of the Grandfather Mountain window. The lithology and stratigraphic position of the rocks of the allochthonous sequence beneath the Shady dolomite strongly suggest that these beds are part of the Lower Cambrian and late Precambrian (?) Chilhowee group, presumably representing the Erwin and Hampton formations and, perhaps, parts of the

Unicoi formation. Correlation of the autochthonous sediments is less certain. Lithologically and stratigraphically they differ strikingly from any Chilhowee or younger deposits in the Valley and Ridge province. They are probably pre-Chilhowee, and possibly represent a transitional facies between the nonvolcanic clastic rocks of the Ocoee series to the west and the volcanic rocks of the Mount Rodgers volcanic group to the north, both of which underlie the Chilhowee group. They may, of course, represent an isolated deposit of pre-Chilhowee age for which no correlatives have been recognized.

798th Meeting

The 798th meeting of the Society was held in the John Wesley Powell Auditorium, March 11, 1959, President Joseph W. Greig presiding.

Program—EMILY JAGER: Age measurements on some Alpine and pre-Alpine micas. See note published in Geol. Soc. Amer. Bull., v. 70, no. 12, p. 1553-1557, 1959.

WILLIAM BACK: Calcium carbonate saturation in ground water.

HELEN FOSTER: Mt. Fuji, Japan, and its deposits of volcanic ash.

799th Meeting

The 799th meeting of the Society was held in the John Wesley Powell Auditorium, March 25, 1959, President Joseph W. Greig presiding.

Program — ROBERT B. GUILLOU: Project ARMS (Aerial Radiological Monitoring Surveys)—an important contribution to geology.

The U.S. Geological Survey, on behalf of the U.S. Atomic Energy Commission began a nationwide program of aerial radiological monitoring surveys (Project ARMS) in July, 1958. The purpose of the program is to obtain data which can be used to appraise changes in environmental levels of radiation brought about by nuclear testing programs, operation of reactors and other nuclear facilities, and radiation accidents. At first, most of the ARMS work will consist of surveys of reactor and major production facilities, including the area extending out about 50 miles from the center of each facility. The airborne surveys are flown 500 feet above the ground along parallel flight lines oriented normal to regional geologic trends and spaced one or two miles apart. In addition to aeroradioactivity data, aeromagnetic data are being recorded on all surveys.

ARMS projects scheduled at present include: Savannah River Plant, Georgia Nuclear Aircraft Laboratory, Oak Ridge, New England. Pittsburgh, Chicago, Fort Worth, Los Angeles, San Francisco, Hanford, Idaho Falls, and Nevada Test Site. Reports submitted to the AEC on each area will include aeroradioactivity data and a correlation of aeroradioactivity data, geology, and pedology.

Aeroradioactivity and aeromagnetic data are expected to make a significant contribution to knowledge of the geology of each area surveyed. Work to date indicates that both types of data are extremely useful in mapping and understanding the geology of the Piedmont and other areas of complex geology. In sedimentary terrane, the interpretation of aeromagnetic data can yield information on basement structure while information on the distribution of surficial material is obtained from the radioactivity data.

PAUL BARTON and P. M. BETHKE: Distribution of minor elements between coexisting sulfides.

ROBERT S. SIGAFOOS: Botanical evidence of floods and flood-plain deposition.

800th Meeting

The 800th meeting of the Society was held in the John Wesley Powell Auditorium, April 8, 1959, President Joseph W. Greig presiding.

Program—HUGH D. MISER: Our Society—retrospect and prophecy.

SIDNEY P. CLARK, JR.: Estimates of temperature in the outer mantle.

T. C. PHEMISTER: Nature of the contact of Temiskaming and Grenville geological provinces in northern Ontario.

801st Meeting

The 801st meeting of the Society was held in the John Wesley Powell Auditorium. April 22. 1959, President Joseph W. Greig presiding.

Program—ALAN E. PECKHAM: preliminary investigations of underground waste disposal near Arco, Idaho.

Since 1954 the U.S. Geological Survey, in cooperation with the U.S. Atomic Energy Commission, has been studying the direction, rate of movement, and the dispersion of saline-water effluent discharged from the Chemical Processing Plant (CPP) to the underlying basalt aquifer through a disposal well at the National Reactor Testing Station (NRTS), Idaho. The effluent averages about 250 ppm in chloride concentration, whereas natural waters in this area normally have chloride concentrations of less than 20 ppm.

Earlier studies indicate that the regional ground-water flow is from northeast to southwest. Detailed interpretation of the movement is made difficult by local variations in permeability, the effects of intermittent recharge from the Big Lost River, and intermittent pumping of the CPP production wells, combined with the dynamics of the disposal well and the aquifer itself.

Chloride concentrations of more than 150 ppm have been detected in 3 test wells near the disposal well, and 2 other wells have yielded water containing about 100 ppm of chloride. Six more distant test wells have yielded water having chloride concentrations as much as 3 times that normally expected in water from this area. The significance of these data is difficult to establish.

The lag in time between changes in plant discharge through the disposal well and changes in chloride concentrations in test wells indicates straight-line average rates of ground-water movement of 15 to 50 feet per day, from the disposal well to "intercept" wells south and west of the disposal well. The effluent moves radially from the disposal well in one or more permeable zones for some distances (perhaps 1,000 feet) before the flow lines trend directly down the regional ground-water gradient. This is just the reverse situation of the lines of flow into a pumped well in a region in which ground water has a constant motion in a general direction, as described by C. S. Slichter in the 19th Annual Report, part II, of the U.S. Geological Survey.

It is hoped that future tracer tests and other studies, supported by some additional test wells, will yield more accurate knowledge of the geologic and hydrologic character of the aquifer, and will facilitate operation of AEC's Chemical Processing Plant.

BRIAN SKINNER: System ZnS-MnS-FeS; effects of maganese on the sphalerite geothermometer.

WILLIAM A. OLIVER, JR. and ALONZO W. QUINN: Geology of the Narragansett Basin, Rhode Island and Massachusetts.

Several areas, in all of the New England states except Vermont, have been mapped at one time or another as containing Carboniferous sedimentary or metasedimentary rocks. The 1932 Geologic Map of the United States shows 5 major and several minor basins, extending from the south shore of Rhode Island to Bath, Maine. The age of most of these basins is in question, but the southernmost one, the Narragansett basin, is dated as Pennsylvania (probably Allegheny age) by an abundance of plant fossils.

The Narragansett basin covers a 55 by 25 mile area in eastern Rhode Island and Massachusetts. The sedimentary rocks in the basin are less resistant to erosion than surrounding, older rocks, and the basin is a partially drowned, heavily glaciated, lowland margined by a crystalline escarpment.

Within the basin, the basal Pondville conglomerate is overlain to the north by red shale, sandstone and conglomerate of the Wamsutta formation, 1000 to 2000 feet thick. The thickest and most

widespread unit is the Rhode Island formation which overlies and interfingers with the Wamsutta formation to the north, but rests on the Pondville conglomerate or the older crystalline rocks to the south. The Rhode Island formation consists of some 10,000 feet of grey and black shale, sandstone, and conglomerate with several intercalated coal beds. The youngest formation in the northern part of the basin is the Dighton conglomerate, preserved in the troughs of several synclines. To the south, the Purgatory conglomerate may be of the same age or may represent one or more conglomerate units within the Rhode Island formation.

Plant fossils are common in the black shales and have been found in the sandstone and red shale. Well over 100 species of ferns, seed ferns, arthrophytes, lepidophytes and miscellaneous plants have been described or listed from the Rhode Island formation. A few species are known from one or two localities in the Wamsutta formation. Animal fossils, all from the Rhode Island formation, consist of some 14 insects (mostly cockroaches), 1 arachnid, 12 to 15 fresh water pelecypods, and a few worm tubes. Locally common are 4 species of conchostracans.

The Pennsylvanian rocks of the Narragansett basin rest uncomforably on, and are downfaulted against. older Paleozoic and Precambrian (?) crystalline rocks. Numerous faults and folds lie within, as well as along, the margins of the basin. In the southern part of the basin, small folds with axial plane cleavage are abundant and there appears to be at least one major overturned anticline. Stretched pebbles reflect increasing structural complexity toward the south. Northeast of Providence, pebbles in the sedimentary rocks are apparently undistorted; just south of Providence they are 2 to 3 times as long as they are wide; and in the southwest corner of the basin a length-width ratio of 13:1 has been reported. Wherever determinable, the long axes of the pebbles lie in the plane of the bedding and parallel to the axes of associated north trending folds. Southwestward increases in metamorphic grade of the rocks, and in coal rank, are also noted.

The shape and extent of the Narragansett basin in Pennsylvanian time is unknown, but the abundance of coarse conglomerate throughout the section seems to indicate considerable surrounding relief and the area probably consisted of one or more intermontaine basins. Portions of the basal conglomerate were locally derived, but the bulk of the sediments in all formations were transported some distance by streams. The sandstones and conglomerates have the characteristic, irregular cross-bedding and cut-and-fill features of stream deposits. The finer sediments were deposited on the flood plains, and at one time or another coal swamps covered much of the basin. There is no indication of any marine connection at any time. A northern source for most of the sediment is indicated by (1) sedimentary structures, (2) an increase in quartz content of sediments to the south, and (3) the red to gray-black facies change.

The red color of the Wamsutta formation is due to the preservation of red iron pigment which was brought in during sedimentation. The area of deposition of this sediment was apparently slightly higher and better drained so that the red color could be preserved. To the south, lower gradients with poorer drainage produced conditions under which the iron-oxide was reduced so that grays and blacks predominate. Later deposits over the whole basin are predominately gray sandstones and conglomerates with only minor amounts of shale. Evidently the area continued to be mountainous throughout the period of deposition.

The Narragansett basin is the only Pennsylvanian coal basin of its kind in North America, but it is strikingly similar in its characteristics and history to the limnic coal basins of France and adjacent countries. The Narragansett basin and the limnic basins of Europe were intermontaine basins that received great thick-

nesses of non-marine sedimentary rocks which were deposited in complete isolation from the sea and from areas of alternately marine and non-marine deposition. They have comparatively few, but thick, coal beds and exhibit rather complex, commonly metamorphic structures dating from late phases of the orogenic movement which produced the intermontaine basins in the first place.

802nd Meeting

The 802nd meeting of the Society was held in the John Wesley Powell Auditorium, October 14, 1959, President Joseph W. Greig presiding.

Program — HARRY W. SMEDES: Structural interpretation of western Montana and northern Idaho.

An east-trending trough in western Montana marks a major crustal block which has affected sedimentation since Precambrian Belt time and has influenced Laramide deformation. Between Helena and Missoula, the trough is characterized by infolded Belt rocks and younger strata and is bounded by Belt strata to the north and pre-Belt crystalline rocks to the south. The Boulder and Philipsburg batholiths and an eastern salient of the Idaho batholith are restricted to the area of this block. The northern boundary, marked by en echelon folds and east-west thrusts, lies on strike with the straight northern edge of the Idaho batholith. Thrust belts east of the Boulder batholith and near the Philipsburg batholith bulge eastward within the trough. A wedge pattern of northwesterly trending faults in Idaho forms an apparent apex near Missoula. Displacement along some of these faults such as the Osburn fault, is right lateral.

These structural elements can be integrated by the following kinematic interpretation. During the Laramide orogeny, the supracrustal rocks of the trough (and perhaps the crustal block itself) moved eastward and produced: (1) a left-lateral tear zone along the northern border, marked by en echelon folds and thrusts which may have localized the northern contacts of the batholith; and (2) eastward deflections of the Lewis-Lombard and Philipsburg fold and thrust belts. Right-lateral faults branched from the tear zone near Missoula to form a composite wedge that moved relatively westward, as though pinched between the trough rocks and those to the north.

L. T. ALDRICH: Mineral ages in the metamorphic rocks of Iron and Dickinson Counties, Michigan.

Thirty-five independent mineral ages of micas suggest the following sequence of events: Basement gneisses formed and basal member of Dickinson series laid down before 2000 m.y. ago; metamorphic events at 2000 m.y.; pegmatite intrusion at 1800 m.y.; metamorphism at 1650 m.y.; and granite intrusion and metamorphism at 1400 m.y. The 1650 m.y. event may be the result of the super-position of the 1800 and 1400 m.y. events.

MARIAN KSIAZKIEWICZ: Sedimentation and tectonics in the Carpathians. See published paper in Geol. Soc. Amer. Bull., v. 70, no. 8, p. 1089-1118, 1959.

803rd Meeting

The 803rd meeting of the Society was held in the John Wesley Powell Auditorium, October 28, 1959, President Joseph W. Greig presiding.

Program — ALLISON R. PALMER: Early Late Cambrian stratigraphy of the United States.

Sedimentation during the early late Cambrian seems to have been in three generally contrasting belts approximately parralleling the shoreline. The inner and outer belts are characterized by considerable amounts of argillaceous and arenaceous materials. The middle belt is characterized by oolitic, echinodermal, algal, sublithographic, banded or mottled, and generally clean carbonate rocks. In addition, sediments in the inner belt are often glauconitic. Limestones included in the inner belt are generally muddy, whereas those in the outer belt are generally silty. Fine suspended material, in the liquid resulting from solution of limestones from

these belts in acid, is generally brown, yellow or orange for limestones from the inner belt, and black for limestones from the outer belt.

The general early late Cambrian sedimentary history indicates lateral movement of the sedimentary belts toward the continental shoreline during the early and later parts of this time. A short-lived, but widespread, movement of the sedimentary belts away from the shoreline took place between the times represented by the beginning of the *Aphelaspis* zone and the end of the *Dunderbergia* zone of the standard early Late Cambrian faunal succession (Lochman and Wilson, 1958, p. 333). According to the interpretation presented here, the Nolichucky and Conasauga formations of Tennessee and Alabama represent the outer sedimentary belt, and the Maynardville limestone and some of the lower part of the Knox group (of authors) represent the generally eastward regressive movement of the middle carbonate belt over the outer belt. In eastern Nevada and western Utah, the eastward transgressive movement of the outer belt is represented in the Dunderward shale (of Nevada only), the Lincoln Peak formation in eastern Nevada, and thin-bedded limestones, shales, and siltstones in the middle part of the Orr and Hicks formations in western Utah. The Johns Wash limestone in eastern Nevada and limestones in the upper part of the Orr and Hicks formations in western Utah represent westward regressive movement of the middle carbonate belt. The Corset Spring shale in eastern Nevada and the "Dunderberg" shale (of authors) in western Utah represent the maximum westward regression of the inner sedimentary belt.

Refinement of knowledge of the early Late Cambrian faunal succession in eastern Nevada and western Utah shows that the fauna of the "Dunderberg" shale (of authors) in western Utah is partly younger than that of the Dunderberg shale of Nevada. Regional stratigraphic evidence indicates that the two units represent sedimentation from different sources and that they were probably never coextensive.

Sedimentary successions of Early and Middle Cambrian age, later Cambrian age, and Early Ordovician age in western United States can probably also be explained in terms of the three shifting belts of sedimentation. Study of the facies significance of particular kinds of carbonate sediments within the middle carbonate belt presents a challenge with considerable potential for further refinement of Cambrian stratigraphy.

Reference

Lochman, Christina and Wilson, J. L., 1958, Cambrian biostratigraphy in North America; Jour. Paleontology, 32, no. 2, p. 312-350.

DAVID B. DOAN: Some eustatic sea levels of the Western Pacific.

H. A. TOURTELOT, L. G. SCHULTZ, and J. R. GILL: Chemical and mineralogical composition of the Pierre shale in South Dakota and adjacent states.

804th Meeting

The 804th meeting of the Society was held in the John Wesley Powell Auditorium, November 11, 1959, President Joseph W. Greig presiding.

Program—DONALD R. NICHOLS and LYNN A. YEHLE: Mud volcanoes in the Copper River Basin, Alaska.

Two groups of mud volcanoes, consisting largely of clayey silt cones which discharge gas and highly mineralized spring water, occur within 15 miles of Glennallen. The four cones of the Tolsona group range in height from 20 to 60 feet, and lie west of the Copper River near coal-bearing rocks of Tertiary age: three cones are active, discharging methane and nitrogen gas and sodium and calcium chloride water. The three cones in the Drum group are 150 to 300 feet high, lie east of the Copper River near the slopes of the volcanic Wrangell Mountains, and emit carbon dioxide gas and warm sodium chloride and bicarbonate waters.

The gas source of Tolsona springs may be from buried marsh or coal deposits because the springs contain only a trace of carbon dioxide and lack hydrocarbons heavier than methane. Gas from Drum springs probably emanates from volcanic sources. Water in Tolsona springs may be a mixture of meteoric, connate, or highly saline ground water; the Yuma springs may also include small amounts of volcanic water.

Formation of the cones was by quiet intermittent accretion and, in the Drum cones, probably included eruptive phases. Most of the cones formed largely before or during the last major glaciation.

ALICE D. WEEKS: The role of diagenesis of sandstone-type uranium deposits.

GORDON G. LILL: The Moho deep drilling project.

805th Meeting

The 805th meeting of the Society was held in the John Wesley Powell Auditorium, December 9, 1959, Vice-President C. A. Anderson presiding.

Program — The Presidential address: JOSEPH W. GREIG: Development of phase equilibrium studies in the interest of petrology.

67th Annual Meeting

The 67th annual meeting was held immediately following the 805th meeting, President Joseph W. Greig presiding. The reports of the secretaries, treasurer, and auditing committee were read and approved. The Awards Committee presented first prize for the best paper of the year to W. GARY ERNST for his paper "Glaucophane stability and the glaucophane schist problem." Second prize was awarded to JOHN C. REED, JR. and BRUCE H. BRYANT for their paper "Lower Cambrian and Late Precambrian rocks in the Grandfather Mountain window, North Carolina." Three honorable mention awards were given to: R. S. SIGAFOOS for his most enjoyable talk on "Botanical evidence of floods and flood-plan deposition"; E. S. SIMPSON for his controversial "A ground water mechanism for the deposition of glacial till"; and EMILY JAGER for her paper "Age measurements on some Alpine and pre-Alpine micas." The Sleeping Bear Cup was presented to HENRY FAUL, a consistent critic of geologists, over the years.

Officers for the year 1960 were then elected:

President: HARRY S. LADD
First Vice-President: LUNA B. LEOPOLD
Second Vice-President: WALTER S. WHITE
Secretary (2 Years): JOHN T. HACK
Treasurer: MARGARET COOPER
Members-at-Large of the Council (2 years): PHILIP H. ABELSON, DEAN S. CARDER, and S. WARREN HOBBS.

The Society nominated CARLE H. DANE to be a Vice-President of the Washington Academy of Sciences for the year 1960.

Science in Washington

SCIENTISTS IN THE NEWS

This column will present brief items concerning the activities of members of the Academy. Such items may include notices of talks given, important conferences or visits, promotions, awards, election to membership or office in scientific and technical societies, appointment to technical committees, civic activities, and marriages, births, and other family news. Formal contributors are being assigned for the systematic collection of news at institutions employing considerable numbers of Academy members (see list on masthead). However, for the bulk of the membership, we must rely on individuals to send us news concerning themselves, and their friends. Contributions may be addressed to **Dr. Harold T. Cook, U.S.D.A., Washington 25, D.C.**

APPLIED PHYSICS LABORATORY

Ralph E. Gibson presented a talk, "A Systems Approach to Research Management," at the Naval Research Reserve Seminar on Research Planning and Management, held August 25 at Princeton University.

Alfred J. Zmuda published a paper, "Ionospheric Electrostatic Fields and the Equatorial Electrojet," in the August issue of the *Journal of Geophysical Research.*

CATHOLIC UNIVERSITY

Karl F. Herzfeld, head of the Physics Department, will be awarded the Gibbons Medal by the University Alumni Association at its annual meeting in November. This medal is presented annually for outstanding contributions to the United States of America, the Catholic Church, or Catholic University.

Dr. Herzfeld attended the 8th Annual Symposium on Combustion, held at Pasadena, Calif., August 28 to September 2.

George D. Rock, professor of physics, has be named secretary-general of the University.

William S. Osgood, who recently retired from Renssalaer Polytech with the title of professor emeritus, has been appointed professor of civil engineering.

W. Gardner Lynn, head of the Biology Department, presented a paper, "Types of Amphibian Metamorphosis," at the American Society of Zoologists' Refresher Course on Metamorphosis at Stillwater, Okla., August 29. Professor Lynn also attended the 10th International Congress for Cell Biology in Paris, September 4-9, and the Symposium of the International Institute of Embryology at Pallanza, Italy, September 15-20. While abroad he visited the biological laboratories of the University of Milan, the Oceanographic Institute in Paris, Louvain University, the University of Stockholm, and Bedford College, University of London.

GEOLOGICAL SURVEY

Waldemar T. Schaller presented a paper, "Some Ideas on Beryl," before the Mineralogical Society of Great Britain and Ireland on June 2. He also attended sessions of the 21st International Geological Congress, held in Copenhagen August 14-25. During the summer, Dr. Schaller traveled in various other European countries, visiting fellow scientists and points of scientific interest.

During the summer, **Clarence S. Ross** attended meetings of the International Geological Congress in Copenhagen, served as delegate to a conference of the International Mineralogical Association, and participated in a field trip around North Cape, Norway. While in Europe, Dr. Ross visited several other countries before returning to Washington on September 20, his 80th birthday.

Thomas P. Thayer gave a paper at the International Geological Congress in Copenhagen on "Some Critical Differences between Alpine and Stratiform Ultramafic Complexes." In September Dr. Thayer examined ultramafic complexes in Yugoslavia and Turkey, and attended a conference on chromite in Ankara, September 26-October 5, for the International Cooperation Administration.

Edwin W. Roedder attended meetings of the International Geological Congress in Copenhagen and gave a paper on "Fluid Inclusions as Samples of Ore-forming Fluids." Dr. Roedder and his family also toured a number of Scandinavian and other European countries before returning to Washington.

George T. Faust attended sessions of the International Union of Geodesy and Geophysics at Helsinski, Finland, July 24 to 27, and of the International Mineralogical Association and International Geologic Congress in Copenhagen. Dr. Faust served as secretary *pro tem* of the Mineral Data Commission of the IMA and was elected secretary for 1961-62. Between the meetings in Helsinski and Copenhagen he made several field trips in Norway, and after the meetings in Copenhagen he did field work in West Germany and Alsace before returning to Washington.

Jewell J. Glass participated in field trips in Norway and Sweden and attended sessions in Copenhagen of the International Geological Congress. After the Congress she visited West Germany.

Martha S. Carr and **Walter B. Lang** were married July 21. Both retired on July 31, having been in the Geological Survey since 1918 and 1922, respectively. Since their marriage, Mr. and Mrs. Lang have been traveling in England and Europe; they attended meetings of the International Geological Congress in Copenhagen during August.

Irving May has been appointed a member of the Division of Chemistry and Chemical Technology of NAS-NRC, to serve as liaison representative on behalf of the Geological Survey.

Raymond L. Nace received the Ph.D. degree (geology) from Columbia University on June 6.

HOWARD UNIVERSITY

The year 1960 has brought three distinct honors to **Moddie D. Taylor,** professor of chemistry. In June, he was selected as one of six winners of the Manufacturing Chemists' Association's Chemistry Teacher Awards. Each award consists of a medal, a citation, and $1,000, given for outstanding undergraduate teaching. Francis O. Rice of the Georgetown University Chemistry Department also was a winner of a 1960 MCA award.

Dr. Taylor also was one of a group of five well-known scientists selected by the Robert A. Welch Foundation to participate in its Visiting Scholar Program. Dr. Taylor will spend the academic year 1960-61 conducting personal re-

search on rare earth compounds at Prairie View (Tex.) A&M College. The other four participants are Edward Teller, who will visit at Rice University; Hans Jonassen of Tulane, who will visit at the University of Texas; W. B. Smith of Ohio State University, who will visit at Texas Christian; and Daniel Bovet, Nobel laureate in chemistry from the University of Rome, who will visit at Southwestern Medical School in Dallas.

Also, Dr. Taylor's book, "First Principles of Chemistry," was published this year by D. Van Nostrand. It has already been adopted by 25 schools throughout the country and promises to become one of the more rigorous general chemistry texts on the market.

Dr. Taylor has been on the faculty at Howard University since 1948, and is very active in chemical education at the college and high school level. His research has included work on the hydrogen bond of dimeric carboxylic acids, and on the physical properties of rare-earth halides and benzoates.

NATIONAL BUREAU OF STANDARDS

Allen V. Astin, director of the Bureau, was one of 35 new members recently elected to the National Academy of Sciences.

William D. Appel, former chief of the Textiles Section before his retirement received an honorary doctor of science degree from North Carolina State College at its May commencement.

William N. Harrison, chief of the Enameled Metals Section, was one of 19 persons to receive the 1960 Award of Merit of the American Society for Testing Materials, in recognition of distinguished service to the Society. He received a certificate at the ASTM June meeting in Atlantic City.

Archibald T. McPherson, associate director, received the 1960 Honor Award of the Washington Chapter, American Institute of Chemists, at a dinner on May 24. Dr. McPherson was cited for "unselfish devotion to the encouragement of young scientists, and interdisciplinary contributions in the national interest through his imaginative leadership in calibration and specification activities."

Lauriston S. Taylor, chief of the Radiation Physics Division, received an honorary doctorate of science from the University of Pennsylvania on June 15.

William W. Walton has been appointed chief of the Floor, Roof, and Wall Coverings Section of the Building Technology Division. **Kurt E. Shuler,** formerly consultant to the Heat Division, has been appointed consultant to the director.

Several Academy members have retired from the staff in recent months, as follows: **Garbis H. Keulegan,** physicist in the Fluid Mechanics Section, on July 31; **Fred L. Mohler,** chief of the Mass Spectrometry Section, on July 15; **Hubert R. Snoke,** assistant chief of the Building Technology Division, on July 31; and **Harold F. Stimson,** senior physicist in the Temperature Physics Section, on April 30 after more than 42 years at the Bureau.

Academy members presenting papers at recent international meetings have included the following: **Norman Bekkedahl,** "Research Work in the Polymer Structure Section of the National Bureau of Standards," at the Institut Argentino Elastomeres, Buenos Aires, September 21; **Francis C. Breckenridge,** "A Correlation of Signal Color Recognition Tests," at the 6th International Technical Conference on Lighthouses and Other Aids to Navigation, Washington, September 26-30; **Herbert P. Broida,** "Electronically Excited CN Produced by Reactions of Atomic Nitrogen with Hydrocarbons: Pressure Dependence of Rotationally Perturbed Lines in the Ultraviolet Band Spectrum of CN," at the Symposium on Atomic Reactions, McGill University, Montreal, September 7; **H. P. R. Frederiske,** "Properties of Turile (TiO_2)," at the IUPAC Conference of Semiconductors, Prague, August 29-September 2; **Gordon M. Kline,** "Absorption of Polyesters and Other Polymers to Glass and Other Substrates," at the IUPAC Division of Plastics and High Polymers Symposium on Reinforced Polyester Resins, Turin, Italy, September 28; **Ladislaus Marton,** "Characteristic Energy Losses of Electrons," before the Czechoslovakian Academy of Sciences, Prague, in August; and **Charlotte M. Sitterly,** "Report on Atomic Spectra," before the Triple Union Commission on Spectroscopy, Ottawa, September 5.

NATIONAL INSTITUTES OF HEALTH

Chester W. Emmons, head of the Medical Mycology Section, National Institute of Allergy and Infectious Diseases, gave his presidential address before the Mycological Society of America at its recent meeting in Stillwater, Okla. "Mycologists must continue," he stated, "to take increasing responsibility in the study of the fungi" which cause systemic mycoses. Emphasizing the importance of work in this field, Dr. Emmons noted that in one recent year mycotic deaths in the United States equalled the number of poliomyelitis deaths and exceeded by one the total number of deaths reported for whooping cough, diphtheria, scarlet fever, typhoid, malaria, and brucellosis.

Sarah S. Stewart, of the National Cancer Institute, and **Bernice E. Eddy,** Division of Biologics Standards, have reported that the resistance of mice to tumor induction by the SE polyoma virus has been traced to the presence of antibodies in serum and milk of the mothers. Their paper, of which Marjean Irwin and Stephanie Lee are co-authors, appeared in a recent issue of *Nature*.

Nathan B. Eddy, principal pharmacologist at NIH since 1939, and the foremost world figure in the field of drug addiction and analgesics, re-

tired September 1 at the mandatory age of 70. Dr. Eddy announced that he planned to make few changes in his regular schedule of scientific activities.

NAVAL ORDNANCE LABORATORY

Hermann H. Kurzweg has left NOL to become assistant director of research at the National Aeronautics and Space Administration. He has been succeeded as associate technical director for aeroballistics by **Robert E. Wilson,** who for the past three years had been chief of the Laboratory's Aeroballistics Program.

USDA, BELTSVILLE

Clarence H. Hoffmann, assistant director of the Entomology Research Division, gave a lecture, "Approaches to Biological Control by the Entomology Research Division of the U.S. Department of Agriculture," at the recent 11th International Congress of Entomology in Vienna; he was an official delegate of the Entomological Society of America. While abroad, Dr. Hoffmann visited a number of scientific laboratories, educational institutions, and chemical companies.

Dr. Hoffmann also presented a paper, "Effects of Insecticides on Aquatic Life," at a Conference on Physiological Aspects of Water Quality, held in Washington under the auspices of the Public Health Service.

USDA, WASHINGTON

Robert W. Webb received a high public tribute from Senator John S. Cooper (R. Ky.) in the September 2 issue of the *Congressional Record Appendix.* Senator Cooper called attention to Dr. Webb's pioneering research on the nature and properties of cotton fiber, and stated that it had completely changed the concepts of cotton quality in production, marketing, and utilization. He inserted an article in the *Record* entitled, "He Pioneered a New Science that Changed the Ways of a Great Industry," that described Dr. Webb's work.

Hazel K. Stiebeling, director of the Institute of Home Economics, was a member of the organizing committee of the Fifth International Congress on Nutrition, held here September 1-7. She served as co-chairman of one of the sessions and reported on original research.

Joseph R. Spies presented a paper, "The Chemistry of Allergens XV. Inactivation of the Castor Bean Allergen and Ricin by Heating with Aqueous Calcium Hydroxide," before the Biological Chemistry Division of the American Chemical Society, meeting in New York on September 12. **E. Jack Coulson, Harry S. Bernton,** and **Henry Stevens** were co-authors.

Elbert L. Little, Jr., dendrologist of the Forest Service, represented the United States in the FAO Latin American Conifer Seminar and Study Tour, held in Mexico September 19 to October 28.

UNIVERSITY OF MARYLAND

In the Institute for Molecular Physics, **Edward A. Mason** and **Homer W. Schamp, Jr.,** have been promoted from associate professor to professor.

UNCLASSIFIED

Ellsworth P. Killip, retired, has described 11 new species of the passion-flower family in a recent Smithsonian Institution publication. Dr. Killip, who has had a lifelong interest in the passion-flower, some years ago listed the 365 species then known in America. He discovered the new varieties during explorations in Colombia and Venezuela.

Samuel B. Detwiler, retired, spoke on "Trees, Forests, and Water" before the science class of Gunston Junior High School, Arlington, on September 14. This was the first lecture to be given in the current scholastic year under the visiting scientists and engineers program sponsored by the Joint Board on Science Education.

DEATHS

Frank C. Kracek died July 5 at the age of 69. He received his doctorate in physical chemistry from the University of Minnesota in 1924, and 33 years was a physical chemist associated with the Geophysical Laboratory of the Carnegie Institution; his principal researches at the Geophysical Laboratory were in the field of phase equilibrium studies of the alkali silicates, sodium sulfate, and the silver sulfides and tellurides. More recently, his research was in the field of mineral thermochemistry, in particular determining heats of formation of the feldspar minerals and alkali silicates. In 1956, upon retirement from the Geophysical Laboratory, he became associated with the Geological Survey, continuing his work on the thermochemistry of rock-forming minerals.

AFFILIATED SOCIETIES

Experience during the first several months of the current year indicates that the *Journal* will better serve the Academy members if it reports the activities of the affiliated societies in two separate ways. We shall, as occasion permits, gradually shift our format in this direction, and hope to have the change fully accomplished in time for the January, 1961, issue. One facet of this proposed arrangement will be a "Calendar of Events," to include only those programs which will be held after the scheduled (and, we hope, actual) appearance of the *Journal.* This calendar will be listed by date, rather than by organization, and will restrict itself essentially to title and a minimum of other essential data. A second feature of the projected reporting system will be devoted to the activities of the societies, special projects, executive committee actions, educational activities and any other newsworthy material. Up to now we have signally failed to get a representative amount of this kind of thing, yet we are

convinced that it would be interesting as well as valuable if we had it. Our decision to separate the calendar of events from the news items is largely prompted by the hope that more time will thus be freed for gathering the latter. Finally, we hope to publish, at least once each year, a complete listing of the affiliated societies, including the incumbent officers, the place and time of regular meetings, scheduled election dates, and so on.

For this and the December issue, the prevailing format will be retained in reporting the activities of the affiliated societies.

Acoustical Society of America, Washington D.C. Chapter

On 19 September, Mr. M. K. Bull, Department of Aeronautics and Astronautics, University of Southampton, spoke on boundary layer work, particularly as it concerns measurement of pressure fluctuations on the walls of wind tunnels and water tunnels.

The October 17 program featured R. K. Cook and J. M. Young, National Bureau of Standards, dealing with "Strange sounds in the atmosphere."

American Institute of Electrical Engineers, Washington Section

A panel meeting on "Planning the structure of the engineering profession for unity", providing an opportunity for participation by members of the section, and looking to a vote on certain alternative plans, was held on October 11. Ample evidence of the need for facing the problem of unified action is indicated by the fact that there are now well over one hundred different engineering organizations in the U. S.

American Society for Metals, Washington Chapter

On November 14, John A. Bennett, Chief Metallurgy Section, National Bureau of Standards, will speak on "What the metallurgist is doing about fatigue."

American Society of Civil Engineers, National Capital Section

At the September 13 meeting, Mr. Erskine Stewart, Acting Director, Better Highways Information Foundation, spoke on the role of his organization. The following month, October 11, Mr. O. A. Schmidt, who is World Bank director of operations for the Western hemisphere, described the program of the organization in general and discussed some specific projects in Latin America.

The section is arranging to hold joint meetings with various student chapters in the Washington area; the first, on October 5, was at the George Washington University.

Two prizes, one for associate members and one for student members, are to be awarded for papers on the place of professional ethics in the engineering curriculum, and on ethics in the legal, medical, and engineering professions, respectively. Candidate papers are to be given before sectional or student chapter meetings, and the best entered in a final competition for the Daniel W. Mead award.

American Society of Mechanical Engineers, Washington Section

September meetings included a discussion on September 8 of the "Utilization of outstanding rubbers and plastics" by G. W. Flanigan of the B. F. Goodrich Chemical Co., and on September 22 a talk by Dr. A. G. Norem, Institute of Defense Analyses, on "Engineering aspects of aerodynamic heating."

On October 13, R. E. Fischell and M. A. Schreiber, both of the Johns Hopkins Applied Physics Laboratory, described the design and use of the Transit satellite, supplementing their remarks with a sound color film. Two papers were presented on October 27: (1) Jeffrey Watkins, of the Solar Aircraft Company, on "Design and development of an advanced high performance gas turbine engine," the 1100 HP Saturn; and (2) J. J. Pippenger, Double A Products Company, Michigan, on "Fluid power controls," including comment on the modification of industrial equipment for ground support.

Botanical Society of Washington

At the first meeting of the current season, C. B. Davey and George Papavizas, of the Plant Industry Station, Beltsville, jointly summarized their research of the past three years on the "Biological control of soil pathogens," particularly as it relates to root rot fungi.

Chemical Society of Washington

Two concurrent sessions were held, following dinner, on October 13, at Catholic University: (1) P. J. Elving, University of Michigan, on "Mechanisms of organic electrode reactions," and (2) a panel discussion, moderated by Frederick Nachod, Sterling-Winthrop Research Institute, on "Improving the professional stature of chemists and chemical engineers."

In addition to the election of officers, the November 10 meeting included a talk by Stephen Brunauer, Portland Cement Association Laboratories, on the "Hydration of the calcium silicates."

Arthur Cope MIT, and president-elect of the ACS, is scheduled to address the society at its December 1 meeting in Hurst Hall, American University, on the subject "Unusual transannular reactions." There will be a dinner in Mary Graydon Hall preceding the program.

Columbia Historical Society

The society's first meeting of the season, October 18, featured presentation by Donald

Mugridge of a "Photographic record of Washington during the Civil War," and by Richard Mansfield on "Washington as Dick Mansfield knows it."

Recent gifts to the organization include: several hundred old lantern slides from the collection of the late Dr. Laurence Schmeckebier, covering more than fifty years; bound volumes of clippings from various sources; material on the history of the Marine Band, and a large collection of first edition Sousa marches; a gavel made from wood recovered in the 1927 repair of the White House roof; and several inauguration programs of historical interest and value.

Helminthological Society of Washington

An all-day program of scientific programs, culminating with a banquet, was held on October 8. at the University of Maryland in commemorating the fiftieth anniversary of the founding of the Society. Formal papers on perspectives in parasitology, on dietary factors affecting ovarial transmission of symbiotes, on physiology of intracellular parasites, and on goals for parasitologists, in the morning, were followed by afternoon informal discussions organized about six "interest groups." The banquet speaker was Dr. C. D. Leake, whose address was entitled "Paralouge and Parasite."

Insecticide Society of Washington

Four papers, all directed to the problem of the face fly in livestock, made up the October 19 meeting. The material was presented by scientists from the Entomology Research Division of the USDA and from the Department of Entomology of the University of Maryland.

Institute of Radio Engineers, Washington D.C. Section

Phil Allen, of the Naval Research Laboratory, who has been long concerned with satellite tracking techniques, spoke on October 10 of the "Monopulse system—a precision tracking radar." The emphasis was laid on new microwave techniques and components.

A series of lectures, at two-week intervals until December 6, is offered jointly by the Professional Groups on Microwave Theory and Technics and on Antennas and Propagation, on the general topic "Antenna theory and techniques." Selected lecturers will be featured, and the sessions held, beginning October 11, in the East Building of the National Bureau of Standards.

Medical Society of the District of Columbia

A considerable array of programs of interest to medical personnel in the Washington area were noted in the October issue of *Current Medical Events.* Among these were: October 6 symposium organized by the Committee on Public Information and Education for the doctors' office staff; a forum on "General problems in medical practice" held October 29 arranged by the Medical Council of the Washington Metropolitan Area; and a series of postgraduate lectures on the basic sciences, weekly from October 5 to November 15, in the auditorium of the Medical Society Building at 1718 M Street, N.W.

Philosophical Society of Washington

A special *Fifteen Hundreth* meeting of the society is scheduled for December 2!

ACADEMY ACTIVITIES

Board of Managers, June Meeting

These notes are intended to outline briefly, for the information of the membership, the principal actions taken at Board meetings. They are not the official Minutes as prepared by the Secretary. —Ed.

The Board of Managers held its 530th meeting on June 21 at NBS, with President Wood presiding. The Minutes of the 529th meeting were approved as previously circulated, with minor corrections.

Dr. Wood announced appointments to the 1960 Committee on Awards for Scientific Achievement, as follows: General chairman, Archie I. Mahan; panel chairmen, W. Gardner Lynn (biological sciences), Charles Herzfeld (engineering sciences), Francis E. Johnston (mathematical sciences), Norman Bekkedahl (physical sciences), and Ralph B. Kennard (teaching of science). Dr. Wood also indicated that the membership of the panels would be established by agreement between the general chairman and each panel chairman.

Chairman Hall of the Membership Committee presented, for first reading, the names of 14 candidates for membership.

In the absence of Chairman McPherson of the Policy and Planning Committee, Arnold M. Sookne stated that the Committee has met to consider means for improving relations between the Academy and its affiliated societies. The Committee plans to meet with society officers to check the amount of interest in the Academy, and in particular to determine the present number of society members who are also members of the Academy; also, it hopes to prepare some literature on the Academy's objectives and activities for the information of scientists of the metropolitan area. Further, it is examining the feasibility of issuing a joint directory of the Academy and affiliated societies, along the lines of the one that appeared in 1948. The Committee felt that the voting privileges of representatives of affiliated societies at WAS Board of Managers meetings should not be curtailed.

Dr. Hall presented for second reading the names of 11 candidates previously proposed for Academy membership, as follows: Morris K. Barrett, Morris Belkin, Robert W. Berliner, William R. Carroll, Margaret K. Derringer (Mrs. Morris K. Barrett), George W. Howard, George

B. Mider, David P. Rall, Joseph L. Stearn, Paul DeL. Thomas, and Charles G. Zubrod. These candidates were thereupon elected to membership.

The secretary reported the following figures on Academy membership: Resident active, 765; resident retired, 61; nonresident active, 184; nonresident retired, 60; total, 1070.

The treasurer reported that for the period January 1 to June 21, receipts were $13,526 and disbursements were $12,066.

Board of Managers, October Meeting

The Board of Managers held its 531st meeting on October 18 at NBS, with Secretary Specht presiding in the absence of the President and President-Elect.

The minutes of the 530th meeting were approved with minor corrections.

In the absence of Chairman Stiehler of the Meetings Committee Dr. Specht announced the next three meetings as follows:

October 20. Dr. S. L. Madorsky. Impressions of a recent trip to Russia.

November 17. Professor E. Bright Wilson, Jr. An introduction to scientific research. A joint meeting with the Junior Academy and the D. C. Chapter of Sigma Xi.

December 15. Dr. Harry Wexler. Weather satellites.

Commenting on these talks, A. T. McPherson pointed out that Dr. Madorsky, having been born in Russia, can speak the language and has taken advantage of his opportunity to talk to the people; that Professor Wilson has written a book on his subject; and that Dr. Wexler's satellites are completely revolutionizing the forecasting of weather.

In the absence of Chairman Hall of the Membership Committee, Howard H. Campaigne presented, for first reading, the names and citations of 21 candidates for membership.

For the Committee on Grant-in-Aid, Dr. Specht reported $916.22 available for grants.

Chairman McPherson of the Policy and Planning Committee reported that his committee is making a systematic attempt to obtain from the affiliated societies suggestions for strengthening the bonds between them and the Academy. He thanked Gerhard Brauer for a report on this subject from the Washington Section of the International Association for Dental Research.

For the Committee on Science Talent, Dr. Specht reported success of a summer program for providing scientific working experiences for selected high school students. The Academy contributed toward pin money for the students' lunch and car fare.

For the Joint Board and the Committee on Science Education, Dr. Specht passed around for inspection John K. Taylor's report of July 15 to the National Science Foundation on the activities of the Academy's 1959-60 science education program that had been supported by the Foundation.

Dr. Campaigne presented for second reading the names of 14 candidates proposed last June. They were elected and will be invited to accept membership in the Academy. Their names and affiliations are listed at the end of this report.

Dr. Specht reported the following figures on Academy membership: Resident active, 778; resident retired, 62; non-resident active, 177; non-resident retired, 63; honorary, 6; total, 1086.

Treasurer Aslakson reported that as of September 30 receipts were $11,599; disbursements, $12,302.

Chairman Shepard of the Special Committee on By Laws handed to Dr. McPherson a draft of a revision of the Standing Rules of the Academy for consideration by the latter's Committee on Policy and Planning. Dr. Shepard's committee was then discharged with the thanks of the Board.

Present by invitation of President Wood to report this meeting for the *Journal of the Washington Academy of Sciences*, Past President Campbell gave the Board an informal report of plans of the editorial group for the 1961 *Journal* and allocation of responsibility for its production.

Mrs. R. R. Fell, the Academy's staff officer, suggested that a member wishing to resign in good standing before the end of a calendar year be permitted to pay partial dues for his last year, covering the period from January 1 to the date of his resignation. No action could be taken immediately on this proposal.

The meeting adjourned at 9:15. Dr. Specht requested the Vice-Presidents representing the Affiliated Societies to remain for a special meeting to nominate officers of the Academy for 1961.

Elected to Academy Membership

John I. Bohnert, Naval Research Lab.
Rollon O. Bondelid, Naval Research Lab.
Bernard B. Brodie, Nat. Heart Institute
Harvey R. Chaplin, Jr., David Taylor Model Basin
Kenneth L. Dunning, Naval Research Lab.
Alan C. Kolb, Naval Research Lab.
Cornell H. Mayer, Naval Research Lab.
Edward F. McClain, Jr., Naval Research Lab.
Leonard M. Murphy, Coast and Geod. Survey
Bruce M. Pollock, Plant Industry Station
Milton S. Schechter, Agr. Res. Center
Allen H. Schooley, Naval Research Lab.
Robert F. Steiner, Naval Med. Res. Institute
Eligius A. Wolicki, Naval Research Lab.

THE BROWNSTONE TOWER

Frank L. Campbell

One would think that all readily understandable improvements in ordinary devices that make our lives easier would have been invented long ago and that all modern improvements might be confined to sophisticated applications of mathematical physics and chemistry, the kind of wizardry that old-timers who failed to keep up to date cannot now understand. Actually, inventors are as busy as they ever were and are turning out devices that are so effective and so simple that we exclaim, "Why didn't *I* think of it!"

The first Washington inventor we ever heard of was the late husband of our Aunt Mary. He had invented (nowadays we say "formulated") a potent mixture that our aunt firmly believed to be a panacea. Before the days of the Food and Drug Administration there was nothing to prevent Aunt Mary from proclaiming the virtues of "Johnson's Painkiller" without restraint and from making it in Washington and trying to sell it in Philadelphia. It was probably harmless, for she used it and lived to an overripe old age.

This early experience did not cause us to concoct a better panacea. We just didn't have the practical inventive urge, but we have always been interested in the achievements of those who are often called gadgeteers. Why this term should be not quite respectable, is a mystery to us. Is a happy turn of phrase more worthy than a better mouse trap? We think not. We believe that the imagination, knowledge, and skill required to build a better mouse trap are quite as rare and more valuable than the art of putting words together in a way that should cause a reader to pay attention. Indeed, we would glorify the mouse trap builder, and consign to perdition those advertisers who for a price imply that Sylvan Cigarettes are the breath of romance or that Belch Beer and beauty are synonymous.

As a boy our best friend was a gadgeteer, and we encouraged, applauded, and sometimes financed his creative adventures, which culminated in the building of an automotive vehicle. In between our catalytic activities in gadgeteering, we read Le Comte de Monte Cristo and other impractical creations of Alexandre Dumas, père.

We did not encounter inventive genius again until many years later here in Washington. Then we had the privilege of knowing Dr. Lyle D. Goodhue, a member of the staff of the Division of Insecticide Investigations of the old Bureau of Entomology, U. S. Department of Agriculture. It happened that we worked in the same building at the Agricultural Research Center in Beltsville. Lyle realized that the effectiveness of a liquid or solid insecticide depended not only on its chemical composition but on the size of particles brought into contact with the insect. A priori it seemed that the effect would be proportional to the degree of dispersion of the insecticide, the smaller the particles the greater the effect for a given weight of material. Therefore he became interested in the production of insecticidal smokes, or, as he called them, aerosols, a term then current in colloid chemistry. He made a systematic study of ways and means for producing such smokes, for example, by impinging a fine stream of insecticide on a hot plate, or by burning a flammable mixture containing a stable insecticide.

One day in 1935 it occurred to Lyle that it would be possible to produce a useful aerosol by dissolving an insecticide in an inert volatile liquid that could be sprayed out of a container by the pressure of its own vapor. He asked us to witness this idea in his notebook. This we did by initialing his description of it. Thus we were present at the birth of one of the most lucrative ideas that was ever gestated by a Washington scientist. It was later the subject of a Public Service Patent that was the beginning of a billion dollar industry, not only for the convenient dissemination of insecticides, but for the pushbutton application of a hundred other products including paint, perfume, and shaving lather.

In the beginning Lyle was not trying to create a general labor-saving device, but merely to produce satisfactory insecticide aerosols. Thus his work may be called basic to the tremendous practical devlopments that followed. He was successful because of his thorough grounding in physical and chemical principles, methods, and materials, his ability to do his own shop work, and his lively curiosity about current scientific developments. Looking back, one can identify the key that opened the door for Lyle; it was his knowledge of the physical and chemical characteristics of Freon, a fluorinated hydrocarbon then, and still, used as a refrigerant, that caused him to select it as a safe solvent and propellant for his insecticide. After that it was just a matter of working out mechanical details and of testing and promoting the resulting "aerosol bombs," which were used to protect our soldiers in World War II. The testing and promotion were well done by our former assistant. William N. Sullivan.

Did Lyle Goodhue become a millionaire? No, he did not even become prosperous as a result of his flash of genius, but he did benefit by it. He became Director of Research in Agricultural Chemicals for the Phillips Petroleum Company

in Bartlesville, Oklahoma, and has raised his family there in a very pleasant environment. Although seriously handicapped by defective vision throughout his life, Lyle has always been an unusually happy person with a penetrating sense of humor. His job now is to find agricultural uses for chemicals that Phillips can produce. So far he has not hit a jack pot remotely approaching the potential of the push-button propellant but he still has the pleasure of the search from which products now unimagined may arise. Currently he is investigating the action of certain chemicals on pest birds, having found one that will temporarily prevent birds from flying. It seems that birds so grounded become frustrated and when they are able to fly away they do not return to the scene of their discomfiture. We look forward to the destarlingization of Washington by this method.

When Lyle is not working for Phillips, he is usually to be found at home, working in the greenhouse that he built himself for the production of exotic house plants. He has made the interior of his greenhouse a thing of beauty and a source of some additional income. By any reasonable standards he is a very successful man.

We cannot close this little excursion into inventive genius without calling attention to an invention of our own, which we think reduces the daily business of shaving to the lowest common denominator. And Lyle Goodhue was responsible for it. We had been using one of his pressurized lather cans while on a trip that enabled us to visit him in Bartlesville. At the Tulsa Airport we opened our bag and found everything in the central compartment buried in lather. Something in the bag had pressed against the valve of the can and released all the lather in it! From that moment we resolved never to use Lyle's lather dispenser again. Then we quickly found by trial of various cakes of soap that some produce suds more readily and abundantly than others. Furthermore, we found that it is not necessary to use a brush or soap container for the purpose of whipping up and applying a lather; one simply washes his face and hands with the right kind of soap and then continues the motions of hand washing without rinsing until the foam, originally in large bubbles, has been reduced to a creamy persistent lather. Then by using one hand as a squeegee on the other the lather is collected into a large blob on the fingers of one hand, by which it is applied to the face as one would apply a blob from a pressure can. Thus materials for shaving are reduced to a razor and cake of soap, the hands and face are washed at the same time (not a necessary accompaniment of the use of an electric razor), and cost is minimized. As an inventor we now bow out.

JOINT BOARD

Gravatt Coleman, General Engineer with the C & P Telephone Co., is the new Executive Secretary, Science Projects, for the Joint Board on Science Education. He replaces Dr. William T. Read who was unable to continue due to other commitments. Mr. Coleman will be responsible for many details of the science project program of which Dr. John K. Taylor is Director.

A Virginian by birth and education, Mr. Coleman had two engineering degrees from Virginia Polytechnic Institute at the age of 21. He was a 1st Lieut., Machine Gun, in World War I. Grav has been with the TELCO Engineering Dept. since 1923 and retires in Feb. '61, when he will devote even more time to JBSE work. The TELCO should be given a vote of thanks for permitting him, in the meantime, to engage in this very excellent public relations job.

He has been active in the Washington Section of the AIEE, having held most of the local committee's chairmanships and elective positions, and a member of one of the National Committees for several years. He helped to establish the Student Branch of the AIEE at Maryland University.

The Washington Society of Engineers will remember him for the banquets he ran for them longer than they will remember his work as a Director of their organization. He has cooperated extensively on the annual Engineers, Scientists and Architects Day celebrations each February.

While with the TELCO, he has determined location for central offices, laid out underground conduit systems for a number of cities in Maryland, Virginia, West Virginia, as well as D. C., prepared cost studies and originated a system of record keeping which has been in use for over 20 years. More recently he has been responsible for engineering contracts with other associated companies and with the Long Lines Department of the A. T. & T. Co., joint ownership of plant used by more than one company, and the engineering decisions on Division of Revenues for toll usage.

Project Ideas for Young Scientists is the title of a new book just published by the Joint Board on Science Education. Some 400 suggestions are given for science projects that should be instructive and stimulate research and investigation by secondary school students.

The book is the outgrowth of several years of collection of ideas for science projects from a large number of leading scientists of the local area. Dr. John K. Taylor, Dr. Phoebe Knipling, and Dr. Falconer Smith edited these contributions and prepared supplemental material which is contained in the 144 page book. Mr. George E. Taylor, science teacher at Wakefield High School assisted in the collection of many of

the suggestions prior to his leaving the area for a year of sabbatical leave to do further graduate work. A copy of the book has been donated to the library of every secondary school of the Washington area.

The book contains a preliminary chapter on general considerations for preparing a science project. Ten chapters follow that deal with the several subject-matter categories of science fairs. All project ideas include references for further information. A chapter entitled Annotated Titles presents some 200 ideas in abstract form and a bibliography that should be especially helpful for background material.

A grant from the Eugene and Agnes E. Meyer Foundation has made it possible to donate the library copies mentioned above and also to permit the sale of the book at a price somewhat below cost. Teachers and students desiring copies may obtain them at $1.25 per copy, postpaid, by writing to the Joint Board on Science Education, 1530 P Street, N.W., Washington 5, D.C. Checks should be made payable to the Joint Board.

Teaching conferences planned for Fall and Winter. As part of the program made possible by a grant from the National Science Foundation, the Joint Board will hold a series of conferences concerned with the teaching of science and mathematics. Patterned after the highly successful series held last year, the conferences will take place during the fall and winter seasons.

As in the past, conferences on the teaching of the senior high school subjects of biology chemistry, mathematics, and physics are being scheduled. In addition, a series of meetings devoted to junior high school general science will be held.

A somewhat different procedure than last year will be followed. A single conference for the entire area will be held for each of the four senior high school subjects. Approximately 100 persons will be invited to attend the all-day sessions and will be the guests of the Joint Board to luncheon. A prominent speaker will address a joint session. after which attendees will be divided into discussion groups to consider problems concerned with subject matter teaching. As formerly, teachers, university instructors, and scientists will participate.

The junior high school conferences, four in number, will be held in as many areas of the local region. Approximately 100 persons from that particular area will be invited to a meeting similar to that described above. Attendees will be selected from junior high school teachers, and scientists.

The first conferences are scheduled for November. One in general science for the Virginia area will be held at St. Agnes Espiscopal school in Alexandria on November 5. Dr. John K. Taylor will serve as chairman of the conference. A conference for the entire area on the teaching of physics will be held at Catholic University on November 19, at which Dr. Raymond J. Seeger will preside.

It is regretted that attendance at these conferences is limited and must be confined to a small group of invitees. Extensive notes will be taken, however, and will be available on request to the office of the Joint Board.

Joint Board supports experimental courses. Is science more meaningful when taught quantitatively with the aid of lots of mathematics? Is arithmetic easier to understand when its application to the solution of laboratory experiments is stressed? The answers to these and many other questions are being sought in eleven experimental classes being conducted by several local school systems with financial assistance from the Joint Board.

The support of experimental teaching programs was a major objective of the Joint Board in its request in 1959 through the Washington Academy of Sciences to the National Science Foundation for a grant. The Foundation approved of the idea and $20,000 was allocated to nine schools to underwrite part of the costs of the experimental classes. Descriptions of the program were carried in the 1959-60 issues of THE REPORTER and are given in more detail in the Summary Report which is available from the Joint Board office.

The 1960-61 grant from the NSF to the Joint Board makes it possible to continue the program. Currently, grants totalling $22,000 have been allotted by the Joint Board for experimental classes in 10 schools. They are summarized as follows:

Beauvoir School will continue to develop a course of study and curriculum materials for a K-3rd grade science program.

Fairfax County will continue an experimental study of the coordination of science and mathematics instruction at the 5th Grade level.

D. C. Schools will continue its experimental classes at the 3rd grade and initiate a new one at the 6th grade level. Both are concerned with applying arithmetic to the study of science.

The excellent experimental classes in elementary education sponsored last year in Montgomery County and also with the Archdiocese of Washington are being continued.

In addition to these, Arlington County also developed an experimental course under Joint Board sponsorship during the 1959-60 school year. They did not request assistance during the current year. It is understood that the course is being continued with county support during the present year, however.

At the junior high school level, grants have been renewed to Arlington County, to the D.C. Schools and to Sidwell Friends School to con-

tinue their excellent experimental programs of last year. In addition, Prince Georges County and Georgetown Day School have been given grants to initiate experimental classes on the coordination of mathematics and science instruction at the junior high school level.

Another newcomer is Osbourn High School at Manassas, Virginia, which is the recipient of a grant to help develop a 12th grade course for accelerated students who have previously had biology, chemistry, and physics. The course will attempt to correlate the science and mathematics already covered into a meaningful fund of knowledge.

SCIENCE AND DEVELOPMENT

The tellurometer, an electronic distance-measuring instrument that eliminated the time-consuming taping method used in surveying, has now gone airborne. Currently being tested by the Army Engineer R&D Labs at Fort Belvoir, the airborne tellurometer is expected to provide a position determination or a distance measurement up to 150 miles with a high degree of accuracy; the range of the ground instrument is 40 miles. In addition, the airborne equipment will not be hampered by line-of-sight restrictions, such as curvature of the earth and mountains, which limit the operation of the ground instrument. It involves the application of ground tellurometer microwave phase comparison ranging techniques to aircraft use.

Geological Survey's "Geologic Map of the United States," first published in 1933, has been reprinted with important color changes that make it easier to read. The 1960 edition is issued in four 27-by-47-inch sheets and sells for $6.00 a set. The scale is 1:2,500,000. Long considered to be a masterpiece of lithographic art, when first issued the map was printed on old-style flat-bed presses from 92 lithographic stones quarried in Germany; each stone weighed 400 to 500 pounds, and lithographing 5,000 copies required 138 working days, or about six months. The 1960 run was printed on presses capable of handling 5,000 sheets an hour, printing two colors simultaneously; instead of the heavy stones, 48 aluminum lithographic press plates were used.

American University was honored on September 12 as the "birthplace of the Army Chemical Corps." A plaque was unveiled on McKinley Hall by Col. C. P. Wood of the First Gas Regiment and accepted by AU President Hurst R. Anderson; principal speaker at the ceremonies was Maj. Gen. Marshall Stubbs, the Army's chief chemical officer. Among those attending was 82-year-old Maj. Gen. Amos Fries, retired, chief of the Gas Service under General Pershing, and first chief chemical officer from 1921 to 1924. The plaque recounts AU's 1917 offer of its campus and buildings for war work, and its occupation by the Bureau of Mines for use as chemical warfare laboratories and proving grounds. In August 1917 the 30th Engineers, later known as the First Gas Regiment, was organized at the University; units of this regiment marched from the campus on Christmas Day, 1917, and sailed for France the next day. In June, 1918, the Chemical Warfare Organization of the Bureau of Mines was transferred to the War Department as a step toward the creation of the Chemical Warfare Service, now the Army Chemical Corps.

In its recent report, "Meteorology on the Move," the NAS-NRC Committee on Atmospheric Sciences notes with satisfaction a number of recent undertakings by government and academic institutions in response to previous Committee recommendations—including a first step toward a National Center for Atmospheric Research—but points out that still further steps are urgently required. Chief among the latter are the rapid development by the National Center of an extensive research and analysis program and the strengthening of the research program of the Weather Bureau. To point up the need for urgency, the report underscores the striking success of the weather satellite TIROS I, man's first instrument for the continuing observation of large-scale weather phenomena. "Analysis of such world-wide meteorological information obtained at regular, short intervals," the report states, "may be expected to increase greatly our understanding of the basic principles of meteorology as well as the precision of forecasting. One may expect that this increased understanding will some day provide the answer to the question whether small- or large-scale weather control is possible."

The first phase of an improved global weather communications network for the regular exchange of weather information on a coordinated basis began operation on October 1, according to Weather Bureau announcement; this involves the activation of weather communication centers at New York, Frankfurt/Offenbach, Moscow, and New Delhi, which will exchange northern hemisphere weather data collected from observation stations within their designated areas of responsibility. A second phase, activation of a Tokyo center in the spring of 1961, will provide for completely coordinated exchange of information for the whole northern hemisphere. A third phase of the program will involve establishment of a similar network in the southern hemisphere, connected with the northern hemisphere network to permit a world-wide exchange. Eventually the network, sponsored by UN's World Meteorological Organization, will consist of an unbroken chain of point-to-point radio teletypewriter and land-line teletypewriter circuits involving the 102 member states and territories represented in WMO.

Vice-Presidents of the Washington Academy of Sciences Representing the Affiliated Societies

Acoustical Society of America	Richard Cook
Institute of the Aeronautical Sciences	*Not Named.*
Anthropological Society of Washington	Regina Flannery
Society of American Bacteriologists	Mary Louise Robbins
Biological Society of Washington	Herbert Friedman
Society for Experimental Biology and Medicine	Kathryn Knowlton
Botanical Society of Washington	Herbert C. Hanson
Chemical Society of Washington	William J. Bailey
American Society of Civil Engineers	*Not Named.*
International Assn. for Dental Research	Gerhard Brauer
American Inst. of Electrical Engineers	Robert D. Elbourn
Washington Society of Engineers	Howard S. Rappleye
Entomological Society of Washington	Harold H. Shepard
Society of American Foresters	*Not Named.*
National Geographic Society	Alexander Wetmore
Geological Society of Washington	Carle Dane
Helminthological Society of Washington	Carlton M. Herman
Columbia Historical Society	U. S. Grant, III
Insecticide Society of Washington	Joseph Yuill
Amer. Society of Mechanical Engineers	William G. Allen
Medical Society of the Dist. of Columbia	Fred O. Coe
American Society for Metals	John A. Bennett
American Meteorological Society	Morris Tepper
Institute of Radio Engineers	Robert Huntoon
American Nuclear Society, Washington Section	Urner Liddel
Philosophical Society of Washington	Louis R. Maxwell
Society of American Military Engineers	*Not Named.*

Chairmen of Committees

Standing Committees

Executive	Lawrence A. Wood, *Nat. Bureau of Standards*
Meetings	Robert D. Stiehler, *Nat. Bureau of Standards*
Membership	Wayne C. Hall, *Naval Research Laboratory*
Monographs	Dean B. Cowie, *Dept. of Terrestrial Magnetism*
Awards for Scientific Achievement	Archie I. Mahan, *Applied Physics Laboratory*
Grants-in-Aid for Research	B. D. van Evera, *George Washington University*
Policy and Planning	A. T. McPherson, *Nat. Bureau of Standards*
Encouragement of Science Talent	Leo Schubert, *American University*
Science Education	Raymond J. Seeger, *Nat. Science Foundation*

Special Committees

By Laws	Harold H. Shepard, *Dept. of Agriculture*
Library of Congress	John A. O'Keefe, *Nat. Aeronautics & Space Admin.*
Repres. on AAAS Council	Howard A. Meyerhoff, *Scientific Manpower Commission*

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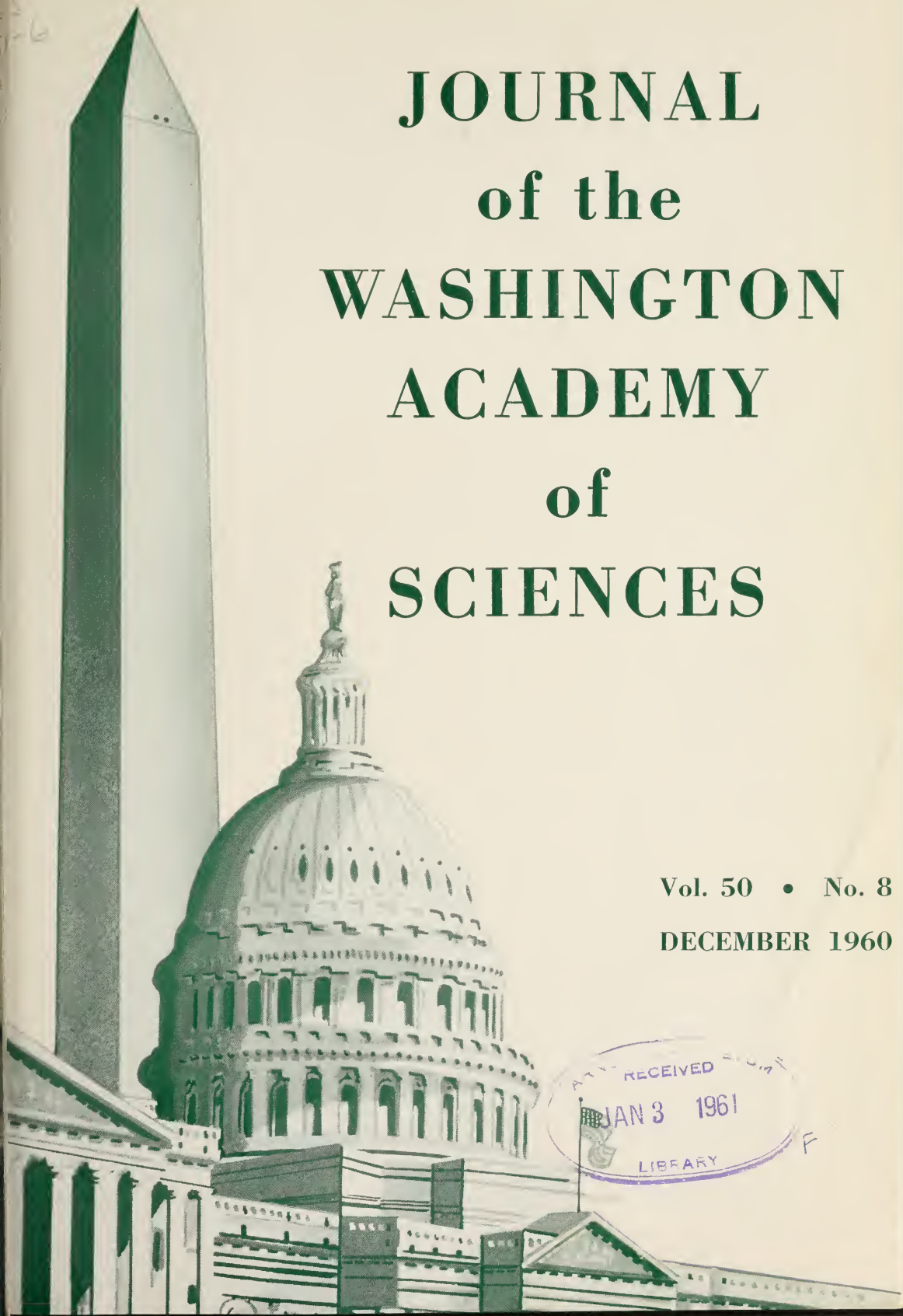

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DECEMBER 1960

JOURNAL OF THE WASHINGTON ACADEMY OF SCIENCES

Editor: Chester H. Page, National Bureau of Standards

Managing Editor: Ileen E. Stewart, National Science Foundation

This Journal, the official organ of the Washington Academy of Sciences, publishes: (1) historical articles, critical reviews, and scholarly scientific articles, (2) original research, if the paper, including illustrations, does not exceed 1500 words or the equivalent space, (3) notices of meetings and proceedings of meetings of the Academy and its affiliated societies, and (4) regional news items, including personal news, of interest to the entire membership. The Journal appears eight times a year in January to May and October to December.

Manuscripts and original research papers should be sent to the Editor. They should be typewritten, double-spaced, on good paper; footnotes and captions should be numbered and submitted on a separate sheet. The Editor does not assume responsibility for the ideas expressed by any author.

Contributions to the regular columns should be sent to the appropriate Associate Editor whose name appears at the beginning of each column, or to one of the Contributors, listed above. The deadline for news items is approximately three weeks in advance of publication date. News items should be signed by the sender.

Proof of manuscripts will generally be sent to an author if he resides in the Washington area and time allows. Otherwise the Editor will assume responsibility for seeing that copy is followed.

Subscription rate	$7.50 per yr. (U.S.)
Single issues	$1.00 per copy.

Subscription Orders or requests for back numbers or volumes of the Journal, or copies of the Proceedings, should be sent to the Washington Academy of Sciences, 1530 P St., N.W., Washington, D.C. Remittances should be made payable to "Washington Academy of Sciences".

Claims for missing numbers will not be allowed if received more than 60 days after date of mailing plus time normally required for postal delivery and claim. No claims will be allowed because of failure to notify the Circulation Manager of a change of address.

Changes of address should be sent promptly to the Academy Office, 1530 P St., N.W., Washington, D. C. Such notification should include both old and new addresses and postal zone number, if any.

Advertising rates may be obtained from the Managing Editor, Ileen E. Stewart, Office of Science Information Service, National Science Foundation, Washington 25, D. C.

Reprint prices may also be obtained from the Managing Editor.

Prices of back numbers and volumes, of Monograph No. 1, "The Parasitic Cuckoos of Africa" by Herbert Friedmann, Index to Vols. 1-40, and Proceedings may be obtained by writing to the Academy Office.

Entered as second class matter at the Post Office, Washington, D. C. Printing by McArdle Printing Co., Washington, D. C.

Science in Washington

SCIENTISTS IN THE NEWS

This column will present brief items concerning the activities of members of the Academy. Such items may include notices of talks given, important conferences or visits, promotions, awards, election to membership or office in scientific and technical societies, appointment to technical committees, civic activities, and marriages, births, and other family news. Formal contributors are being assigned for the systematic collection of news at institutions employing considerable numbers of Academy members (see list on masthead). However, for the bulk of the membership, we must rely on individuals to send us news concerning themselves, and their friends. Contributions may be addressed to ***Harold T. Cook, Associate Editor, U. S. Department of Agriculture, Agricultural Marketing Service, Room 3917 South Building, Washington 25, D. C.***

GEOLOGICAL SURVEY

Dean S. Carder, chief seismologist, attended the second conference of Joint Working Group No. 16 (CJOWOG-16), London and Aldermaston, England, September 19-23, 1960, and consulted geophysicists in Cambridge. The CJOWOG-16 consists of English and American geophysicists. Its function is the detection of clandestine nuclear explosions. Dr. Carder presented illustrations showing traces of seismograms from underground nuclear explosions and from comparable earthquakes.

Raymond L. Nace attended the Annual Information Meeting of the Health Physics Division, Oak Ridge National Laboratory, October 27 and 28.

Clarence S. Ross attended the Ninth Annual Conference on Clays and Clay Minerals, Purdue University, Lafayette, Indiana, October 5-8. He reported on the discussion on clay mineral nomenclature of C.I.P.E.A. in Copenhagen, Denmark, in August.

GEORGE WASHINGTON UNIVERSITY

Harold G. Mandel, professor of Pharmacology, has been named Executive Officer of that department in the School of Medicine. He succeeds the late **Paul K. Smith.**

Benjamin D. Van Evera, with Mrs. Van Evera, has returned from a nine-week holiday trip in Europe this past summer. Dr. Van Evera attended the American Council on Education meetings in Chicago, October 6-7.

HOWARD UNIVERSITY

Kelso B. Morris has taken a second year's leave of absence to serve as visiting professor of chemistry at the Air Force Institute of Technology, Wright-Patterson Air Force Base.

Lloyd N. Ferguson served as visiting professor of chemistry at the University of Oregon, Summer, 1960.

NATIONAL BUREAU OF STANDARDS

Allen V. Astin, NBS Director, was awarded a lifetime Honorary Membership by the Instrument Society of America. This is the highest honor of the Society and Dr. Astin is the eighth man to receive this distinction since the society was founded in 1946.

Harry A. Bright (Ret.) received the Anachem Award of the Association of Analytical Chemists at Detroit, Michigan, on October 25, 1960. The award is presented annually for outstanding achievement in analytical chemistry. Following the presentation Mr. Bright spoke on "NBS Standards—Past Forty Years in Retrospect."

USDA, BELTSVILLE

Lawrence Zeleny recently returned from an extended foreign trip which included a month in the USSR as a member of a U. S. Scientific Exchange team studying grain handling, storage, and processing in the Soviet Union.

James H. Turner received the Brayton Howard Ransom Memorial Award for "meritorious service to Parasitology and related Sciences" at the 50th Anniversary meeting of the Helminthological Society of Washington, October 8, 1960. This marks the first time the award has been presented.

Edna M. Buhrer received "The Anniversary Award of the Helminthological Society of Washington" at the 50th Anniversary meeting of the Society October 8, 1960. The award is "in recognition of distinguished contributions and service toward achievement of the Society's aims and objectives." The "Anniversary Award" was established at this time, and is to be granted in the future, on anniversary dates, but not necessarily every year.

Ross W. Davidson reports that Dr. Kiyowo Aoshima, Government Forest Experiment Station, Tokyo, Japan, is in this country on a fellowship award and will be studying for six months at the Forest Disease Laboratory, Plant Industry Station.

Ross W. Davidson attended the annual New York State fall Mycological Foray at Paul Smiths, New York, October 9 and 10.

E. E. Wehr presented papers on "Further observations on the life history and development of *Ascaridia columbae* (Gmelin, 1790) Travassos, 1913, in the pigeon" and "Occurrence of *Capillaria obsignata* Madsen, 1945, in the peafowl and its transmission to chickens" at the 34th Annual Meeting, American Society of Parasitologists, University Park, Pa. Dr. Wehr also attended the 11th World Poultry Congress in Mexico City, Mexico, and presented a paper on "Glimpses into poultry parasite problem in the United States."

USDA, WASHINGTON

Joseph R. Spies presented a paper, "Allergenic proteins from oilseeds," at the Eastern Experiment Station Collaborators' Conference on Proteins, U. S. Department of Agriculture, Eastern Utilization Research and Development Division, Philadelphia, Pa., October 26, 1960.

Benjamin Schwartz attended the First International Conference on Trichinosis in Warsaw, Poland, September 12 and 13, as a consultant in parasitology to Federal meat inspection. The conference designated Dr. Schwartz, who read a paper on "Trichinosis in the United States," chairman of an international committee charged with the responsibility of organizing a second international conference on Trichinosis to be held in 1962, encouraging research on this parasitic disease of animals and man, making a study of the prevalence and host relationship of trichinae throughout the world, and stimulating efforts leading to the ultimate eradication of these nematodes. Other members of the committee are one representative each from France, West Germany, USSR, and the United States.

NATIONAL SCIENCE FOUNDATION

Raymond J. Seeger, deputy assistant director for Mathematics, Physical and Engineering Sciences, gave the 1960 James Mapes Dodge Lecture for Young People at the Franklin Institute in Philadelphia on Nov. 1 and 2. His lecture was entitled "Faster than sound."

DEATHS

Paul K. Smith, Professor of Pharmacology, George Washington University since 1946, died on October 6 at the age of 52.

AFFILIATED SOCIETIES

Acoustical Society of America, Washington D.C. Chapter

The November meeting, on Monday the 14th, featured a presentation by Dr. Cyril Harris, Columbia University, on "Some impressions of acoustics in Japan."

American Institute of Electrical Engineers, Washington Section

Dr. William B. Kouwenhoven, for many years a member of the faculty of the Johns Hopkins University, spoke on November 9 on the topic, "The effect of electric current on humans," dealing, among other things, with techniques for restoring normal heart function after electric shock.

The monthly bulletin reports local efforts to raise funds toward the twenty story Engineering Center now being erected in New York city to house the major engineering societies.

The Section is moving ahead on its program to organize technical groups within five basic divisions (communications; instrumentation and telemetry; transportation, industry and management; power; and science and electronics). The Instrumentation and Telemetry division held its first meeting on the 15th, featuring a talk by W. A. Geyger on magnetic amplifiers in instrumentation.

The Student Guidance Committee places most of its emphasis on cooperating through the Joint Board on Science Education to establish closer liaison between professional men and interested high school students. They point out, further, the desirability of offering summer employment to students and teachers.

American Society for Metals, Washington Chapter

Dr. Robert C. McMaster, Professor of Welding Engineering, spoke on December 12 on the subject of "Nondestructive testing." The program for January 9 will feature Fred D. Rosi, RCA, in a presentation on "Materials for auxiliary power energy conversion." It should be noted that the latter event, and subsequent meetings, will be held at the AAUW Headquarters, 2401 Virginia Avenue, N.W.

American Society of Civil Engineers, National Capital Section

On November 8 William N. Dripps, Dept. of Licenses and Inspections, gave a talk on "Building construction and inspection in the District Columbia."

December 29 is the date set for the annual Christmas party.

The Associate Member Forum is sponsoring a basic course in the use of electronic computers open to any member of the National Capital Section. It is scheduled to start in early December and to continue for about 12 weekly sessions, at a cost of $5.00 per registrant.

American Society of Mechanical Engineers, Washington Section

Wade S. Plummer, on November 10, discussed the modernization program in the Post Office Department, particularly the extensive introduction of mechanized and automated equipment, and showed a film entitled "Machines to move tomorrow's mail."

The schedule for December and January as presently arranged calls for a December 8 meeting on creative design (Mr. Jacob Rabinow), one on hydrofoils for January 12, and on aviation reliability, January 26 (John Coutinho).

Anthropological Society of Washington

The 1960-61 program will focus on anthropology and human behavior, with the twofold purpose of calling attention to current inquiry in psychology and related disciplines and of examining theory underlying two possible approaches to the study of culture. The series was introduced on October 18 by Dr. Thomas Gladwin, NIH. On November 15, Dr. Dell H. Hymes, University of California (Berkeley) dealt with "Speech and personality," and on December 20 Dr. Ulric Neisser, Brandeis University, discussed "Cognitive and cultural discontinuities."

Botanical Society of Washington

The annual business meeting and election of officers took place on December 6, at which time the retiring President, Dr. H. T. Cook, spoke on "Plant disease control without chemicals."

Chemical Society of Washington

The outgoing president of the Society, Dr. A. L. Alexander, speaks on January 12 concerning "Recent research on functional organic coatings."

At the October 18 meeting of the Board of Managers, it was reported by John Leonard of the Education Committee that lunch money and carfare was provided for 15 youngsters working in area laboratories during the summer.

The Society now numbers just under 2500 members, as judged by a newly assembled directory, which makes it the 8th largest of the local sections of the American Chemical Society. The *Capital Chemist* now has a circulation of 2725. The Public Relations Committee has not been successful in interesting local television stations directly in the affairs of the Society, but has received requests for assistance and advice in choosing programs.

Geological Society of Washington

At the first meeting of the fall season, K. J. Murata, USGS, presented color slides and motion pictures to document a description of the 1959-60 eruption of Kilauea. H. B. Stewart, Jr., of CGS, then described the formation and movement of submarine sand ridges off the New England coast in which he showed that Georges Shoal, 120 miles east of Cape Code, is topped by a swarm of elongate ridges rising to within two fathoms of the surface. Evidence suggests that these ridges have migrated westward for distances up to 900 feet since the 1931 survey. Despite almost constant transport of sediment there is no net movement resulting from tidal currents; the answer seems to lie in bottom oscillations induced by the predominantly westward-moving surface waves. This can be shown in motion pictures.

Insecticide Society of Washington

Two papers were given on November 16 at the regular meeting: Morris Alpert, Bureau of Ships, spoke on "Military requirements for military pesticides and how they are met"; Dr. Clyde S. Barnhart, U. S. Army, dealt with "New developments in pesticide dispersal equipment for military use."

International Association for Dental Research, Washington Section

Dr. Samuel Natelson, biochemist, Roosevelt Hospital, discussed the application of x-ray spectroscopy to analysis of elements in biological systems on November 7, specifically as the technique relates to phosphorus, sulfur, calcium, potassium, iodine, strontium and iron, in microgram quantities or less. A second paper, on studies related to carbohydrate metabolism in calcified tissues, was presented by Dr. Robert Van Reen, presently supervisory chemist at the Naval Medical Research Institute. Dr. Van Reen handled certain biochemical studies related to citric acid metabolism in these tissues which are of special interest in that they can accumulate up to 5% of the dry, fat-free weight of the citric acid.

Medical Society of the District of Columbia

Not fewer than 25 meetings of interest to medical scientists are noted in the period November 1 to December 2, as many as five in a single day. While many are highly specialized or technical, only three are designated as closed meetings, and a number range into related areas of the biological sciences.

Philosophical Society of Washington

On Friday, November 18, Dr. Alexander Rich, MIT, spoke on "The structure of biological macromolecules."

The 1500 meeting of the Society, open to the public, was held December 2, in the Natural History Museum Auditorium, and featured an address by E. U. Condon, of Washington University. A dinner at the Raleigh Hotel preceded the affair. Under the circumstances, it seems entirely appropriate to reproduce the following summary of the organization, as it appears in the program announcement; prepared by F. N. Frenkiel:

"The Philosophical Society of Washington was founded on March 13, 1871, and was incorporated on May 20, 1901, in the District of Columbia. The aims for which the Society was incorporated are "the promotion of science, the advancement of learning and the free exchange of views among its members on scientific subjects."

Since March 26, 1887, the date of the 300th meeting of the Society, the meeting place has been the Assembly Hall of the Cosmos Club, except on special occasions. Prior to the organization of the Cosmos Club in 1878 and for some nine years thereafter, meetings were held in the library of the Surgeon General's Office, Old Ford's Theater, where Lincoln was assassinated.

Meetings are now held usually on alternate Friday evenings from October to May in the John Wesley Powell Auditorium of the Cosmos Club (Entrance: 2170 Florida Avenue, N.W.). Following the scheduled programme for the evening, opportunity is given for the presentation of informal communications. Refreshments are served following adjournment of meetings.

In 1931 the Society inaugurated the Joseph Henry Lectures sponsored annually (except in 1943) by the Society in honor of its first president. In 1952 the Society inaugurated the Annual Christmas Lectures which are arranged primarily for high school and advanced junior high school students and which have been held, since 1954, in the Lisner Auditorium of the George Washington University.

On June 6, 1874, the Society adopted the rule that in the official records of the Society no title except "Mr." shall be used. This rule was amended on May 26, 1945, to include "Mrs." and "Miss." As the oldest scientific society of the Washington area, the Philosophical Society maintains many of its traditions. In April 15, 1899, the Society celebrated its 500th meeting. The 1000th meeting was celebrated on January 18, 1930. The 1500th meeting will be held on December 2, 1960.

With the exception of business transacted at the Annual Meeting in December, the Society is managed by the General Committee composed of the elected officers of the Society, four elected members-at-large, the latest two living ex-Presidents of the Society and members of the Committee on Communications. Regular meetings of the General Committee are held before each regular meeting of the Society.

Membership in the Society is open to all persons who are interested in the aims for which the Society was incorporated. A nomination for membership must be signed by three members of the Society, and accompanied by a statement of the qualifications of the candidate. The annual dues of active members were five dollars during the first thirty years of the existence of the Society. For about sixty years the dues have been reduced to three dollars. The General Committee has recommended that the dues of the Society be reinstated to five dollars in 1961. There is no entrance fee. Members of the Society are entitled to subscribe at a reduced rate to the journals published by the American Institute of Physics with which the Society is affiliated. Annual subscription to Physics Today can be obtained through the Society at a special rate of two dollars.

This year's Annual Christmas Lectures are set for December 22 and 23, on the general topic "Genes as living molecules," by G. W. Beadle of the California Institute of Technology.

The December 16th meeting was the Ninetieth Annual Meeting.

Society of American Bacteriologists, Washington Branch

The annual dinner meeting was held on November 28 at the Officer's Club of the Walter Reed Army Medical Center. Dr. Charles R. Phillips, Fort Detrick, chose the topic "The Moon, Mars, and Microorganisms." In addition to election of officers, Life Membership Certificates were awarded to William R. North, Jr., H. H. McKinney, and Katherine Alvord.

This is perhaps the place to note that the parent organization, now the Society of American Bacteriologists will very shortly become the American Society for Microbiology; presumably the local section will follow suit in due time.

Society of American Military Engineers, Washington Post

The November 21st meeting, at the Officers' Club, Naval Weapons Plant, was addressed by Dr. A. C. Mason, USGS, on "The first photogeologic study of the moon." All meetings for the current year have been in line with the "Space Exploration" theme.

ACADEMY ACTIVITIES

Board of Managers, November Meeting

The following notes are for the timely information of the membership; they are not the official minutes of the meeting. Ed.

The Board of Managers held its 532 meeting on November 15 at NBS, with President Wood presiding.

The minutes of the 531st meeting were approved.

Reporting a meeting of the Executive Committee, Dr. Wood announced that the Committee recommended the election of Samuel B. Detwiler, Jr., as Editor of the *Journal of the Washington Academy of Sciences* for 1961. He said that Chester H. Page would retire as Editor and

that Ileen E. Stewart would continue temporarily as Managing Editor. The Committee recommended the election of Frank L. Campbell, Harold T. Cook, Russell B. Stevens, and John K. Taylor as Associate Editors. He announced that Robert C. Miller of the California Academy of Sciences will talk to the Board of Managers at its February meeting. He reported that the Washington Board of Trade has been setting up a Science Bureau. This development has been discussed by the Joint Board, and Ralph Cole of Melpar will report on it to the Board of Managers at its next meeting.

Chairman Stiehler of the Meetings Committee reminded the Board of the meeting of November 17 at which E. Bright Wilson, Jr. will speak on "An Introduction to Scientific Research." This will be a joint meeting with the Junior Academy and the D. C. Chapter of Sigma Xi. He announced that Dr. Harry Wexler of the Weather Bureau will speak on recent developments in meteorology.

Chairman Hall of the Membership Committee presented for first reading the names of two candidates for membership.

There was no report from the Committee on Awards for Scientific Achievement. A. T. McPherson again recommended that the Board consider the establishment of an award in the field of earth sciences. President Wood referred this recommendation to the Committee on Policy and Planning for study and recommendation.

Secretary Specht read a letter from Chairman Van Evera of the Committee on Grants-in-Aid for research recommending that a grant of $55.00 be made to Michael Finnegan of the Fairfax High School. A letter of recommendation from the instructor, Mr. Tishler, was read. The application was approved by the Board.

Chairman A. T. McPherson of the Committee on Policy and Planning moved the adoption of the revised Standing Rules of the Academy as presented last month by Chairman Shepard of the Special Committee on Bylaws. Some discussion preceded the adoption of the standing rules by the Board.

Dr. McPherson, concerned about improving relations between the Academy and its affiliated societies, recommended that a dinner be arranged for the Presidents of the affiliated societies to discuss: (1) the production of a directory covering the members of the Academy and the affiliated societies, (2) the possibility of obtaining headquarters for the Academy large enough to be used also by some of the affiliated societies and (3) cooperation between the Academy and the affiliated societies in promoting scientific activities in this area.

In the discussion that followed it was pointed out that it would probably be impossible to assemble all the Presidents of the affiliated societies at one time. The Board agreed that this was really not necessary but that every society should be represented by a responsible officer who of course might be the delegate of the Society to the Academy. It was moved that the Academy pay the bill for this dinner. The Board voted to do so.

Elected to Academy Membership

Meyer R. Achter, Naval Research Laboratory
Frank H. Attix, Naval Research Laboratory
Louis A. Beach, Naval Research Laboratory
Peter L. Bender, National Bureau of Standards
George E. Clark, Jr., Johns Hopkins University
John R. Clement, Jr., Naval Research Laboratory
Walter D. Compton, Naval Research Laboratory
James W. Davisson, Naval Research Laboratory
Paul H. Egli, Naval Research Laboratory
Howard W. Etzel, Naval Research Laboratory
Robert J. Ginther, Naval Research Laboratory
John Mandel, National Bureau of Standards
Matthew F. M. Osborne, Naval Research Laboratory
William C. Overton, Jr., Naval Research Laboratory
William S. Pellini, Naval Research Laboratory
Edward I. Salkovitz, Office of Naval Research
Sidney T. Smith, Naval Research Laboratory
Helmut Sommer, Diamond Ordnance Fuze Laboratories
Harald W. Straub, Diamond Ordinance Fuze Laboratories
Carl I. Vigness, Naval Research Laboratory
Peter Waterman, Naval Research Laboratory

Inadvertently Dr. Shubert's opinions were reported as Dr. Watson Davis' in the report of the May meeting of the Board of Managers (page 12, column 2, paragraph 2.) The meeting reporter apologizes for this error.

THE BROWNSTONE TOWER

Frank L. Capbell

Reflecting on the meaning of the word "editor", we turned to our favorite book, the English dictionary, and found as we expected, that "editor" is given more than one definition. We could wrap them all into one by defining an editor as a middleman between writers and printers. In various ways editors determine what is printed, their actions ranging all the way from application of rules of punctuations to the determination of the objectives and character of a publication.

Among those who are responsible for the pub-

lication of a scientific periodical the unmodified title "editor" should be reserved for the person who heads the whole operation, who is responsible for the organization and performance of the staff, for control of expenditures and acquisition of income, and for format and content of the periodical—all within lines laid down by representatives of those for whom the periodical is published. In brief, the "editor" should be the boss.

All scientific periodicals, whether restricted to the publication of the results of research (primary scientific publication) or open to other kinds of material of interest to scientists, can benefit by active solicitation of manuscripts by the editor and his assistants. Where demand for space is sufficient the editor of a primary scientific publication can get by without solicitation of manuscripts. He need only select, with the help of advisers, the manuscripts he thinks should be published. However, the more general the periodical the greater the desirability of soliciting the material to be published. For some journals solicitation may be a necessity for survival and growth.

The editors of the old *Journal of the Washington Academy of Sciences* were usually passive, accepting whatever manuscripts they received that seemed to be scientifically respectable. One will never know whether earlier active solicitation of manuscripts would have established and preserved an interdisciplinary research character for the *Journal*, which was probably wanted by most of the members of the Academy. Certainly, with little or no solicitation of manuscripts the *Journal* became irreparably unbalanced in the direction of descriptive science, which the majority did not want.

The transition from a passive to an active editor of the *Journal* has been taking place during the past year, after the *Journal* was changed suddenly from an archival repository of taxonomic research to the Academy's house organ. In 1961 the *Journal* will have an active editor, Samuel B. Detwiler Jr., a chemist who is a Special Assistant to the Administrator of the Agricultural Research Service, USDA. Sam is noted in the Agricultural Research Service for his capability as an organizer of complex programs of agricultural research, particularly chemical research on the utilization of farm prducts. He is noted outside of ARS as the Editor of *The Capital Chemist*, the publication of the Chemical Society of Washington that pays for itself through receipts from advertising. We predict he will become noted as the editor of the *Journal of the Washington Academy of Sciences* who caused the members to look forward to its appearance and to read it.

Some members of the Academy have queried, "Why take the time and go to the expense of publishing a *Journal* for which there is no clear demand?" Our answer is that we should not quit when demand is weak but should strive to create demand in the belief that a good *Journal* will help to make the Academy strong and useful. Sam can do it because he will set an example of hard work that his staff will emulate and that will gradually permeate the Academy.

Sam will become Editor in January 1961 under difficult circumstances, for he will be traveling in India and Southeast Asia on official business for several weeks before he takes over. Therefore in October 1960 he was setting up schedules and deadlines and allocating responsibility among the members of his staff for the contents of next year's issues. He does not want any predictions or promises to be made about these contents; he wants next year's issues to speak for themselves, hoping that the members of the Academy will recognize that they are becoming more timely and hence more useful. We can say, at least, "Don't judge the 1961 Journal by 1960 issues—we can do better."

JOINT BOARD

The Joint Board is engaged in its annual financial campaign to raise funds for its budget for the 1960-61 school year. A total of $7,500 must be obtained to carry on its program of science education.

Two major activities account for more than half of the Budget. One of these is the cost of publication of *The Reporter*. This 8-page newsletter is published monthly from October to June and is sent free to each teacher of science and mathematics in every secondary school of the Greater Washington Area. Also, school contact persons, education committee chairmen of technical societies, and others interested in science education are included in the circulation of some 2200.

The second major activity is cooperating with local school systems in underwriting expenses incurred in their operation of the five area science fairs. Printing costs for publicity materials (posters, etc.), entry blanks, record forms, and similar items are paid for by the Joint Board. In addition, the Board pays entry fees and travel expenses of contestants from three of the areas to the National Science Fair. (Expenses of this nature for the Northern Virginia fairs are provided for by the Alexandria-Arlington-Fairfax Realty Board.)

Other budgetary items include the operation of the School Contacts Program, popular lectures for school children known as the "Frontiers of Science Lectures", as well as the normal expenses concerned with operation of the Board.

There has been some confusion about the projects financed under a grant from the National Science Foundation. These funds are specifically granted for three projects: The Visiting Scientists and Engineers Program of lectures for school classes and science clubs; cooperative experimental educational programs; and a series of

conferences for teachers and the scientific community. It also provides for the maintenance of the office required to administer the program. No part of the $35,000 grant may be used for the general program of the Joint Board. It is separate and financed from locally raised funds.

The Board's Finance Committee, under the chairmanship of Dr. Russell W. Mebs, is engaged in raising the Budget for this year. Local scientific and engineering societies and private industrial, research, and business organizations are requested to contribute. Many societies provide funds for the Joint Board in their budgets. Others solicit contributions from their members at a meeting of their society. The Joint Board, however, has adopted a policy of *not* soliciting individual contributions.

Individuals may assist in several ways to further the program of the Joint Board. One of these is to see that the technical societies with which they are affiliated provide funds in their budgets for the Joint Board's program, which is being carried on in their behalf. The other is to volunteer for participation as individuals in various phases of the program. One of the most urgent needs at the present is for science fair judges. Lists are currently being prepared for use of the schools beginning in late February. Further information may be obtained from the office of the Joint Board on Science Education, 1530 P Street, N.W., Washington 5, D.C., Telephone NO. 7-3661.

SCIENCE AND DEVELOPMENT

A Pacific Science Information Center has been established at the Bishop Museum in Honolulu, Hawaii. It was established by the Pacific Science Association with the help of a grant from the National Science Foundation. Information will be gathered and made available on current activities in special fields such as human ecology, land fauna, geography of the Pacific and relevant cartographic and statistical data.

Pear decline is causing death of many pear trees in Washington, Oregon, and California. Scientists of the U. S. Department of Agriculture and the Washington and California Experiment Stations have not yet found the cause of the condition. Quick decline kills some trees in about two weeks in mid-summer or late-summer. Slow decline takes longer. The trees show little or no terminal growth, leaves are small, sparse and pale green, and there is a gradual loss of vigor, and eventually death. The malady is not connected with malnutrition, unfavorable soil condition, fungus attack, or orchard practices. It occurs on trees grown on Oriental rootstock, but not on trees grown on Bartlett rootstock. Studies are being made to determine if pear decline is caused by a virus.

The world adopted a new standard of length at 6 PM, Paris time, October 14, 1960. The new standard is a "wavelength of light." It replaces the meter bar which has served as the standard for over seventy years. The action was taken by the 11th General Conference on Weights and Measures. The American delegation to the Conference was headed by Allen V. Astin, a member of the Washington Academy of Science. Another Academy member in the delegation was A. G. McNish, Chief, Metrology Division, National Bureau of Standards. The new meter is defined as 1,650,763.73 wavelengths of the orange-red line of krypton 86. The new standard is of great importance to those engaged in precision measurements since it relates the meter to a constant of nature, the wavelength of a specified kind of light, which is believed to be immutable and can be reproduced with great accuracy in any well equipped laboratory. There was doubt in the minds of some scientists regarding the stability of the international meter bar.

Flies of the genus *Ogcodes* pass the larval stage of their lives inside spiders and devour the tissues, sometimes almost completely, apparently without much obvious awareness on the part of the doomed spider. How the fly larva gets into the spider is a matter of conjecture. Presumably, it is swallowed in a very immature stage or maybe the egg is swallowed and hatched inside the host. Once the larva is inside, the spider is doomed. The amount of feeding varies. Often only an empty shell is left. The doomed spider continues the normal activities until very near the end, but usually at a considerably reduced rate. When the larval stage is about over, the parasite eats a hole through the spider's abdomen, escapes to the outside world and eventually leads a normal adult fly existence.

Unusual recordings of infrasonic disturbances in the atmosphere have been reported by the National Bureau of Standards. This is believed to be the first time the relation between sources of infrasonic waves generated in the atmosphere and the incident sound pressure, the direction of approach of the incident wave, and the speed of the wave across the earth's surface have been studied quantitatively. A system of detectors of the type used in this study could track tornadoes and could probe upper atmospheric disturbances, especially interactions of the sun and the earth's magnetic field. These studies were begun under the late *Peter Chrzurowski*, a member of the Washington Academy of Science.

The U. S. Coast and Geodetic Survey has achieved a spectacular degree of accuracy in earth measurement. With unprecedented

precision the Survey succeeded in tying a network of nine missile tracking ballistic cameras, spread over an area of 4,000 square miles, with the launching site at Cape Canaveral, Florida, to pinpoint tracking of space missiles and flares against a background of stars. The camera sites were calculated to within an average probable error of about 0.2 feet with respect to a fixed point at Cape Canaveral, achieving an accuracy of better than one to 1,000,000, or 1/16 of an inch in one mile. The precision of the instruments, superior advance planning for the project, and the highly refined skills of the field engineers combined to produce a degree of accuracy in geodetic measurements hertofore unattained anywhere.

The tracking, warning and forecasts during the passage of Hurricane Donna were the most complete in history according to Dr. F. W. Reichelderfer, Chief of the Weather Bureau, Department of Commerce. If this most destructive and vicious hurricane since 1886 had occurred 5 years ago hundreds of people in the United States might have lost their lives and thousands more would have been seriously injured. From the time Donna was sighted 1,200 miles east of Puerto Rico, the Weather Bureau hurricane warning centers in San Juan, Miami, Washington and Boston issued over 90 advisories and bulletins on the storm's progress. Much of the success in tracking the hurricane was made possible by the high powered weather radar installed in 1959 and 1960 along the Gulf and Atlantic Coasts and the dozens of missions flown by the Weather Bureau's National Hurricane Research Project's aircraft.

A fish with a "lamp" inside its mouth is a prize specimen collected by the Danish oceanographic ship Galathea. It was collected from a depth of two and a half miles in the mid-Pacific and has been named *Galatheatharuna axeli*. It is an aberant member of the coldly predaceous anglerfish group and lives far below the deepest penetration of light. Some fish of this group carry luminous organs on stalks protruding from the head region. The lights are used to attract other mid-depth organisms close to the mouth where they can be trapped by the big sharp teeth and swallowed. This creature is unique in having the light inside the mouth. It rests on the bottom in the darkness with the mouth wide open.

An analysis of spectrograms obtained by photographing the planet Jupiter has been completed at the National Bureau of Standards. The first detailed measurements were made of lines in Jupiter's ammonia and methane bands. The presence of the hydrogen molecule was detected from its quadruple rotation-vibration spectrum. A continuous absorption recorded in the violet and ultraviolet regions closely resembles that of the nitrogen tetroxide molecule. Spectrograms were recorded from 3600 to 8900 A, using high-dispersion gratings.

Formal organization of the Science Information Exchange within the Smithsonian Institution was announced on September 28 by Leonard Carmichael, secretary of the Institution. Basic purpose of the group is "to foster and facilitate effective planning and management of scientific research activities supported by United States agencies and institutions by promoting the exchange among participating agencies of administrative data about all types of current research . . ." Sponsoring agencies are PHS, Defense, NSF, Veterans Administration, NASA, AEC, and the Smithsonian. For the coming year, Orr Reynolds is chairman of the Governing Board and Lyndon Lee is vice chairman. Staff director is Stella L. Deignan, director of the former Bio-Sciences Information Exchange, of which the new group represents an expansion.

"Invisible fishes" whose bodies are as translucent as the clearest glass are described by Leonard P. Schultz, Smithsonian Institution curator of fishes, in a comprehensive recent report on the fish life around the Marshall and Marianas Islands. Members of the family Trichonotidae, they are called "sand divers" because, says Dr. Schultz, that is exactly what these fishes are. One to two inches long, they spend their lives entirely buried in loose coral sand at the sea bottom. Through this sand they apparently make their way as easily as other fishes can through water. They are extremely difficult to attract to the surface. They have hairy fringes around the lips that keep the sand out of their mouths.

Electronic digital computers will be used by Coast and Geodetic Survey for the more accurate location of the origin of earthquakes. The new system requires that the data reported from some of the 200 earthquake stations in the world-wide network be punched on standard business machine cards; the coding process includes the name of the reporting station and the exact time that the first shock wave was recorded. It is believed that this method will eventually be accurate to within seven miles of the point of origin.

Two new research groups have been set up by Coast and Geodetic Survey as part of a major shift in program emphasis. An Office of Research and Development has been established to pursue basic research in the earth science fields of the Survey's work, and coordinate and assist in applied research and development conducted by technical divisions in its field of competence. A new Office of Oceanography will be responsible for a comprehensive program of oceanographic surveys, and a broad complex of related programs related to the sea as one of man's major environmental elements.

Vice-Presidents of the Washington Academy of Sciences Representing the Affiliated Societies

Acoustical Society of America	Richard Cook
Institute of the Aeronautical Sciences	*Not Named.*
Anthropological Society of Washington	Regina Flannery
Society of American Bacteriologists	Mary Louise Robbins
Biological Society of Washington	Herbert Friedman
Society for Experimental Biology and Medicine	Kathryn Knowlton
Botanical Society of Washington	Herbert C. Hanson
Chemical Society of Washington	William J. Bailey
American Society of Civil Engineers	*Not Named.*
International Assn. for Dental Research	Gerhard Brauer
American Inst. of Electrical Engineers	Robert D. Elbourn
Washington Society of Engineers	Howard S. Rappleye
Entomological Society of Washington	Harold H. Shepard
Society of American Foresters	*Not Named.*
National Geographic Society	Alexander Wetmore
Geological Society of Washington	Carle Dane
Helminthological Society of Washington	Carlton M. Herman
Columbia Historical Society	U. S. Grant, III
Insecticide Society of Washington	Joseph Yuill
Amer. Society of Mechanical Engineers	William G. Allen
Medical Society of the Dist. of Columbia	Fred O. Coe
American Society for Metals	John A. Bennett
American Meteorological Society	Morris Tepper
Institute of Radio Engineers	Robert Huntoon
American Nuclear Society, Washington Section	Urner Liddel
Philosophical Society of Washington	Louis R. Maxwell
Society of American Military Engineers	*Not Named.*

Chairmen of Committees

Standing Committees

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Meetings	Robert D. Stiehler, *Nat. Bureau of Standards*
Membership	Wayne C. Hall, *Naval Research Laboratory*
Monographs	Dean B. Cowie, *Dept. of Terrestrial Magnetism*
Awards for Scientific Achievement	Archie I. Mahan, *Applied Physics Laboratory*
Grants-in-Aid for Research	B. D. van Evera, *George Washington University*
Policy and Planning	A. T. McPherson, *Nat. Bureau of Standards*
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Science Education	Raymond J. Seeger, *Nat. Science Foundation*

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