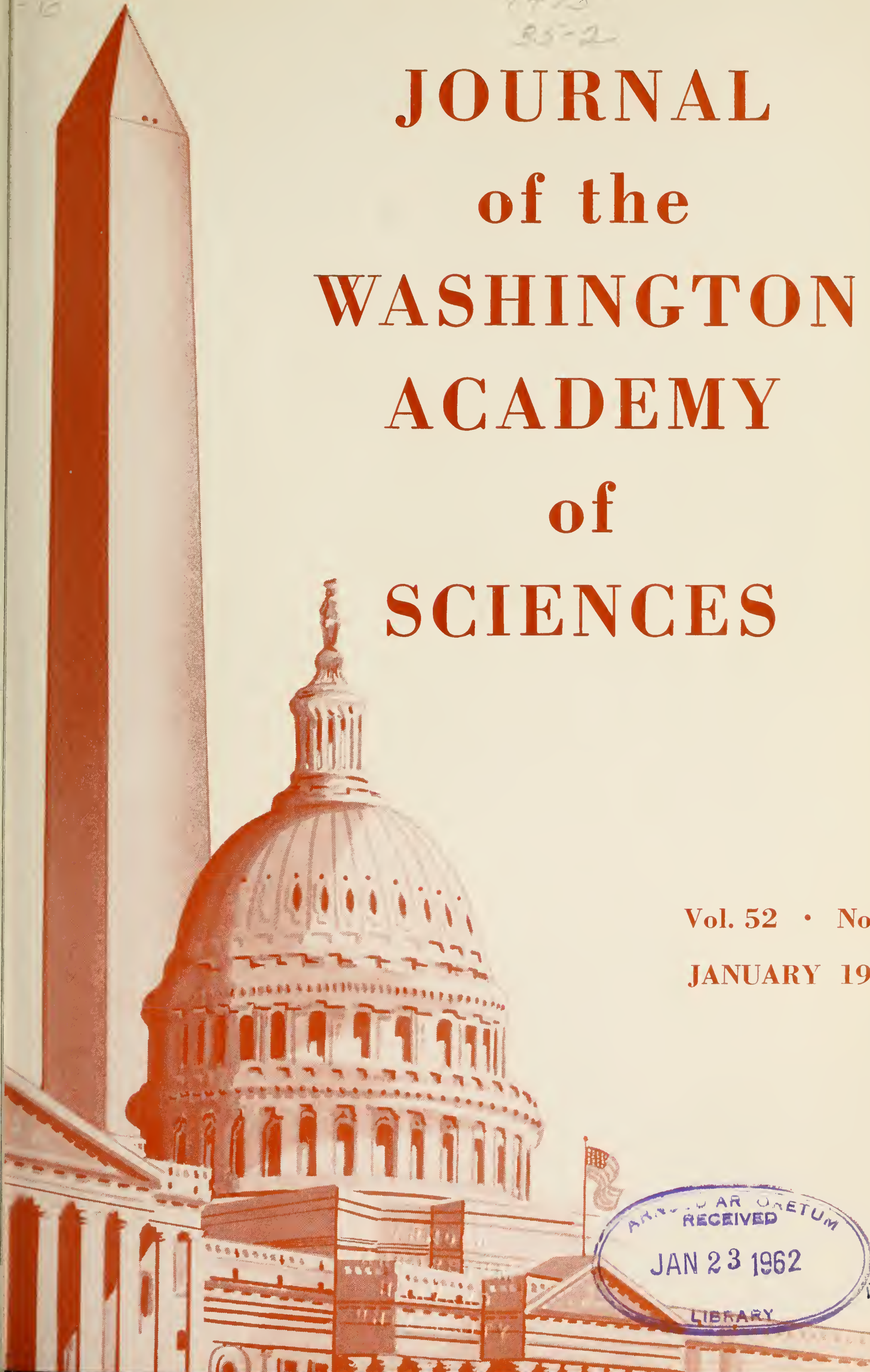
JOURNAL of the WASHINGTON ACADEMY of SCIENCES



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Editor: SAMUEL B. DETWILER, JR., Department of Agriculture

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Academy to Honor Six Outstanding Scientists

Six Washington-area scientists will receive awards for scientific achievement at the Academy's 64th Annual Meeting and Dinner, scheduled for January 18 at the Cosmos Club.

Recognition for significant achievement will be extended to Robert W. Krauss of the University of Maryland, in the biological sciences; John D. Hoffman of the National Bureau of Standards, in the physical sciences; Rodney E. Grantham of the Naval Ordnance Laboratory, in engineering; and Lawrence E. Payne of the University of Maryland, in mathematics. Additionally, Charles R. Naeser of George Washington University and Ralph D. Myers of the University of Maryland both will be recognized for outstanding service in the teaching of science.

The awards, consisting of scrolls engrossed with a citation, will be presented by retiring Academy President Philip H. Abelson, following introductions by Chairman Norman Bekkedahl of the Awards Committee. The awards also include election to membership in the Academy—where the recipient is not already a member—with remission of dues for the first two years.

The Academy's awards program was initiated in 1939 to recognize young scientists of the local area for "noteworthy discovery, accomplishment, or publication" in the fields of biology, engineering, and the physical sciences. Awards for outstanding teaching were added in 1955, while mathematics was included for the first time in 1959.

Award winners must be under 40 years of age except in science teaching, where there is no age limit. This year's nominations, received from Academy members and from local scientific groups, were evaluated by a series of panels under the general chairmanship of Dr. Bekkedahl, with panel chairmen as follows: Harald A. Rehder (biological sciences), Malcolm C. Henderson (physical sciences), Freeman K. Hill (engineering), Harry Polachek (mathematics), and John K. Taylor (teaching of science).

Biological Sciences

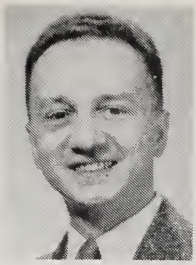
Cited "for meritorious researches and publications in the physiology of algae," Robert W. Krauss is professor of plant physiology in the University of Maryland's Department of Botany. Born in 1921, he received the B.S. degree from Oberlin in 1947, the M.S. degree from the University of Hawaii in 1949, and the Ph.D. degree from the University of Maryland in 1951. Dr. Krauss held appointments at the Carnegie Institute of Washington (1951-54) and the Marine Biological Laboratory at Woods Hole (1955-57) before joining the Maryland staff in 1958. He has numerous publications.

Dr. Krauss has been a pioneer in the applied development of algae cultures, and at present directs a very significant project in this field. He is known as an inspiring teacher and colleague.

Physical Sciences

John D. Hoffman, currently chief of the Dielectrics Section in the Electricity Division, National Bureau of Standards, was born in 1922. He received a pre-War B.S. degree from Franklin and Marshall, and post-War M.S. and Ph.D. degrees from Princeton University. His professional experience includes research at Oak Ridge as a diffusion-plant group leader, and research in physical chemistry at General Electric.

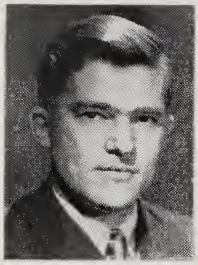
Dr. Hoffman was cited "for fundamental



R. W. KRAUSS

J. D. HOFFMAN

R. E. GRANTHAM



L. E. PAYNE

C. R. NAESER

R. D. MYERS

contributions to the science of polymer physics." His theoretical work on dielectric relaxation has become an accepted part of the theory of dielectric materials, and his recent concept and analysis of folded-chain polymer crystals has received international acclaim. This theory resolves some paradoxes in the field of polymer behavior.

Engineering

Rodney E. Grantham is a supervisory electronic engineer and chief of the Advanced Engineering Division, Air and Surface Evaluation Department, at the Naval Ordnance Laboratory. Born in 1921, he received the B.S. degree in electrical engineering from Purdue University in 1942, and the M.S. degree in physics from George Washington University in 1951; additionally, he has studied at the University of Maryland and at MIT Radar School.

Mr. Grantham served as an electronic scientist at the National Bureau of Standards in the period 1946-1950, and thereafter transferred to NOL. During the last 11 years at NOL he has earned an impressive number of awards and commendations for his work in missile and communications systems; this work has resulted in 10 patents and about 20 publications. He was cited "for technical management in development of the Polaris arming and fuzing system."

Mathematics

Lawrence E. Payne, born in 1923, received the B.S., M.S., and Ph.D. degrees from Iowa State College in 1946, 1948, and 1950, respectively. After teaching experience at Iowa State and the University of Arizona, he joined the University of Maryland staff in 1951 as research associate, and advanced to research professor in 1960.

Dr. Payne has about 50 publications in various fields of higher mathematics. He

was cited "for his contributions to the theory of partial differential equations."

Teaching of Science

Charles R. Naeser is professor of chemistry and chairman of the Chemistry Department of George Washington University. After receiving the B.S. degree from the University of Wisconsin and the M.S. and Ph.D. degrees from the University of Illinois, he joined the George Washington faculty in 1935. Except for three years of Army service, he has devoted his entire professional career to teaching and research at that institution. His field of specialization is the lesser-known elements.

Dr. Naeser has conducted a very active graduate and undergraduate teaching program, and has directed the research of many graduate students, particularly in the chemistry of the rare earths. Among his former students now engaged in research and teaching throughout the country are the dean of the Graduate School of the University of Nevada, a professor of inorganic chemistry at the University of Minnesota, and a professor of chemistry at George Washington.

Dr. Naeser has been very active in affairs of the Chemical Society of Washington and the Washington Academy of Sciences, and participates in many secondary school science education activities. He was cited "for contributions to chemical education, particularly at the university level."

Ralph D. Myers, co-recipient with Dr. Naeser of the science teaching award, was cited "for outstanding contributions to postgraduate education of area physicists." He was educated at Cornell University, with B.S., M.A., and Ph.D. degrees in 1934, 1935, and 1937 respectively. His early research was in nuclear theory, and most recently he has been working in solid state theory.

Dr. Myers joined the Physics Department of the University of Maryland in 1938, and became a full professor in 1948. He is chairman of the Department's Graduate Committee, and leader of the University's large research program in solid state phenomena. Dr. Myers is described as a truly outstanding teacher, who has taught nearly all the regular courses offered in the Physics Department at one time or another during his 23 years at the University. He is called upon by graduate students and his colleagues for advice in problems of physics, more than any other member of the Department.

During 1962 Dr. Myers is serving as president of the Philosophical Society of Washington.

Soil Reservoirs of Pathogenic Fungi*

Chester W. Emmons

National Institute of Allergy and Infectious Diseases, National Institutes of Health

Your invitation that I give the Annual Dinner Lecture this year was highly gratifying to me as a recently elected Life Member of this Branch and as a medical mycologist. Even when I became an active member of the Branch 25 years ago, medical mycologists felt at home among bacteriologists. Now that a legal change in the name of our national society has formally sanctioned the fraternization of

*Lecture presented at the Annual Dinner Meeting of the Washington Branch of the American Society for Microbiology, November 28, 1961.

bacteriologists and mycologists, we can anticipate that the bonds between us will be strengthened.

Mycology and bacteriology have several common meeting grounds. One is in and around that group of microorganisms (the actinomycetes) which have been claimed by both mycologists and bacteriologists. Some of the actinomycetes produce chronic granulomatous diseases which resemble in certain respects the systemic mycoses. The species of Streptomyces and Nocardia which are the etiologic agents of these diseases grow in soil or compost, and these environmental sources of infection also are reminiscent of mycoses. Morphologically the actinomycetes produce extensive branching hyphae by terminal growth, after the manner of fungi. I concede, however, that these hyphae are narrower than many bacteria and if you all follow Bergey's Manual in classifying them among the higher bacteria. I shall not dispute the point.

Let me emphasize, however, that soil and humus rather than diseased man or animals are the reservoirs from which pathogenic species of Streptomyces and Nocardia enter the respiratory tract or the subcutaneous tissues of the patient. The free saprophytic growth of fungi which cause human disease is the subject of my lecture this evening. It is a fundamental concept in any consideration of the systemic and subcutaneous mycoses that, with very few exceptions, these mycoses are infectious but not contagious diseases, that they do not spread from man to man or animal to man, and that the fungi which cause them are normal components of the varied and complex microflora of the soil or of organic debris in the soil. Man and animals are exposed to infection from this environmental source, most cases of coccidioidomycosis and histoplasmosis (and perhaps of other mycoses) are asymptomatic or mild, and contact with the patient is not hazardous. Probably the human or animal host does not play an essential role even in reseeding soil. The pathogenic fungi, once established in a favorable environment, are capable of indefinite growth as saprophytes in suitable soil. These concepts are basic to the epidemiologic aspects of the systemic mycoses. They furnish reliable clues to the solution of many of the previously puzzling aspects of the geographic distribution and sporadic occurrence of mycoses.

For many years before the saprophytic habitats of pathogenic fungi were well known, localized epidemiologic data of various kinds strongly suggested environmental sources of infection in the systemic and subcutaneous mycoses. Most of our first attempts to isolate these fungi were like the proverbial search for a needle in the haystack. We still are groping for some of these pathogenic fungi but for Allescheria, Nocardia, Histoplasma, Cryptococcus, some dermatophytes and Aspergillus, we now know where to take samples and we have effective if not efficient methods of isolating these fungi. Once you know how and where to look, the search becomes easy. A similar phenomenon was immortalized by that poet of American foibles and folkways, Ogden Nash: "You shake and shake the catsup bottle: first none'll come and then a lot'll."

Some of the early reports of the free-

EDITOR'S NOTE—The four principal diseases discussed in this article are defined as follows in "The American Illustrated Medical Dictionary," 22nd edition (W. B. Saunders Company, 1951):

Coccidioidomycosis.—A disease caused by infection of the lungs with *Coccidioides immitis.* It is marked in initial stages by symptoms resembling those of pulmonary tuberculosis.

Histoplasmosis.—A disease of the reticuloendothelial system caused by infection with the fungus *Histoplasma capsulatum.* It is characterized by enlargement of the liver and spleen, fever, anemia, and leukopenia.

Aspergillosis.—A diseased condition caused by species of *Aspergillus* and marked by inflammatory granulomatous lesions in the skin, ear, orbit, nasal sinuses, lungs, and sometimes in the bones and meninges.

Cryptococcosis.—An infection by *Cryptococcus neoformans* which may involve the skin, lungs, or other parts, but has a predilection for the brain and meninges.

living saprophytic occurrence of pathogenic fungi were imaginative, and the epidemiological significance of others is equivocal. Bostroem's report 70 years ago that *Actinomyces bovis* grows in soil and vegetation and that the disease is acquired by chewing straws resulted from mistaking a contaminant for the pathogen, and this erroneous concept was perpetuated by repetition in some textbooks for 50 years. Beurmann and Gougerot reported 40 years ago the isolation of *Sporotrichum schenckii* from the scouring rush (Equisetum) and from the beech tree. These sources have not been confirmed by modern studies, but perhaps no one has looked for the fungi in these habitats. We do know that typical strains of *S. schenckii* are isolated occasionally from sphagnum moss, mulching materials, and soil with which gardeners work. More spectacularly, *S. schenckii* was isolated repeatedly by Brown and associates from timbers and ground waters of certain gold mines in the vicinity of Johannesburg, and nearly 3000 cases of sporotrichosis were seen in miners during a three or four year period before the epidemic was controlled by sanitation and by rot-proofing of mine timbers.

It may be appropriate to return to the actinomycetes to begin a review of modern studies of the habitats of pathogenic fungi. Two of our former members, Ruth Gordon and W. A. Hagan, in 1936 first isolated *Nocardia asteroides* from soil by using the time honored "baiting" technic. Taking advantage of the ability of *N. asteroides* to utilize paraffin, they buried paraffin-coated glass rods in soil and isolated several strains of *N. asteroides* on this selective medium. The success of their search can be regularly duplicated, but we do not know from systematic studies the extent to which this pathogenic microorganism is distributed geographically in soil. A persistent search for *Nocardia* in sputum has indicated that pulmonary nocardiosis is more prevalent in man than present morbidity and mortality statistics record and suggests that this disease sometimes masquerades as tuberculosis in the wards of hospitals. A closely related species, *N. brasiliensis*, which causes mycetoma in tropical and subtropical areas of the Americas, also probably is a frequent inhabitant of soil. A similar saprophytic habitat is well known for *Allescheria boydii* and can be confidently assumed for the numerous other fungi which cause mycetomas.

A systematic enumeration of all the etiologic agents of mycoses which are known or suspected to be present in soil would be tedious and out of place on this occasion. I propose to spend the remainder of my time in discussing four of the important pathogens of man about which we have interesting and well-documented information. Such a review must include *Coccidioides immitis*. Its first isolation from soil was reported by Stewart and Meyer in 1932 from a soil specimen taken from near a house occupied by patients with coccidioidomycosis. In 1942 I isolated this fungus from soil and from many desert rodents in southern Arizona, and interest in the distribution and occurrence of *C. immitis* has continued.

The geographic distribution of *C. immitis* is limited to desert areas, and animals as well as man are accidental hosts to the fungus. The rodents apparently play only an incidental role in maintenance of the fungus in soil, and even reseeding of soil from the carcasses of animals which die of the mycosis probably is of no importance in the life history of the fungus. The fungus survives the intense solar radiation of summer in the sheltered and cooler microclimate of the rodent burrow. From this haven it grows (according to the observations and hypothesis of Egeberg and his associates) after the rainy season makes the desert floor more tolerable to life. It has been assumed that at this time the competition from other fungi and from bacteria in soil is reduced and *C. immitis* is able to grow rapidly in a soil relatively free of antagonists. *C. immitis* is less thermophilic than many other

fungi and its limitation to desert areas cannot be explained merely by its ability to grow at high temperatures. There is no evidence that it has become established, however, in cooler and more humid climates, to which it surely must have been introduced many times by the migrations of human hosts who were infected while resident or in transit in endemic areas of the fungus.

Three other pathogens of man have no such geographic limitation but occur around the world. Histoplasmosis was first described in Panama in 1905 by Darling, who reported three cases of this mycosis. It is characteristic of this elusive disease that it remained almost unknown in Panama for 50 years thereafter, although modern studies now indicate clearly its present prevalence there. Pathologists have uncovered evidence that it was present in this area during the long interval while it was not observed. It was nearly unrecognized in Panama for 50 years because, like coccidioidomycosis, most cases are asymptomatic or are so mild as to be confused with a common cold. Like coccidioidomycosis, the disease is not contagious and the source of infection is in man's environment.

Histoplasma capsulatum was isolated from soil first in Loudoun County, Va. The soil specimen was taken under a small chicken house. We made this isolation during an intensive study of histoplasmosis begun after the death of two brothers (the first time two associated cases of histoplasmosis had been diagnosed.) In a community-wide study we found that hypersensitivity to the antigen, histoplasmin, began to appear shortly after infancy, that the percentage of histoplasmin reactors rose very sharply in the early school years, and that 84 per cent of the general population presented evidence of past infection by reacting to histoplasmin.

The disease is similarly prevalent in Maryland. In the search for environmental sources of infection, I examined 382 soil specimens before finding the fungus. Now we know where to look and can depend upon finding the fungus regularly in certain areas. Zeidberg and Ajello first called attention in a publication to the frequent association between chicken houses and *Histoplasma*. No host-parasite relationship is involved. The chicken is not a host of the mycosis and is not susceptible to a progressive infection. The fungus finds an acceptable substratum and habitat in soil enriched by the excreta of the chicken, and can be isolated from the soil under or adjacent to the foundation of many chicken houses.

However, it was soon observed that other habitats are equally acceptable to *H. capsulatum*. It grows in bat guano in caves in many parts of the world. In South Africa, speleologists from the Johannesburg area are generally histoplasmin positive, indicating a past infection, while speleologists from the Cape Town area are generally nonreactive unless they have entered caves in the north.

The common brown house bat *(Eptesicus fuscus)* also can provide a suitable environment for the fungus, and we have for many years studied this relationship in an old house near Clarksburg, Md. A colony of more than 100 bats occupies the attic of this residence, and their droppings are apparent adjacent to the foundation walls of the house where the bats leave the house or approach it for ingress, or where droppings have fallen down between the inner wall and the siding of the house. We isolate *H. capsulatum* with great regularity from soil collected next to the foundation wall of this house, but rarely find it beyond six feet from the house. With Arthur Greenhall, director of the bat rabies control program in Trinidad, W. I., we have found a similar association in that area where bat infestation of both urban and rural houses is commonplace.

Until recently, histoplasmosis was thought to be predominantly rural in distribution, and it was assumed that urban residents with histoplasmosis or evidence

of past infection had been infected during trips to the country. When it became evident that there must be also some urban sources of infection, we began to take soil specimens from selected sites in cities. You may remember the report in a news magazine of a school outbreak of histoplasmosis in Milan, Mich., in which the children were infected from soil on the playground underneath trees in which starlings roosted. Furcolow and associates reported cases of histoplasmosis in Boy Scouts who helped clear a neglected forested 11-acre tract in Mexico, Mo., where starlings again were a factor.

The first isolation of *Histoplasma capsulatum* from a congested downtown area was in Washington, D. C. A year ago we isolated the fungus from all of 10 soil specimens collected under sycamore trees in a tiny park at 7th Street and Pennsylvania Avenue, N. W., and we have isolated the fungus in subsequent samples from this site. These trees provide roosting sites for large numbers of starlings, and we believe the contamination of the soil by these birds provides the environmental conditions suitable for the growth of this pathogenic fungus. Our studies of roosting sites of starlings in other cities on the eastern seaboard are not yet completed.

Aspergillosis is a relatively rare disease in man, but it causes many deaths in chicks, turkey poults, wild geese, and quail. Most Emperor penguins brought to zoos die of aspergillosis. Renon reported in 1897 the first comprehensive study of aspergillosis in man. Five of his six cases were in either wig cleaners or pigeon feeders. The wig cleaners used meal from cereal grains to comb out the wigs, and *Aspergillus* was found in the meal. The pigeon feeders masticated grain and fed the enzymatic digest of this process directly from their lips to pigeon squabs. Aspergillosis continued to appear in man after the decline of the wig-cleaning industry, and the disease now is not statistically related to pigeon feeding.

For 65 years it has been assumed that man, animals, and birds acquire aspergillosis after exposure to moldy cereal grains upon which the pathogen, *Aspergillus fumigatus*, grows. It is probable that moldy grain or mash and the bedding in brooder and chicken houses are the most frequent sources of infection in domestic birds. *A. fumigatus* is a common fungus with a wide distribution, and man and birds must be frequently exposed by inhalation to it.

In my presidential address to the Mycological Society of America a year ago, I described one type of habitat which supports luxuriant growth of *A. fumigatus* and, potentially, very heavy exposure to this pathogen. *A. fumigatus* is thermophilic and it probably grows very commonly in compost piles. One type of compost supports an almost incredibly exuberant growth of this fungus. Leaves and branches of trees passed through "chippers" yield a type of coarse mulch that provides apparently optimum conditions for growth of *A. fumigatus*. A truck load of this material, dumped upon the lawn of a gardener who expects to use it as mulch around azaleas, is usually already undergoing biological "heating" at the time of its delivery. Within a few days, especially if it has been moistened by a shower, it is dusty with mold spores. If disturbed, a gray-green cloud of these spores floats away on the breeze. Microscopic examination reveals the characteristic conidiophores and spores of *A. fumigatus*. When suspensions of spores from such compost piles were mixed with agar, 90 to 96 per cent of the resultant colonies were of this fungus.

Fortunately, man appears to have a very high natural resistance to aspergillosis. In fact, pulmonary aspergillosis is rare in normal persons and perhaps is usually secondary to tuberculosis, silicosis, or some other primary lung disease. Exposure by inhalation of the spores is not equivalent to infection, but one of my gardening friends is allergic to this fungus, and on more than one occasion has had to go to bed for a day or two with asthma

after handling compost heavily overgrown with *A. fumigatus*.

Finally we come to a mycosis which has been known and diagnosed since 1894, but which, in my opinion, has a wider range of clinical manifestations than is now recognized. Cryptococcosis, caused by the yeast-like fungus *Cryptococcus neoformans*, is the most frequent fungal cause of meningitis. Pulmonary lesions are frequently seen, and it is assumed that the disease begins as a respiratory infection. A prevalent, benign respiratory form, such as we know in coccidioidomycosis and histoplasmosis, is not recognized. I believe such a respiratory form of the mycosis occurs, and this belief is based upon some case reports, suggestive experimental data, and the known prevalence of *C. neoformans* in man's environment.

In 1894 Sanfelice isolated *C. neoformans* from peach juice and it was reported in the same year as a cause of human disease. Its isolation was not reported again from sources unrelated to animals or man, until I isolated it from barnyard soil in 1950. In 1955 I found it was regularly present in old nests and droppings under roosting sites of pigeons. This ecological association was immediately confirmed by Schwartz in Cincinnati, Littman in New York, and Yamamoto in Japan, and it is now generally recognized as common and almost constant in many parts of the world. Nevertheless, histoplasmosis (and not cryptococcosis) is still associated in the minds of some clinicians (erroneously, I believe) with exposure to pigeon excreta.

Several outbreaks of pneumonitis in men exposed to old accumulations of pigeon excreta have been recorded in medical literature. The men were exposed to dust while cleaning or demolishing old buildings which had housed pigeons for many years. None of these outbreaks were studied at the time by laboratory procedures adequate to make a specific diagnosis. The diagnosis of histoplasmosis was based (in one case 20 years after the episode) on the history of pneumonitis, roentgenographic changes, and the results of serologic studies which in the light of today's knowledge must be considered equivocal. The most convincing evidence against the diagnosis of histoplasmosis in these cases is that *Histoplasma* has never been isolated from pigeon dung on the upper floors of buildings, but we almost invariably find virulent strains of *Cryptococcus neoformans* in such accumulations.

We have isolated strains of this fungus indistinguishable from those from fatal human cases of cryptococcal meningitis, from sidewalks under fire escapes in downtown Washington, from window ledges, from cupolas on school houses, from the attics of old buildings to which pigeons have had access, and from almost every spot in which we have been able to take specimens from old accumulations of this material. We have isolated it regularly in Iowa, Virginia and Maryland from pigeon nests in barns and from haymows where the excreta from roosting pigeons accumulates on hay. In these cases, as in the other associations I have mentioned, the pigeon is not a host to the fungus. This is a saprophytic association in which the fungus grows in an unusual substratum which is inhospitable to other fungi.

According to "Vital Statistics of the United States," each of three of the mycoses I have discussed (coccidioidomycosis, histoplasmosis, and cryptococcosis) kills 50 to 75 persons per year. Many medical mycologists and epidemiologists estimate that the actual numbers of diagnosed and undiagnosed fatal cases may be many times these numbers. The numbers of nonfatal infections cannot be estimated with accuracy, but we know that most of the residents of some endemic areas of coccidioidomycosis and histoplasmosis are infected at some time. Our epidemiological tools are inadequate to estimate the frequency of mild forms of aspergillosis and cryptococcosis, but we know from environmental studies that spores of the etiologic agents of these mycoses are

numerous in the soil we tread and the air we breathe. Man's natural resistance to progressive infection by molds, and the acquisition of immunity after a mild infection, are fortunate defenses against these agents of disease. We currently are seeking effective and practical methods of decontamination of soil, and investigating new drugs, in a search for safer and more effective therapy for those unfortunate individuals who acquire progressive and potentially fatal mycoses.

The Tarnished Beetles*

A Study of Underpopulation

Ross H. Arnett, Jr.

Department of Biology, Catholic University of America

Introduction

Darwin gave us a unifying theme for all field studies of speciation when he proposed that a major cause of evolution is population pressure brought about by overpopulation. Almost as important, but generally overlooked or seldom stated, is speciation of underabundant populations, the cause of which is much more subtle than speciation brought about by the factors discussed by Darwin. The underabundant species represent 90 to 95 percent of the described animals and plants. A great majority of these do not occupy all possible areas, not because they are held in check by lack of food or by predators and parasites, but because they are in the process of adaptation to particular environmental conditions. This adaptation is slowed down by lack of numbers sufficient to provide for the genetic variation and selection needed, and for very little else at their present evolutionary stage.

In support of these statements, I offer the following account of five years of concentrated field study of one such underabundant and extremely variable group, the tarnished beetles, members of the genus *Oxacis* (family Oedemeridae). A specimen of this genus is shown in Figure 1.

The Problem

When I started this study of *Oxacis* beetles 13 years ago, there was an abundance of museum material, but all without data other than very general locality labels. Further, the numbers of specimens in each series were so limited that few statistical studies could be made. However, a study of type specimens and the usual museum taxonomic studies of this material permitted the separation and identification of many species (Arnett 1958).

There remained however, the problem of the significance of the variation within species and the proper evaluation of this variation. In other words, are there many poorly formed (sibling) species, or a few large, but extremely variable, species?

It seemed reasonable to suppose that field work could help to show the nature of the variation by finding specimens that were members of the same interbreeding population. Then if the variation were present among the offspring of a single female, one could conclude that it was random throughout the species and had

* Condensation of a talk presented October 5, 1961, before the Entomological Society of Washington. Paper No. 15, Entomological Series of the Department of Biology, Catholic University. Most of the work reported herein was made possible by National Science Foundation Grant No. 14,272: this help is gratefully acknowledged.

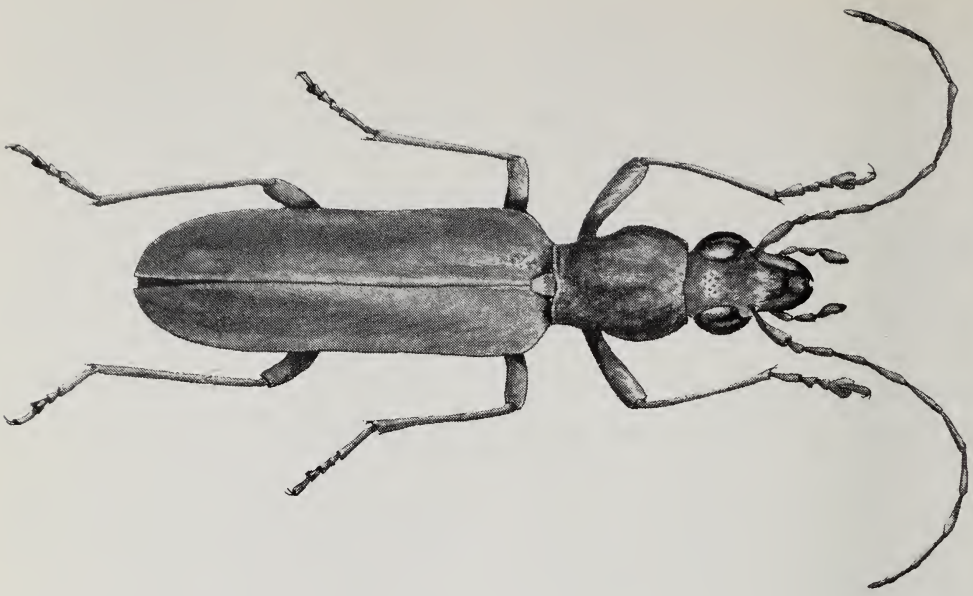


Figure 1. *Oxacis subfusca* Horn, female, 9 mm. in length, from Peña Blanca, Santa Cruz County Ariz., July 24, 1959, R. H. Arnett, coll. (from a watercolor painting by Eileen R. Van Tassell).

no particular evolutionary significance. If, on the other hand, the members of a restricted population were uniform (that is, with no greater variation than that found among those species that are clear-cut and are readily separable from other species of their genus), then the variation seen in museum material should be of evolutionary significance. The problem then would be to determine the factors that had brought about the variation. With such observations and thoughts in mind, field work was undertaken.

Procedure

During the first season (1957) a general survey was made of the entire area occupied by members of the genus *Oxacis*. My family and I (Fig. 2) spent nearly three months in the field. We covered 13,000 miles, collecting throughout southwestern United States and visiting eleven states of Mexico (Arnett, 1959). During 1958 and 1959 comparative studies of populations in the Sonoran Desert were made. Both before and during the rainy seasons, collections were made at regular intervals at various altitudes on several mountains and adjacent desert areas in southern Arizona and northern Sonora. The 1960 season was spent in Oklahoma and northern Texas for the purpose of finding the easternmost extension of the range of the Sonoran Desert species, and to make comparative studies of these populations. In 1961 some of the lacunae were filled in by collecting from the Lower Rio Grande Valley in Texas, through the Chihuahuan Desert, and north through New Mexico to northern Arizona. The greater part of the season, however, was spent in the Peña Blanca area near Nogales, Arizona, where several field experiments were undertaken on three separate populations of the tarnished beetle, *O. subfusca* (Fig. 1).

The data gathered over this five-year period have made possible the following types of studies, all of which are still incomplete.

1. Statistical analyses of local populations were made to determine the standard deviation and coefficient of variation of several morphological characteristics of these species. These have also been checked

by the computation of Student's t for the significance, or level of confidence, of these data.

2. Comparative studies of the abundance and distribution of several species before and during the rainy season were made.

3. Comparisons of populations were made throughout the range for some of the species. For this it was determined by statistical methods that sample stations arranged on a 100-mile grid are of significance for variational studies within this genus. Further collecting has been undertaken by visiting as many grid stations as possible throughout the range of the species.

4. Studies of local ecological factors have been made as far as possible at each of the stations under survey.

5. During the 1961 season, extensive behavioral studies were made, so that some comparative ethology is now possible.

6. Anatomical studies in the field, which show changing conditions in the digestive tract and reproductive system throughout the adult life, are now underway.

7. Dispersal and movement studies were made by the use of the marking, release, and recovery procedure. (For this method, I suggest the name: PNMR system, standing for Population density = Number observed multiplied by number marked and divided by number recaptured.)

8. Host plant and habitat specificity data have been gathered where possible.

The remainder of this paper will report some of the data obtained, and a preliminary interpretation of these data.

Results

Desert islands. The mountains of southern Arizona are isolated by a surrounding barrier of desert flatland. The 1957 season of collecting showed that few tarnished beetles are desert inhabitants; most species are found in canyons or at higher levels in the mountains. The next two seasons of collecting before and during the rains yielded the following hypothesis:

Most tarnished beetles apparently spend their larval life in canyons or on mountains. As the rainy season progresses, the pollen-feeding adults migrate to the mouth of the canyon where they feed on the new blossoms. Eventually they move out onto the desert floor where they meet members of neighboring populations. Copulation takes place throughout the adult life of these beetles. It may be supposed therefore, that isolation is incomplete. There is enough intermixing of the respective gene pools to provide the variation seen in these species. This, if true, also accounts in part for the lack of clear geographical races in these species. The material available is still under study. The statistical calculations made so far seem to bear this out, and have been partially reported (Arnett, 1960). This study indicates that centrifugal population variation has taken place in at least one species.

The general effect of this desert island hypothesis seems to be the addition of another dimension, that of ecology. In the eastern United States where ecological change is more gradual, geographical races are more evident because of the absence of the additional complications of partial seasonal isolation and perhaps longer breeding seasons accompanied by greater dispersal.

Behavior. Several interesting behavioral observations have been added to the growing wealth of data. The best were obtained during the 1961 season, when the actions of the tarnished beetle, *Oxacis subfusca*, while feeding on prickly poppy were observed (Fig. 3) for many hours. In 1959 they were seen to feed on the pollen, not occasionally, as was earlier thought, but routinely. The following account is a typical observation taken from notes made July 22, 1961 in Peña Blanca Canyon, beginning at 5:30 a.m. It was light at this hour, but of course the sun had not risen above the canyon rim. Even so, it was bright enough for the poppy blossoms, which close at night, to be open. Two blossoms were under observation, each harboring a single beetle. These were

Figure 2. The author's family and Eileen Van Tassell, his scientific aide and artist.

Figure 3. Miss Van Tassell observing the behavior of a tarnished beetle in a poppy flower.

called A and B, but B's actions are omitted from the following record. (A measured 9 mm. in length.)

"A is under the anthers. It emerges once or twice during 10-minute periods to feed on the pollen. It keeps its body hidden. 6:05—A is feeding on the anthers near the base. 6:07—A emerges from among the anthers and is crawling on top of the pollen sacs. It is feeding by grasping the sacs with its mandibles. It ruptures these and pushes the pollen into its mouth by means of the palpi. It continues to feed, going from anther to anther, leaving little nicks in the side of the partially deflated sac. Feeding continues steadily. 6:20—an ant, one-half the length of A, crawls onto the flower. A leaves the anthers and moves much more quickly than before and with jerks, which are not characteristic of its normal gait. A is running across the petals waving its antennae. When the ant comes close to A, it goes under a petal. 6:22—A and the ant are both active, neither of them approach the pollen sacs. 6:23—a small bee landed near A, which causes some nervous activity. The bee flies away. (Several honey bees have flown by, but have not stopped to feed on the pollen or nectar.) 6:24—the ant leaves; A is still out on the petals. 6:33—A seems to be "licking" the petals with the ligula. 6:37—a honey bee lands on a petal and searches for the pollen sacs for a moment and then flies away. A is only slightly excited, but remains on the petal. 6:40 to 6:50—A inactive on petal. 6:50—another ant arrives on the petal; A shows little excitment, but goes to the edge of the petal, where it nearly falls off. Now it crawls under the petal for a moment, but immediately reappears, then ducks back under when the ant approaches. 6:59—two ants arrive on the poppy blossom and seem to be chasing A. 7:02—A actively runs for a moment, then rears up on the hind two pairs of legs and flies away toward the nearby mesquite trees."

Some tarnished beetles spend the night closed inside the blossoms of prickly poppy. Others leave the blossoms after feeding and rest in nearby trees. They have been observed to leave the blossoms, circle once or twice, apparently for orientation, and then fly to a mesquite or a walnut tree. Their actions in the trees have beeen observed by means of powerful binoculars. When they first arrive, they are rather active and nervous. They will crawl up and down a leaf several times, but eventually come to rest on the bark of the branch where they remain indefinitely. Specimens have been watched for hours in this position with no movement of any sort observed. Beating trees at night has knocked specimens into nets, which shows that some spent the night in this position.

Population movements. The first marking experiments were conducted during the 1961 season. Marking was done by painting small spots of quick-drying enamel paint of various colors on the beetles. A code system was used. An assortment of colors and positions indicated the date and place of capture and release, so that upon recovery the exact flight distance could be recorded. All marked specimens were released in the same quadrant in which they were captured.

These first studies showed that these beetles readily fly at least 1500 feet from blossom to blossom, and probably further, although this is the greatest distance yet recorded. Specimens were marked and released some distance from the gasoline lanterns at night. Releases were made at the four points of the compass about 500 feet from the light. Recovery was not made on the night of release, but from one to several nights later. These same specimens were also recovered on succeeding days on poppy blossoms up to 1500 feet away.

Three areas of poppies were staked out in quadrants of 25 square feet for extensive marking experiments. Counts were taken over a period of fifteen days, four times a day at 8 and 10 a.m., noon, and 3 p.m. Up to 200 individuals were marked

for a single experiment. These studies showed that there is an hourly as well as a seasonal fluctuation in the population on the poppies. It is reasonable to conclude that the hourly fluctuation is brought about by changes in relative humidity, or more accurately, by rate of evaporation if the latter had been measured. Further, it seems reasonable to suppose that the population fluctuation over the period was due to the increase of rain, with an increase in the population, and then the drying after the rain, with a decrease in the population, this total population fluctuation being connected with the amount of rain falling in this particular area.

The marking experiments have also shown that the beetles will move about in a poppy field at random for several days. Then they disappear, apparently going to nearby trees. After a week to ten days they again return to the poppies. This led to another interesting, but inconclusive discovery described below.

Internal anatomy. When it was first observed that these beetles leave the poppies for awhile and then return, some dissections were made in the field. These revealed that there is present in both sexes a large sac or diverticulum located immediately behind the oesophagus. This sac fills the major part of the abdomen and contains nothing but undigested pollen. It is obvious that the beetles feed on the pollen until this sac is full, then leave the poppies. At the time they leave, the oviducts of the female are empty, with no sign of egg development, although copulation apparently has taken place. These dissections consistently show this condition. Also, in the one case of a specimen recovered after an absence of several days, the sac as well as the oviducts were empty. As yet, full oviducts have never been observed. These facts may mean that pollen is used in egg development, which takes place during the absence of the individuals from the poppy fields, and that eggs are laid at this time.

Miscellaneous. The total population of the Walker Canyon corral area has been estimated at between 1500 and 3000 adults. This has been done by making use of the PNMR method. The more refined methods of measuring total populations and adjusting for survival-rates (i.e., new emergences, invasion, emigration, and death) have not been employed in these computations.

Never once was a predator noted. The most disturbing influence on the populations under study were the grasshoppers that emerged at the end of the rainy season when the tarnished beetles had nearly disappeared. The grasshoppers eat both the petals and the pollen sacs of the poppies and quickly drive away any remaining tarnished beetles. No spider, bird, or insect was observed attacking these beetles.

Interpretation of Present Data

By all commonly understood definitions, the species of *Oxacis* are *rare*. Because of the confusion in the usage of this term, it seems more descriptive to apply the word *underabundant* when referring to populations such as these. The implication of the use of this term is that of a population potentially able to increase, and able to continue an adaptive pattern of speciation. This is in contrast to a rare population that has ceased to expand and develop. The rare population is heading toward extinction, or at best, it has ceased to change and expand.

Some of the data in support of the theory of underabundant populations have been given above. This may be summarized as follows:

1. Many of the species of *Oxacis* are extremely variable morphologically, so that the separation of species is difficult and is possible only after a study of a large population sample.

2. Partial isolation by desert islands has resulted in minute local population differences, yet there is enough mixing of the various gene pools to keep the species intact and to prevent subspeciation.

3. Present evidence seems to indicate that predation, on the adults at least, does

not keep the population in check. Lack of food supply of the adults certainly is not a factor. It can only be concluded that the populations remain underabundant because of some unknown factors in their pre-adult development, and some genetical factors which prevent them from occupying a larger range. These factors are many, no doubt, and warrant a much fuller study. At any rate, in contrast to the normal pattern of an abundant species, where food supply and predators may be the limiting factors, these conditions do not obtain in the adult tarnished beetles.

Future Research

Much remains to be done. These researches need to be refined by gathering more data in future years. The greatest handicap at the present time is the as-yet-unknown life cycle.

During the course of this study it has become increasingly evident that much more could be accomplished by making use of more laboratory equipment in the field. By proper instrumentation, many refined measurements can be made in the field. Microhabitat studies should be made, including records of changes in relative humidity, local rainfall, temperature, and soil chemistry. Better facilities for a study of the changes in internal organs are needed and could be available in a mobile laboratory in the form of a converted "camper" type house trailer, equipped with a gasoline-operated power plant and the necessary laboratory equipment.

It is hoped that future studies of this type in the Peña Blanca area can be made to test the present theory, not only by a study of the tarnished beetles, but by a study of other organisms, both animals and plants.

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THE BROWNSTONE TOWER

Writing this column just before Christmas, I cannot develop a subject that requires time-consuming investigation. It seems best therefore to write about the agency that employs me, the National Academy of Sciences—National Research Council (NAS-NRC), which should be better known in Washington than it is.

What is NAS-NRC? To Washingtonians it is a monumental white marble building on Constitution Avenue between 21st and 22nd streets. In the line of marble buildings, it stands between the Federal Reserve and the American Institute of Pharmacy. To tourists it is a building that excites curiosity. It looks as if some interesting exhibits should be housed in it, but there are displayed only the medals and a copy of the charter of the National Academy of Sciences, and the building is not open to those passing by. To members it is a goal achieved and an opportunity for service—the building is a beautiful symbol of their professional eminence and a convenient place for holding small meetings. To the staff the building is the headquarters of a great variety of activities that depend upon voluntary participation of hundreds of scientists and engineers throughout the United States. There is probably no idea or plan for the improvement of American science or its applications in the United

States or abroad that has not been voiced by someone connected with NAS-NRC, and many of these plans are launched within it. Usually NAS-NRC acts in an advisory or catalytic capacity; it does not perform the teaching or research functions of a university, but it does influence what is done in the universities and in industrial and governmental research and development. A sharper explanation of the functions and activities of NAS-NRC would require, as examples, descriptions of many specific projects and proposals. I hope here only to leave with the reader a true, if indistinct, impression.

As briefly as possible I shall try to answer certain questions: What is the origin of NAS-NRC, how does it work, and how is it supported?

The National Academy of Sciences was established by act of Congress in 1863. It is a private, self-perpetuating body now consisting of more than 600 distinguished natural scientists, who are pledged to advise the Government upon request without financial compensation. During World War I the National Research Council was founded as a reservoir of this country's scientific talent upon which the Academy could draw as needed for advisory services. Now, so far as public service is concerned, the Academy and the Research Council act as a single organization under President Detlev W. Bronk.

The membership of the Academy is divided by scientific disciplines into 14 sections; the smallest with only 11 members, the largest with 96. There are three groups of members who constitute the National Research Council—those representing national scientific societies, those representing government, and those representing only themselves, called members-at-large. These three groups are divided among and attached to eight broad subject Divisions of NAS-NRC. They can control the policies of the Divisions and of NAS-NRC as a whole. They may also serve on appropriate committees of NAS-NRC. The majority of those who serve on NAS-NRC committees are neither members of the Academy nor of the Research Council; they are simply competent working scientists or engineers who upon invitation have agreed to give some of their time and contribute from their knowledge and experience, without financial compensation, to collective thought and action on problems, plans, or operations with which their committees are concerned.

In addition to the eight subject Divisions of the Research Council, there are three Offices—International Relations, Scientific Personnel, and Documentation—that are concerned with the needs of all the natural sciences.

The staff work of the NAS-NRC is done in its main building and is also scattered among 11 office buildings in Washington. Staff salaries, rental of space, supplies, equipment, communications, travel and subsistence of committee members and staff, etc., are paid from funds from a variety of public and private sources. NAS-NRC does not receive annual appropriations from Congress, but most of its operating funds do come from Government agencies for advisory services requested by them. Useful projects may also be initiated in NAS-NRC and offered for support to interested Government or private agencies.

From what I have just said, it should be clear that NAS-NRC is not a fund-granting agency. When and if it appears to be a giver, it is merely allocating funds provided by another agency. Here on Constitution Avenue, the National Science Foundation, a Government agency, is the giver; NAS-NRC, a private organization, the receiver.

—*Frank L. Campbell*

Science in Washington

SCIENTISTS IN THE NEWS

This column presents 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 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 2628 South Building, Washington 25, D. C.

CATHOLIC UNIVERSITY OF AMERICA

W. Gardner Lynn, professor of biology and head of Department, has been appointed associate editor in embryology for the *American Midland Naturalist.* Dr. Lynn presented a paper, "Effects of Thiourea Treatments on the Histology of the Pituitary in *Gambusea,*" at the Southeastern Regional Meeting of the Division of Comparative Endocrinology, American Society of Zoologists, held in Atlanta November 24-25.

Frank A. Biberstein, professor of civil engineering and head of Department, has been appointed a member of the Student Award Committee, American Society for Testing Materials, Middle Atlantic District.

William R. Osgood, professor of civil engineering, has been appointed a member of the Editorial Subcommittee of the American Society for Testing Materials Committee C-15, Manufactured Masonry Units.

GEOLOGICAL SURVEY

George W. Morey visited the Lawrence Radiation Laboratory at Livermore, Calif., for some experimental work on November 13-14, and the Geological Survey Laboratory at Menlo Park, Calif., for conferences on November 15.

HARRIS RESEARCH LABORATORIES

Alfred E. Brown has been appointed to the Scientific Manpower Commission for a three-year term commencing January 1. Dr. Brown also has been elected vice-president of the Commission.

Milton Harris has been elected president of the Yale Chemists' Association.

Anthony M. Schwartz presented a paper on "Recent Developments in Surface Physics" at the semiannual meeting of the Society of Cosmetic Chemists in New York on November 28.

Henry Peper gave a talk on "Interactions in Monolayers" at the Toni Company in Chicago on October 26. Both Toni and Harris Research Laboratories are affiliates of the Gillette Company. Mr. Peper also spoke before the American Home Laundry Conference in Chicago October 27, on the subject of "Soils, Stains, and Detergents."

Milton Harris has been elected to the Advisory Board of *Chemical and Engineering News.*

John Krasny presented a paper entitled, "Fabric Construction for Wash-and-Wear Cottons," at the 10th Annual Cotton Chemical Finishing Conference in Washington on November 8.

Lyman Fourt presented a paper entitled, "Biophysics of Clothing for the Cold," at a meeting of the Northern New England Section of the American Association of Textile Chemists and Colorists,

held October 20 at Natick, Mass.

Alfred E. Brown gave a talk before the Raritan Valley Subsection of the North Jersey Section of the American Chemical Society at New Brunswick, N. J., November 8, on the subject of "Creative Scientists and their Stimulation in Research Laboratories."

Edmund M. Buras, Jr., addressed a luncheon meeting of the Washington Section, American Institute of Chemists, on "Soviet Synthetic Fiber Research." November 14.

NATIONAL BUREAU OF STANDARDS

Lawrence M. Kushner has been named chief of the Metallurgy Division.

Ralph P. Hudson has been appointed chief of the Heat Division. Dr. Hudson will continue to serve temporarily as chief of the Cryogenic Physics Section.

NAS-NRC

Clem O. Miller has resigned as executive secretary of the Division of Chemistry and Chemical Technology, and effective December 1 has become executive secretary of the Research Fellowships Section, Division of General Medical Sciences, National Institutes of Health.

USDA, BELTSVILLE

James H. Turner, research parasitologist at the Beltsville Parasitological Laboratory, has been awarded a Fulbright Research Grant for 1962. Dr. Turner will investigate the pathogenicity and immunology of certain ovine parasites at the McMaster Animal Health Laboratory in Sydney, Australia. He will be granted leave from his position as leader of sheep and goat helminth research at the Beltsville station for the duration of his stay abroad.

E. E. Wehr gave talks on "Observations on the Schizogony of *Leucocytozoon smithi* in the Turkey" at a recent meeting of the Virginia Academy of Sciences, Lexington, Va., and the Avian Diseases Meeting, Morgantown, W. Va.

A. L. Taylor, leader of Nematology Investigations, recently spent two weeks at the Estacion Experimental Agricola, La Molina, Peru, conferring with Dr. Juan E. Simon, in charge of this station, and other research technologists on investigations on the nematode problems in that country. On his return trip he stopped in Biloxi, Miss., to attend the American Phytopathological Society meetings, December 10-13.

USDA, WASHINGTON

Justus C. Ward presented a paper entitled "Proper Use of Pesticides" at the meeting of Entomological Society of America held in Miami, November 27-28. On November 29, he became director of the newly established Pesticides Regulation Division, which will carry out the functions previously performed by the Pesticides Regulation Branch, Plant Pest Control Division.

Harold H. Shepard, as president-elect of the Entomological Society of Washington, became president at the annual business meeting on December 7.

UNCLASSIFIED

Henry P. Kalmus, associate technical director of the Diamond Ordnance Fuze Laboratories, has been awarded the Army's Gold Medal Award for Exceptional Service. This is the highest award the Army bestows upon a civilian. Dr. Kalmus has been issued over 30 patents for inventions, many of which are applicable to missiles, nuclear weapons, and radar and target detection systems which have contributed immeasurably to developments in modern weaponry.

Frank M. Setzler has been appointed director of the Southeast Museum of the North American Indian in Marathon, Fla., according to announcement by the Crane Foundation. Mr. Setzler retired on January 1 from the Office of Head Curator of the Department of Anthropology, U. S. National Museum.

AFFILIATED SOCIETIES

American Institute of Electrical Engineers, Washington Section

The Technical Group on Microelectronics, on December 5, sponsored a joint meeting with the Institute of Radio Engineers and the American Society of Naval Engineers. Gene Strull, of Westinghouse, spoke on "Molecular Electronics."

On December 6, the Technical Group on Nucleonics, jointly with the Professional Group on Nuclear Science of the Institute of Radio Engineers, met to hear Jack Greene, of the Office of Emergency Planning, assisted by a panel of three (D. C. Cook, L. Costrell, and A. W. Carriker) discuss the problem of "Radiation Instruments for Family Use in Civil Defense Emergencies."

The December 12 general meeting, wrongly reported in the Calendar last month, presented Maurice J. Gelpi, of the Westinghouse Corporation, in an analysis of "Ultrasonics."

American Meteorological Society, D.C. Branch

Helmut E. Landsberg, Office of Climatology, U.S. Weather Bureau, spoke to the Branch on December 20 on the general subject "Modification of Climate by Urbanization," pointing out the effects of radical changes in the earth's surface and air pollution on such factors as temperature, humidity, wind, cloudiness, and precipitation. This program was accompanied by a short PHS film on air pollution control.

American Society of Civil Engineers, National Capital Section

"The U.S. Highway Exchange Team Visit to the USSR" was selected as the title of a report by Francis C. Turner, Bureau of Public Roads, at the December 12 dinner meeting. The group traveled about 8,000 miles through the Soviet Union by air, rail, bus, and automobile to observe construction practices, designs, traffic and equipment.

American Society of Mechanical Engineers, Washington Section

Judging by the most recent issue of the Section *Bulletin*, the November meeting, featuring a talk by A. V. Kuznetsov and a film of the Soviet cosmonaut, Titov, was hugely successful.

Two papers were presented at the December 14 meeting: "Thermal Design for Power Reactors," by James Coughlin of Babcock & Wilcox Co.; and "Mechanical Design for Power Reactors," by Joseph V. Cupo, Allis-Chalmers.

Botanical Society of Washington

New officers of the Society for 1962 were elected on December 5. They are: A. C. Smith, president; L. C. Cochran, vice-president; Mason Hale, recording secretary; Marie L. Farr, corresponding secretary; A. A. Piringer, treasurer; and O. L. Justice and D. D. Keck, councillors. Following the installation ceremonies, the retiring president, W. D. McClellan, spoke on "Weeds, Worms, and Other Worrisome Things."

Chemical Society of Washington

The December meeting, held at the National Institutes of Health, featured Karl A. Folkers, executive director of fundamental research at Merck and Company and president-elect of the American Chemical Society, who spoke on "Newer Aspects of Chemical and Biological Research on Coenzyme Q."

Four Topical Groups held before-dinner meetings. Paul L. Day of FDA addressed the Biochemical Group on "The Science of Biochemistry: Past, Present, and Future." Milton Orchin of the University of Cincinnati addressed the Organic Group on "Cis-trans Isomerization Catalyzed by Selenium." George F. Fraenkel of Columbia University addressed the Physical Group on "The Determination of Electron Distributions from Electron Spin Resonance Spectra." And Bourdon F. Scribner of NBS addressed the Analytical Group on "An Analytical Tour of West Europe."

Geological Society of Washington

G. Arthur Cooper, retiring president, spoke at the December 13 meeting on the topic "Stratigraphy of Glass Mountains, Texas." The 69th annual meeting of the Society followed, at which time officers for 1962 were elected.

Institute of Radio Engineers, Washington Section

At the general meeting on December 12, a program postponed from November presented Paul H. Robbins, executive director of the National Society of Professional Engineers, in an examination of the proposition that "Your Technology is Not Enough."

Technical meetings during the month of December included the following: December 4—"Mohole Measurement Problems"; December 6—"Civilian Instruments for Measurement of Radiation Fallout"; December 14—"Kilomegacycle Computer Circuits and Systems"; December 19—"Scoring Criteria for Determining RFI Damage"; and "Electronically Scanned Satellite Antennas."

Measures are being taken looking toward eventual merger of the Institute of Radio Engineers and the American Institute of Electrical Engineers. A detailed consideration of this problem appears in the December issue of the *Washington Bulletin*, by L. V. Berkner.

Philosophical Society of Washington

The Tenth Annual Christmas Lectures, by Frank D. Drake of the National Radio Astronomy Observatory, examined two topics, the first on December 21, the second on December 22: "Searching for Life in Space," and "Cosmic Radio Waves."

Officers of the Philosophical Society for 1962 are R. D. Myers, president; F. N. Frenkiel and M. M. Shapiro, vice-presidents; L. Slack, corresponding secretary; M. C. Henderson, recording secretary; and J. S. Toll, treasurer. Members-at-large of the General Committee are L. M. Branscomb, U. Liddel, B. W. Sitterly, and W. J. Youden.

Society for Experimental Biology and Medicine, D.C. Section

At the December 7 meeting, held jointly with the local chapter of the American Association of Clinical Chemists, four papers were presented, as follows: "On the Carbohydrate Moiety in Fibrinogen," by Koloman Laki, NIH; "Development of the Laboratory Detection of Hepatoma in Rainbow Trout," by S. F. Snieszko, Fish and Wildlife Service; "Automation in the Clinical Laboratory," by J. N. Stabile, Walter Reed; and "Effects of Mannitol on Renal Blood Flow in Experimental Hypotension," by W. E. Braun and L. S. Lilienfield, Georgetown University.

Society of American Military Engineers, Washington Post

Herbert A. Swenson, Geological Survey, addressed the luncheon meeting on December 18 on the topic, "Geological Survey Research in Water."

CALENDAR OF EVENTS

Events which will take place, so far as we can determine at the time of writing, are noted below. Where no indication of the program other than date appears, it will in most instances be a regularly scheduled meeting of the society. Last-minute changes in time and place, or emergency cancellations, cannot be reflected here.

January 11—American Society of Mechanical Engineers, Washington Section

PEPCO Auditorium, 10th and E Sts., N.W., 8:00 p.m.

January 11—Chemical Society of Washington

Two Topical Group meetings at 5 p.m.: *Inorganic*, D. L. Leussing, National Bureau of Standards, "The Transition Metal Ion-Mercaptide Coordination Compounds": *Analytical*, L. T. Hallett, American Chemical Society, "The Author, the Reader, and the Editor."

Social period at 6 p.m., and dinner at 6:45, at Holy Redeemer Catholic Church, Berwyn Road, College Park.

The general meeting at 8:15 will feature

three concurrent sessions with two speakers each, as follows: I. "Recent Advances in Agricultural and Food Chemistry," with Edward O. Haenni of FDA and Sam R. Hoover of USDA; II. "Recent Advances in Chemotherapy," with Abraham Goldin of GWU and Albert Sjoerdsma of NIH; III. "The Chemistry of Macromolecules in Biological Systems," with Leo Mandelkern of NBS and Sterling B. Hendricks of USDA.

All lectures in Nathan L. Drake Lecture Hall, University of Maryland, except that Session III will be held in the Physics Building.

January 15—Acoustical Society of America, Washington Chapter
National Bureau of Standards, 8:00 p.m.

January 15—Institute of Radio Engineers, Washington Section
Meeting of Professional Group on Engineering Management.

January 15—Society of American Military Engineers, Washington Post
YWCA, 17th and K Sts., N.W. Luncheon at noon.

January 16—Columbia Historical Society
Annual Meeting in Heurich Mansion. Two papers will be presented: "Chronicles," by Miss Elizabeth Clark; and "Divided Loyalties in Washington at Time of the Civil War," by James H. Whyte.

January 16—Institute of Radio Engineers, Washington Section
Meeting of Professional Group on Antennas and Propagation.

January 17—Insecticide Society of Washington
Symons Hall, University of Maryland, 8:00 p.m.

January 17—Washington Society of Engineers
Powell Auditorium, 8:00 p.m.

January 18—Society of American Foresters, Washington Section
YWCA, 17th and K Sts., N.W. Dinner meeting at 6:30 p.m.

January 19—Institute of Radio Engineers, Washington Section
Meeting of Professional Group on Reliability and Quality Control.

January 22—Institute of Radio Engineers, Washington Section
Meeting of Professional Group on Electron Devices.

January 23—American Society of Civil Engineers, National Capital Section
Luncheon Meeting, YWCA, 17th and K Sts., N.W., noon.

January 23—Institute of Radio Engineers, Washington Section
Meeting of Professional Group on Space Electronics and Telemetry.

January 23—Society of American Bacteriologists, Washington Branch
Walter Reed Medical Center, 8:00 p.m.

January 25—American Society of Mechanical Engineers, Washington Section
PEPCO Auditorium, 10th and E Sts., N.W., 8:00 p.m.

BOARD OF MANAGERS MEETING NOTES

The Board of Managers held its 541st meeting on November 7 at the National Academy of Sciences, with President Abelson presiding.

Dr. Abelson reviewed the successful outcome of the Institute on Isotopes and Radioactivity which had been concluded during the previous week. He read excerpts of letters from the various high school teachers who had attended the lectures and laboratory as well as comments from auditors who also had been present. He indicated that it was planned to outline the whole procedure involved in organizing such an institute with the hope that it would be used as a model throughout the country. On motion of Dr. Robbins, the Board unanimously commended Dr. Abelson for his fine performance in organizing and conducting the Institute.

The minutes of the 540th meeting were approved with minor corrections.

Announcements. Dr. Abelson announced appointment of the Membership Committee's new Panel on Engineering, as follows: William G. Allen (chairman), John A. Bennett, John L. Torgesen, William A. Geyger, and Joseph M. Caldwell.

Meetings Committee. Dr. Frenkiel an-

nounced that the next meeting of the Academy would be held on Friday, November 17, and that Roger Revelle of the Department of Interior would speak on "The Tragic Scissors of Pakistan"—a discussion of lands ruined by irrigation. He observed that the change from the regular Thursday meeting night had been necessitated by the Cosmos Club's birthday celebration.

Dr. Frenkiel also announced that the following lecture would be held on Thursday, November 30, at which time Richard H. Bolt of NSF would speak on "Planning Resources for Scientific Progress."

Membership Committee. Dr. Robbins gave the first reading of the names of 35 candidates for membership in the Academy.

Committee on Grants-in-aid. Dr. McPherson reported that $854 remained for grants-in-aid, after action had been taken by the AAAS to reimburse the Academy for the $300 earlier donated for the support of high school students engaged in summer research.

The Board approved an increase in a previously-approved grant to Thomas G. Hoffman of Fairfax High School, from $55 to $100. It also approved a grant of $50 to Richard Peacock for a study of the recently-reported "mouse eruption" at Dulles Airport.

Policy and Planning Committee. Dr. Campbell reported the Committee's views on the Academy's most urgent needs, as follows: (1) Consideration must be given to restaffing the Academy office, to furnish the officers with relief from the chores which beset them; (2) the membership should be increased, partly by reaching more eligible individuals under the present criteria, and partly through consideration of other membership structures which would broaden the base of support; (3) the proposed increase in dues is a vital need. Concerning these needs, Dr. Campbell observed that one of the chores, involving sales of back issues of the *Journal* and other Academy publications, might very well be turned over to a commercial organization; and that for staffing the office, it would be desirable to find a retired WAS member to serve as executive secretary, with such clerical assistance as could be afforded.

Committee on Encouragement of Science Talent. The Secretary reported for Dr. Brenner that the Junior Academy has a growing interest in the publication of annual proceedings, and that he was making an effort to promote this in various practical ways. He indicated that papers would be presented again this year at the Junior Academy's December meeting.

Secretary's report. The Secretary reported that, as of November 6, there were 841 resident active members, 66 resident emeritus members, 164 nonresident active members, 70 nonresident emeritus members, and 5 nonresident honorary members. As concerns patron members, of whom there are currently none, he referred to a discussion at the previous Board meeting, concerning the possibility of financial support of the Academy by persons not otherwise qualified for membership. In this connection, he provided the Board with a list of names of the Academy's eight former patrons, elected in the period 1899-1901.

The Secretary also reported the names of members deceased since the May meeting, as follows: Herbert G. Dorsey, Sears P. Doolittle, Percy W. Bridgman, Gotthold Steiner, John W. McBurney, and Paul R. Heyl.

New business. Dr. Frenkiel called attention to the revised *Bulletin* of the Philosophical Society. He circulated copies of a reprint from this periodical, containing the 30th Joseph Henry Lecture by Frances Bitter, on "New Developments in High Magnetic Field Research."

Chicago Academy of Sciences. At the conclusion of regular business, Dr. McPherson presented a talk on the organization and program of the Chicago Academy of Sciences. This was one of a series of presentations on academies of science that have been undertaken by members of the Policy and Planning Committee.

Miscellaneous. Dr. Van Evera suggested that the Board consider use of the *Journal* to carry notices of meetings, in place of the postcard notices presently used; this, he felt, would effect a considerable saving in the Secretary's budget, although it would require the planning of meetings perhaps five weeks in advance. In the ensuing discussion by Drs. Abelson and Frenkiel, it was brought out that setting up a meeting so far in advance is not always feasible in view of limitations in the availability of speakers; also, that the *Journal* is geared to the regular "third Thursday" meeting date, and could not expect to handle notices of special meetings on other dates. No conclusions were reached.

SCIENCE AND DEVELOPMENT

A special transportation seminar for educators from the University of Belgrade was concluded November 10 at Catholic University. The seminar, sponsored by the International Cooperation Administration, was organized to assist the visiting professors in planning a school of transportation to be established in Yugoslavia.

The Report of the President of the Carnegie Institution of Washington, released on December 11, is an interesting account of major advances in understanding the nature of the universe, the structure of the earth, and the mechanisms of life made by scientists of the six research departments of the Institution during the past year. Many of these contributions were made by members of the Washington Academy of Sciences.

The National Science Foundation has awarded a cost-sharing contract for research in mechanical language translation to the Ramo-Woolridge Corporation, Canoga Park, Calif. Research has been underway on mechanical translation of Russian to English in the Synthetic Intelligence Department of this corporation since 1958. Under this contract, Ramo-Woolridge will undertake to compile a dictionary of approximately 300,000 words of Russian text representing five fields of study, a study on cyclical improvement of the translation program and dictionary, and a study of overall system considerations to determine how easily modifications and supplements can be introduced into the program.

Forty meteorologists, representing the weather services of 30 nations, met in Washington on November 13 for a 10-day International Meteorological Satellite Workshop. The purpose of the workshop was to share with weathermen throughout the world, the knowledge and skills obtained from America's exploration of space for use in daily weather forecasting. Several days of laboratory work were scheduled to give the participants practice in using actual satellite photographs and infrared radiation data to prepare weather analyses.

The University of Maryland has been awarded a contract of $912,000 for a four-year interdepartmental research study of materials in the solid state. The study is sponsored by the Advanced Research Projects Agency of the Department of Defense. It will be conducted in the Departments of Physics and Chemistry and the Institute for Molecular Physics. The aim of the study is to aid scientists to understand better the physical properties of materials and their behavior in unusual states in the light of our present knowledge of the structure of matter.

The Fourth Institute on Information Storage and Retrieval will be held February 12-16 at American University. Topics on the program are Organization and Management of Technical Information Centers; Management Information Needs to Administer Technical Projects; Selective Dissemination of Information; Operation of Technical Information Centers; Decision-Making Processes; Guidelines to Technical Library Automation; and Management Control Systems.

BYLAWS
OF THE
WASHINGTON ACADEMY OF SCIENCES

(Last Revised in March 1960)

Article I—Purposes

Section 1. The purposes of the Washington Academy of Sciences shall be: (a) to stimulate interest in the sciences, both pure and applied, and (b) to promote their advancement and the development of their philosophical aspects by the Academy membership and through cooperative action by the affiliated societies.

Section 2. These objectives may be attained by, but are not limited to:

(a) Publication of a periodical and of occasional scientific monographs and such other publications as may be deemed desirable.
(b) Public lectures of broad scope and interest in the fields of science.
(c) Sponsoring a Washington Junior Academy of Sciences.
(d) Promoting science education and a professional interest in science among people of high school and college age.
(e) Accepting or making grants of funds to aid special research projects.
(f) Symposia, both formal and small informal, on any aspects of science.
(g) Scientific conferences.
(h) Organization of, or assistance in, scientific expeditions.
(i) Cooperation with other Academies and scientific organizations.
(j) Awards of prizes and citations for special merit in science.
(k) Maintaining an office and staff to aid in carrying out the purposes of the Academy.

Article II—Membership

Section 1. The membership shall consist of three general classes: active members (including those in life and emeritus status), honorary members, and patrons.

Section 2. Nominations for active membership shall be presented in writing at a meeting of the Board of Managers, each endorsed by at least two members of the Academy, one of whom shall have knowledge of the nominee's field. They shall be accompanied by a statement of the qualifications of the nominee and a list of his more important scientific publications and activities.

Section 3. Election to active membership shall be by vote of the Board of Managers. Final action on nominations shall be deferred at least one week after presentation to the Board and three-fourths of the vote cast shall be necessary to elect. An election to active membership shall be void if the person elected does not within three months thereafter pay his dues or satisfactorily explain his failure to do so.

Section 4. Active members shall be persons who by reason of original research or scientific attainment are deemed worthy of the honor of election to Academy membership. They shall be classed as resident and non-resident, those living within 25 miles of the White House, Washington, D. C., being considered resident members. The number of active members shall not exceed 1500, of whom not more than 1200 shall be resident members, provided that non-resident may become resident members regardless of this limitation.

Section 5. Active members in good standing who have attained the age of 65 and are retired from the gainful practice of their profession, or are retired before the age of 65 because of disability, may become emeritus members. Upon request to the treasurer for transfer to this status, they shall be relieved of the further payment of dues, beginning with the following January first. Such emeritus members shall receive notices of meetings without charge and, at their request, shall be entitled to receive the Academy periodical at one-half the price to non-members.

Section 6. Life members shall be those active members who have made a single payment in accordance with Article III, Section 2, in lieu of annual dues.

Section 7. Former active members who resigned in good standing may be reinstated upon application to the Secretary and approval of the Board of Managers, reinstatement being regardless of the limitations as to size of membership. No consideration of the applicant's qualifications need be made by the Membership Committee in these cases.

Section 8. Honorary members shall be limited to 15 in number. To be nominated for honorary membership, no less than two-thirds of the number of members of the Membership Committee must (a) recognize the candidate to be distinctly outstanding in scientific accomplishments and preferably to have participated or have been interested in the scientific activities of the Washington area, and (b) recommend to the Board of Managers that the candidate be elected. A three-fourths affirmative vote of the Board shall be required for election to honorary membership. The Board of Managers, as an alternative procedure, may nominate for honorary membership and, if two-thirds of the Membership Committee concurs, may then proceed to act on the nomination as though the Membership Committee had initiated the action.

Section 9. Persons who have given to the Academy not less than one thousand (1,000) dollars or its equivalent in property shall be eligible for election by the Board of Managers as patrons of the Academy.

Article III—Dues

Section 1. The annual dues of resident active members shall be six dollars and of nonresident active members five dollars, payable January 1. Dues for fractional parts of a year shall be at the monthly rate of one-twelfth the annual rate. Emeritus members, honorary members, and patrons shall pay no dues.

Section 2. Active members in good standing may be relieved of further payment of dues by making a single payment to provide an annuity equivalent to the annual dues of resident active members (see Art II, Sect. 6). The annuity of such life members shall be computed on the basis of an interest rate to be determined by the Board of Managers.

Section 3. Members whose dues are in arrears for one year shall not be entitled to receive Academy publications.

Section 4. Members whose dues are in arrears for more than two years shall be dropped from the rolls of the Academy, upon notice to the Board of Managers unless the Board shall otherwise direct. Persons who have been dropped from membership for nonpayment of dues may be reinstated upon approval of the Board and upon payment of back dues for two years together with dues for the year of reinstatement.

Article IV—Officers

Section 1. The officers of the Academy shall be a President, a President-elect, a Secretary, a Treasurer, an Editor, a Managing Editor, an Archivist, and a Custodian of Publications. All shall be chosen from resident members of the Academy.

Section 2. The President shall appoint all committees unless otherwise directed by the Board of Managers or provided in the bylaws. He (or his substitute—the President-elect, the Secretary, or the Treasurer, in that order) shall preside at all meetings of the Academy and of the Board of Managers.

Section 3. The Secretary shall act as secretary to the Board of Managers and to the Academy at large. He shall conduct all correspondence relating thereto, except as otherwise provided, and shall be the custodian of the corporate seal of the Academy. He shall arrange for the publication in the Academy periodical of the names and professional connections of new members, and also of such proceedings of the Academy, including meetings of the Board of Managers, as may appropriately be of interest to the membership. He shall be responsible for keeping a register of the membership, showing such information as qualifications, elections, acceptances, changes of residence, lapses of membership, resignations and deaths, and for informing the Treasurer of changes affecting the status of members. He shall act as secretary to the Nominating Committee (see Art. VI, Sect. 2).

Section 4. The Treasurer shall be responsible for keeping an accurate account of all receipts and disbursements, shall select a suitable depository for current funds which shall be approved by the Executive Committee, and shall invest the permanent funds of the Academy as directed by that Committee. He shall prepare a budget at the beginning of each year which shall be reviewed by the Executive Committee for presentation to and acceptance by the Board of Managers. He shall notify the Secretary of the date when each new member qualifies by payment of dues. He shall act as business adviser to the Editor and shall keep necessary records pertaining to the subscription list. In view of his position as Treasurer, however, he shall not be required to sign contracts. He shall pay no bill until it has been approved in writing by the chairman of the committee or other persons authorized to incur it. The fiscal year of the Academy shall be the same as the calendar year.

Section 5. The President and the Treasurer, as directed by the Board of Managers, shall

jointly assign securities belonging to the Academy and indorse financial and legal papers necessary for the uses of the Academy, except those relating to current expenditures authorized by the Board. In case of disability or absence of the President or Treasurer, the Board of Managers may designate the President-elect or a qualified Delegate as Acting President or an officer of the Academy as Acting Treasurer, who shall perform the duties of these officers during such disability or absence.

Section 6. The Editor shall have control of the scientific content of the Academy's publications. He shall be appointed for an indefinite term subject to annual review by the Board of Managers, on nomination of the Executive Committee.

Section 7. The Managing Editor shall sign all contracts and is authorized to supervise all activities connected with the production of the Academy's publications in accordance with fiscal and editorial plans to be approved annually by the Executive Committee and the Board of Managers. He shall be appointed for a term of one year by the Board of Managers on nomination of the Executive Committee.

Section 8. The Archivist shall maintain the permanent records of the Academy, including important records which are no longer in current use by the Secretary, Treasurer or other officer, and such other documents and material as the Board of Managers may direct. The Archivist shall be appointed by the President for a term of three years.

Section 9. The Custodian of Publications shall have general supervision of subscriptions for the publications and of the sale of reserve stocks of publications of the Academy. He shall recommend jointly with the Treasurer to the Board of Managers changes in the procedures and prices relative to subscriptions, reserve stocks of publications and reprints. He shall have charge of and be responsible for reserve stocks of the Academy's publications, and shall maintain a detailed inventory of reserve stocks. The Custodian of Publications shall be appointed by the President for a term of three years.

Section 10. All officers and chairmen of standing committees shall submit annual reports at the January meeting of the Board of Managers.

Section 11. No one shall be eligible to hold elective office until one year after election to membership.

Section 12. Prior to November 1 of each year the Nominating Committee (Art. VI, Sect. 2), having been notified by the Secretary, shall meet and nominate by preferential ballot, in the manner prescribed by the Board of Managers, one person for each of the offices of President-elect, of Secretary and of Treasurer, and four persons for the two Managers-at-large whose terms expire each year. It shall, at the same time and in like manner, make nominations to fill any vacancy in the foregoing. Not later than November 15, the Secretary shall forward to each Academy member a printed notice of these nominations, with a list of incumbents. Independent nominations may be made in writing by any ten active members. In order to be considered, such nominations must be received by the Secretary before December 1.

Section 13. Not later than December 15, the Secretary shall prepare and mail ballots to members. Independent nominations shall be included on the ballot, and the names of the nominees shall be arranged in alphabetical order. When more than two candidates are nominated for the same office the voting shall be by preferential ballot in the manner prescribed by the Board of Managers. The ballot shall contain also a notice to the effect that votes not received by the Secretary before the first Thursday of January, and votes of members whose dues are in arrears for one year, will not be counted. The Committee of Tellers shall count the votes and report the results at the annual meeting of the Academy.

Section 14. The newly elected officers shall take office at the close of the annual meeting, the President-elect of the previous year automatically becoming President.

Article V—Board of Managers

Section 1. The activities of the Academy shall be guided by the Board of Managers, consisting of the President, the President-elect, one Delegate from each of the affiliated societies, the Secretary, the Treasurer, six elected Managers-at-large, the Editor, the Managing Editor, the Archivist, and the Custodian of Publications. The elected officers of the Academy shall hold like offices on the Board of Managers.

Section 2. One Delegate shall be selected by each affiliated society (see Art. VIII, Sect. 3). He shall serve until replaced by his society. Each Delegate is expected to participate in the meetings of the Board of Managers and vote on behalf of his society.

Section 3. The Board of Managers shall transact all business of the Academy not otherwise provided for. A quorum of the Board shall be nine of its members.

Section 4. The Board of Managers may provide for such standing and special committees as it deems necessary.

Section 5. The Board shall have power to fill vacancies in its own membership until the next annual election. This does not apply to the offices of President and Treasurer (see Art. IV, Sect. 5), nor to Delegates (see Art. V, Sect. 2).

Article VI—Committees

Section 1. An Executive Committee shall have general supervision of Academy finances, approve the selection of a depository for the current funds, and direct the investment of the permanent funds. At the beginning of the year it shall present to the Board of Managers an itemized statement of receipts and expenditures of the preceding year and a budget based on the estimated receipts and disbursements of the coming year, with such recommendations as may seem desirable. It shall be charged with the duty of considering all activities of the Academy which may tend to maintain and promote relations with the affiliated societies, and with any other business which may be assigned to it by the Board. The Executive Committee shall consist of the President, the President-elect, the Secretary and the Treasurer (or Acting Treasurer) ex officio, as well as two members appointed annually by the President from the membership of the Board.

Section 2. The Delegates shall constitute a Nominating Committee (see Art. IV, Sect. 12). The Delegate from the Philosophical Society shall be chairman of the Committee, or, in his absence, the Delegate from another society in the order of seniority as given in Article VIII, Section 1.

Section 3. The President shall appoint in advance of the annual meeting an Auditing Committee consisting of three persons, none of whom is an officer, to audit the accounts of the Treasurer (Art. VII, Sect. 1).

Section 4. On or before the last Thursday of each year the President shall appoint a committee of three Tellers whose duty it shall be to canvass the ballots (Art. IV, Sec. 13, Art. VII, Sect. 1).

Section 5. The President shall appoint from the Academy membership such committees as are authorized by the Board of Managers and such special committees as necessary to carry out his functions. Committee appointments shall be staggered as to term whenever it is determined by the Board to be in the interest of continuity of committee affairs.

Article VII—Meetings

Section 1. The annual meeting shall be held each year in January. It shall be held on the third Thursday of the month unless otherwise directed by the Board of Managers. At this meeting the reports of the Secretary, Treasurer, Auditing Committee (see Art. VI, Sect. 3), and Committee of Tellers shall be presented.

Section 2. Other meetings may be held at such time and place as the Board of Managers may determine.

Section 3. The rules contained in "Robert's Rules of Order Revised" shall govern the Academy in all cases to which they are applicable, and in which they are not inconsistent with the bylaws or the special rules of order of the Academy.

Article VIII—Corporation

Section 1. The term "affiliated societies" in their order of seniority (see Art. VI, Sect. 2) shall be held to cover the:

Philosophical Society of Washington
Anthropological Society of Washington
Biological Society of Washington
Chemical Society of Washington
Entomological Society of Washington

National Geographic Society
Geological Society of Washington
Medical Society of the District of Columbia
Columbia Historical Society
Botanical Society of Washington
Washington Section of Society of American Foresters
Washington Society of Engineers
Washington Section of American Institute of Electrical Engineers
Washington Section of American Society of Mechanical Engineers
Helminthological Society of Washington
Washington Branch of American Society for Microbiology
Washington Post of Society of American Military Engineers
Washington Section of Institute of Radio Engineers
District of Columbia Section of American Society of Civil Engineers
District of Columbia Section of Society for Experimental Biology and Medicine
Washington Chapter of American Society for Metals
Washington Section of the International Association for Dental Research
Washington Section of Institute of the Aerospace Sciences
D. C. Branch of American Meteorological Society
Insecticide Society of Washington
Washington Branch of the Acoustical Society of America
Washington Section of the American Nuclear Society

and such others as may be hereafter recommended by the Board and elected by two-thirds of the members of the Academy voting, the vote being taken by correspondence. A society may be released from affiliation on recommendation of the Board of Managers, and the concurrence of two-thirds of the members of the Academy voting.

Section 2. The Academy may assist the affiliated scientific societies of Washington in any matter of common interest, as in joint meetings, or the publication of a joint directory: Provided, it shall not have power to incur for or in the name of one or more of these societies any expense or liability not previously authorized by said society or societies, nor shall it without action of the Board of Managers be responsible for any expenses incurred by one or more of the affiliated societies.

Section 3. Each affiliated society shall select one of its members as a Delegate to the Academy who is a resident member of the Academy (Art. V. Sect. 2).

Section 4. The Academy may establish and assist a Washington Junior Academy of Sciences for the encouragement of interest in science among students in the Washington area of high school and college age.

Article IX—Awards and Grants-in-aid

Section 1. The Academy may award medals and prizes, or otherwise express its recognition and commendation of scientific work of high merit and distinction in the Washington area. Such recognition shall be given only on approval by the Board of Managers of a recommendation by a committee on awards for scientific achievement.

Section 2. The Academy may receive or make grants to aid scientific research in the Washington area. Grants shall be received or made only on approval by the Board of Managers of a recommendation by a committee on grants-in-aid for scientific research.

Article X—Amendments

Section 1. Amendments to these bylaws shall be proposed by the Board of Managers and submitted to the members of the Academy in the form of a mail ballot accompanied by a statement of the reasons for the proposed amendment. A two-thirds majority of those members voting is required for adoption. At least two weeks shall be allowed for the ballots to be returned.

Section 2. Any affiliated society or any group of ten or more members may propose an amendment to the Board of Managers in writing. The action of the Board in accepting or rejecting this proposal to amend the bylaws shall be by a vote on a roll call, and the complete roll call shall be entered in the minutes of the meeting.

Delegates to the Washington Academy of Sciences, Representing the Local Affiliated Societies*

Philosophical Society of Washington	Lawson M. McKenzie
Anthropological Society of Washington	Regina Flannery Herzfeld
Biological Society of Washington	Herbert Friedmann
Chemical Society of Washington	John L. Torgesen
Entomological Society of Washington	William E. Bickley
National Geographic Society	Alexander Wetmore
Geological Society of Washington	Margaret D. Foster
Medical Society of the District of Columbia	Frederick O. Coe
Columbia Historical Society	U. S. Grant, III
Botanical Society of Washington	Harold T. Cook
Society of American Foresters	Harry A. Fowells
Washington Society of Engineers	Howard S. Rappleye
American Institute of Electrical Engineers	William A. Geyger
American Society of Mechanical Engineers	William G. Allen
Helminthological Society of Washington	Doys A. Shorb
American Society for Microbiology	Mary Louise Robbins
Society of American Military Engineers	Delegate not appointed
Institute of Radio Engineers	Robert D. Huntoon
American Society of Civil Engineers	Joseph M. Caldwell
Society for Experimental Biology and Medicine	Kathryn Knowlton
American Society for Metals	John A. Bennett
International Association for Dental Research	Gerhard Brauer
Institute of the Aerospace Sciences	Francois N. Frenkiel
American Meteorological Society	Jack Thompson
Insecticide Society of Washington	Milton S. Schechter
Acoustical Society of America	Richard K. Cook
American Nuclear Society	Urner Liddel

*Delegates continue in office until new selections are made by the respective affiliated societies.

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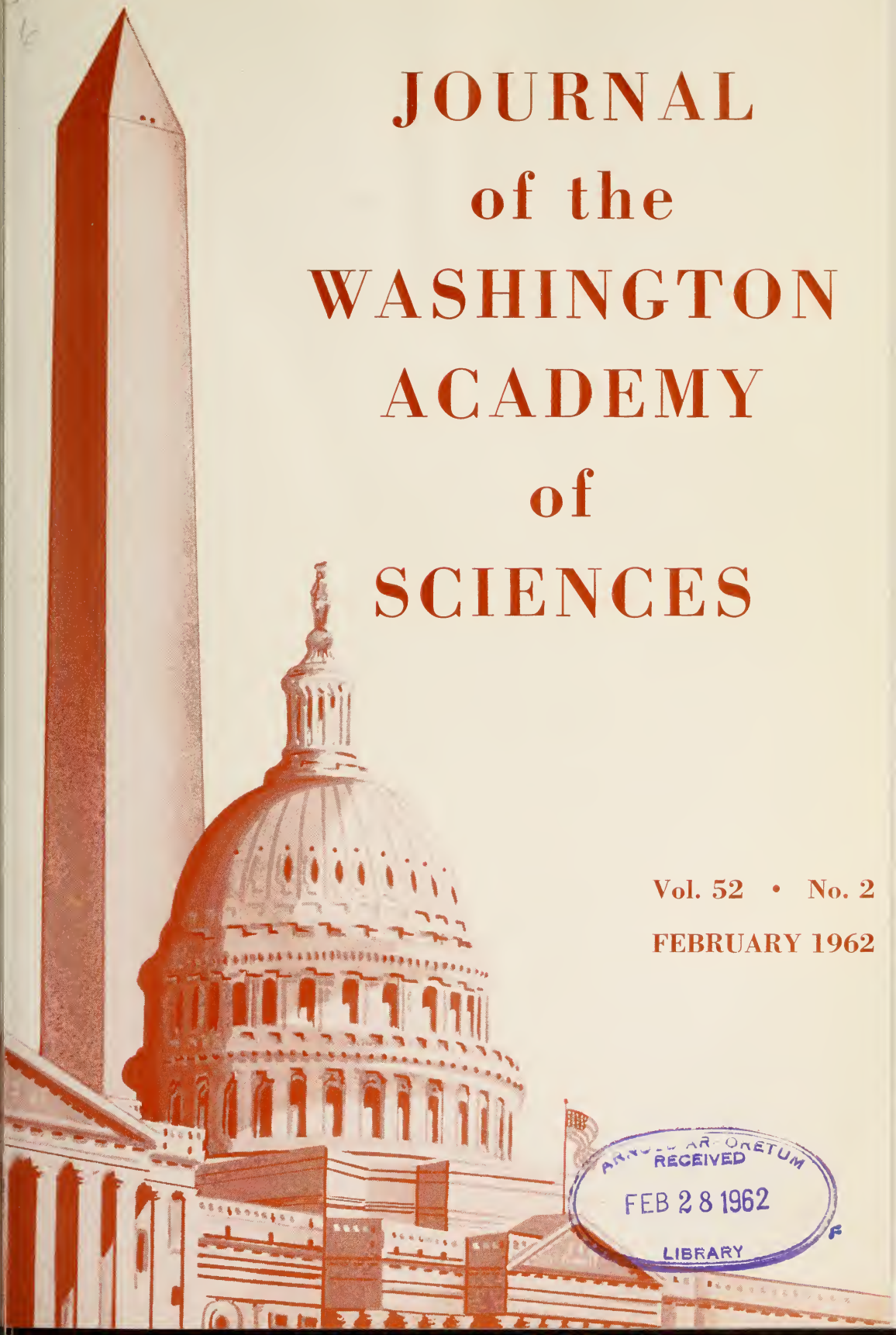

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FEBRUARY 1962

JOURNAL OF THE WASHINGTON ACADEMY OF SCIENCES

Editor: Samuel B. Detwiler, Jr., Department of Agriculture

This Journal, the official organ of the Washington Academy of Sciences, publishes historical articles, critical reviews, and scholarly scientific articles; notices of meetings and abstract proceedings of meetings of the Academy and its affiliated societies; and 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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Trends in Insect Control Agents*

Stanley A. Hall

Entomology Research Division, Agricultural Research Service, USDA

In any scientific field actively under development, it is useful and even necessary from time to time to stand back and attempt objectively to perceive a trend. The advent of DDT about 1945 marked the turning point away from the old inorganic insecticides, such as calcium arsenate, lead arsenate, and paris green, and from the comparatively ineffective organic compounds such as the thiocyanates, dinitrocresols, and phenothiazine. A trend then started toward the development of the chlorinated hydrocarbon insecticides, as we now call them. DDT stimulated the production of TDE, methoxychlor, BHC and lindane, the cyclodiene-type materials (chlordane, heptachlor, aldrin, dieldrin, and endrin), and other types such as toxaphene and strobane. Although DDT production in the United States last year was the highest ever—over 160 million pounds—I believe we are turning away from chlorinated hydrocarbons as a class of insecticides. We get very few new candidate materials in this class for evaluation at field laboratories of the Entomology Research Division.

We must recognize that an insect control agent is subjected every day of its useful life to selection pressures that will surely affect the volume of its use, its rise to prominence, its decline, its ultimate survival, or its failure to survive. To determine a trend, it is well to gear our thinking to the past few decades and to the next decade or two, or perhaps three, and then proceed to consider some of the chief selection pressures to which an agent is subjected.

* Adapted from a talk given before the Insecticide Society of Washington at the University of Maryland, November 15, 1961.

Selection Pressures

1. *Performance.* This means effectiveness of a material as compared with the nearest competing materials. Low dosage is important here.

2. *Cost.* This needs little elaboration. Consider (a) the effective dosage and (b) the potential cost. Remember that large-volume usage can scale down the cost of a material considerably. Also, look for any possibilities of improved chemical processes based on cheaper starting materials.

3. *Toxicity to Warm-blooded Animals.* Although an unfavorable acute toxicity can result in eliminating a material from the market, it more often happens that its chronic toxicity can generate the stronger pressure against it. If the toxicological studies point to carcinogenicity of a material, then the odds are very much against its survival.

4. *Residues.* Is the material persistent as a residue on a treated surface? Is its chronic toxicity unfavorable? Does the material find its way into meat or milk? What is the legal tolerance? Residue tolerance is a very real selection pressure which can surely influence the usage or survival of a given material.

5. *Resistance.* By this is meant the development of resistance in an arthropod species to an insecticide or acaricide. There are two crucial questions to ask here: (a) Is the material failing seriously against one or more important insect species? and (b) Does the resistant species, say the DDT-resistant house fly, soon become resistant or possess cross-resistance to the material in question?

A new material effective against the resistant strain will exert a strong selection pressure against competing materials. I

might mention the possibility of a new material being *more* effective against, say, a DDT-resistant strain than a DDT-susceptible strain. Although we have no such material today, we should always be on the lookout for the possibility of its discovery. Obviously it would quickly find itself in a commanding position, and would exert a strong pressure against materials of waning effectiveness due to resistance.

Let us look now at the newer organic insecticides and consider trends in their use in the light of selection pressures mentioned above.

Organophosphorus Insecticides

How many would have guessed in 1945 that Schrader's so-called HETP (active ingredient, tetraethylpyrophosphate) and his parathion in 1946 would have opened up the floodgates of organophosphorus insecticides? Gerhard Schrader is a recognized pioneer and guiding genius of organophosphorus insecticides. I had an opportunity about a year ago to discuss at some length with Dr. Schrader in his laboratories at Elberfeld, Germany, the many aspects of organophosphorus compounds and how many he synthesized per year. He estimated that his chemists synthesize, on the average, about 1500 compounds per year. He thought that this number was not even enough to send through the screen because there are so many different properties to be found in these compounds. Thousands of candidate organophosphorus insecticides have been synthesized in the laboratories of every industrial country in the world, such as Geigy, Ciba, and Hoffman-LaRoche in Switzerland; Monticatini in Italy; and Imperial Chemical Industries and others in England. In the United States, American Cyanamid, Monsanto, Dow, Hercules, Chemagro, Shell, Cal-Spray, *et al.* are actively engaged in exploring the many properties of organophosphorus insecticides. The Russians also have a very active program and are particularly concentrating on phosphonates. Melnikov, who heads up this work in Moscow, believes that phosphonates possess a broader spectrum of effectiveness against more arthropod species than do other organophosphorus compounds. His view may or may not turn out to be accurate. The important thing is that organophosphates as a class comprise by far the greatest number of new candidate materials that are being tested and synthesized as insect control agents. The very strong trend toward the organophosphorus insecticides is a matter of record, and it continues. We think of the organophosphorus materials as being short-lived and therefore not plagued with built-in residue problems. However, there is now a tendency to synthesize organophosphorus compounds of longer residual action than Guthion (Figure 1).

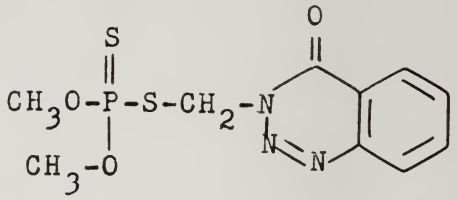
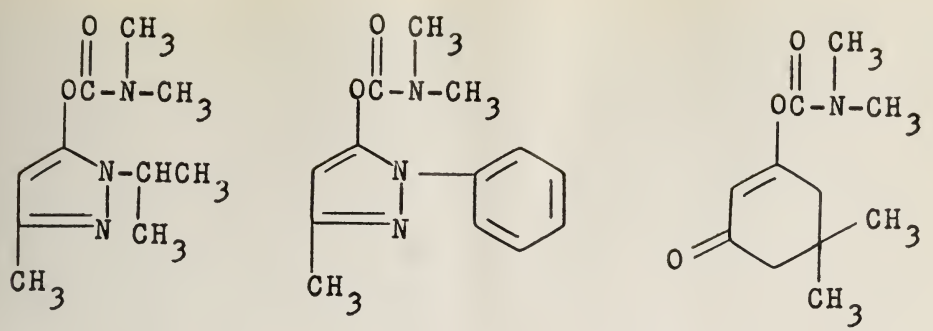


Figure 1 - GUTHION

Certainly most of our residue problems arise from the chlorinated hydrocarbon materials, and we may surely expect organophosphorus insecticides to replace the chlorinated hydrocarbons in part. This process is already under way and may be expected to proceed further, even to the point where possibly some of the more vulnerable chlorinated hydrocarbons could drop out of the picture entirely. The real beauty of the organophosphorus compounds lies in their inherent richness in many varied biological properties. This is what Schrader meant when he told me that he would like to synthesize and test even more of these extraordinary compounds. Some organophosphorus insecticides (like TEPP) will kill insects, then hydrolyze and leave no residue. Others are systemic either in growing plants or in animals; i.e., they act on the pest through the sap of a plant



Isolan Pyrolan Dimetan

Figure 2 - EARLY CARBAMATE INSECTICIDES

or the blood of an animal. The development of systemics for livestock and other animals in recent years has been nothing short of phenomenal.

Now, we know that resistance has not only developed to chlorinated hydrocarbons but also to organophosphorus insecticides, and in some laboratories this situation has given impetus to finding a new class of materials with some of the desirable residual properties of chlorinated hydrocarbons as well as the property of killing resistant insects. The carbamates seem to be fulfilling some of this need.

Carbamate Insecticides

The first study of carbamates as insecticides (Figure 2) was made by the Geigy Company in Switzerland. These turned out to be materials of limited usefulness, some of which are finding a market in Europe but not in the United States. Then along came Union Carbide with an unusually effective carbamate, Sevin (Figure 3). Sevin was found in the same way that practically all our new materials are found, i.e., by the empirical approach, the chemist making all obvious and intuitive variations of structure; this approach naturally included substitution of many alkyl groups on the nitrogen atom. It was found that a single methyl group was the best and 1-naphthyl was an effective radical. Even so, the resulting compound is highly insoluble and difficult to formulate. Sevin came upon the market at a time when there was a great need for an effective residual material that did not create another meat and milk residue problem. During the summer of 1961, Union Carbide shipped by air 2,300,000 pounds of Sevin to save the Egyptian cotton crop, which was threatened by an explosive infestation of a leafworm. This particular carbamate seems to have been the right material at that critical time. But of course new carbamates are cropping up, and some are likely to be better than Sevin in fulfilling certain peculiar requirements of our enormously varied insect control problems (Figure 4). The question arises, do the carbamates constitute a trend? Certainly they do. Is it a very significant long-term trend? My feeling—and here I go out on a limb—is that carbamates do not represent a trend that will ever compare in magnitude and significance with the organophosphorus insecticides. I say this because there is no evidence that carbamates as a class possess anything like the versatility, as insecticides, of the organophosphorus compounds. Some of the carbamates, indeed, show growth-regulating properties and are used as selective herbicides. This is a biological property not sought in an agricultural insecticide. Some carbamates have carcinogenic properties.

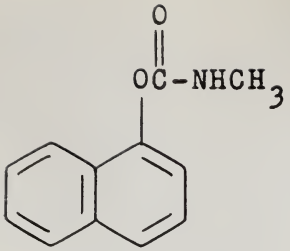
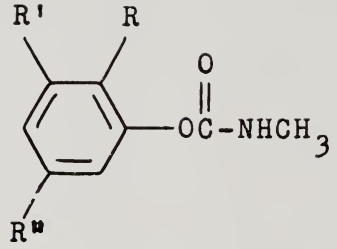


Figure 3 - SEVIN

Many of the carbamates are very toxic and inhibit cholinesterase, but these properties are also found in the organophosphorus compounds as a group.

Where To Look

However, if I were looking for a new profitable insecticide and heading a group of chemists synthesizing in this field, the goal being to replace a chlorinated hydrocarbon which is no longer useful either because of insect resistance or because of residue problems, I should still focus my search mainly in the realm of organophosphorus compounds, realizing that this search has not only become more costly but has also become what I would call much more powerful and more sophisticated. There is no room now for a simple hit-or-miss approach. Those days are over. We are in fact beginning to design new molecules in a way that has never really been done before. It is not enough that an insecticide kill insects in very low concentrations, or even that it be of acceptable moderate toxicity to warm-blooded animals, or that it fulfill, as I pointed out earlier, all the various competitive demands under selection pressures. It must meet exact standards of performance, and the way this new material can be found is first of all through synthesis, assuming that there is a library of a great many compounds to start with. The large research organization now sets up screening procedures which will not only challenge the insecticide spectrum of its candidates against a representative selected group of insects, but also the spectrum of its residual properties, its stability to sunlight, its



R	R'	R"	Name
$OCH(CH_3)_2$	H	H	Bayer 39007
$N(CH_3)_2$	CH_3	CH_3	Zectran (Dow)
H	$CH(CH_3)_2$	H	Hercules 5727 Carbide 10854

Figure 4 - NEWER CARBAMATE INSECTICIDES

freedom from phytotoxic effects, and its low warm-blooded toxicity. The candidates are measured against standards which may be DDT, parathion, or malathion. Thus, the requirements for a new insecticide are set high and realistically. *What you look for you find—eventually.* It is entirely feasible to write specifications in advance for the type of compound you want, and then to start screening and recording data to be fed into a modern digital computer which will store all these data in its electronic memory. When you wish to search for any combination of desirable characteristics the machine will furnish these data on command. It will not only do this, but also will select for you quickly, from a large storehouse of many, many thousands of compounds, any related structures so that these can be scheduled for testing. Thus, we are using much more of a guided synthesis than ever before. We do not know the biological mechanism of action, but we know the results and we know how to select and make the right kind of related compounds. Today the empirical approach is geared to more precise requirements and to groups of highly selected chemical structures. This development will result in our finding insecticides ultimately which are free from residue problems, which will hit certain resistant species and do a job that other insecticides today will not do. This is not a pipe dream, but an actual thing that is going on today in some of the big, well-supported laboratories. It is a big job which only the best equipped, best staffed organizations can tackle. Other byproducts will come from this approach. For example, from the process of screening, observations on the repellent effect of chemicals will be recorded in the system. There are probably repellents so powerful that a hungry insect will starve to death before it will eat the treated host material, which otherwise it would prefer. But the goal is to get a safe compound that will do this job at a very low applied dosage. So these screening goals are set up and the machines select this information. To sum up, the secret is (1) to set up a screening program to find the biological properties and performance you want; (2) to have thousands of chemicals to run through the program; (3) to synthesize enough new compounds to follow up adequately on leads obtained; and (4) to store and retrieve the information processed when you want it, to draw out the significant elements of interesting structures for testing, and really to guide the synthesis chemist. This approach is not confined to new insect control agents; it is the same approach used in the pursuit of new drugs. We know that we have today drugs that were formerly undreamed of in their specificity and high degree of effectiveness. We shall have the same with new

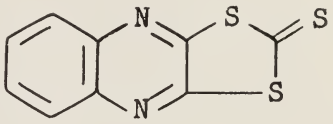


Figure 5 - ERADEX

insect-control agents. It is only a question of where to concentrate the effort and how much to put into it. When a new insecticide is developed, it does not mean that another highly useful one will be completely extinguished thereby. Take DDT, for example. This is such an extremely useful insecticide, and so cheap and safe to apply, that I should certainly expect it to be in use for at least another 25 years: but I should also expect its widespread use gradually to decline. It will be supplanted in part by other more useful materials, especially where insect resistance occurs. We shall not continue to use DDT for house fly control. This use has practically been abandoned in many areas. DDT will also be replaced where residue problems, especially in meat and milk, come into the picture.

New Types of Pesticides

There is no reason to think that we will not get into entirely new types of insect-control agents. In a certain sense, carba-

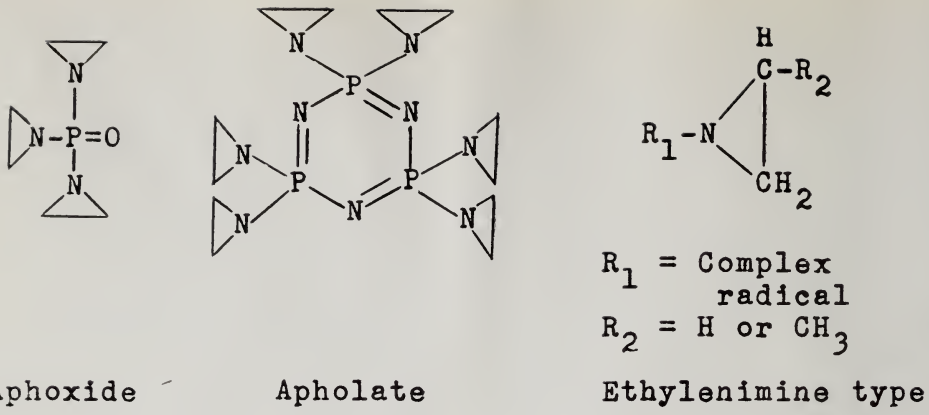


Figure 6 - CHEMOSTERILANTS

mates could be called a new type, but not in the same large sense as organophosphorus compounds. There are undoubtedly new types being explored in a number of pesticide-research laboratories. A successful new molecular type is something to watch for, an event that occurs infrequently. I point out the new acaricide Eradex (Figure 5) not to indicate a new broad type of pest-control agent, but just to show an entirely different type of acaricide. This comes from Bayer in Germany.

Chemosterilants

Chemosterilants will *not* move in quickly to replace insecticides. We know that certain ethylenimine derivatives are strikingly effective as chemosterilants (Figure 6). We do not know of any other type of compound at present that is nearly as effective as the ethylenimine derivatives. I am confident that we shall find better ethylenimine derivatives than we now have: better in the sense of being more effective, somewhat safer to use, and possessing the particular stability characteristics that we need. Instability and a strong tendency to polymerize are characteristic properties of these compounds: this picture may be good or bad depending on how you look at it. Ultimately we shall find entirely new types of chemosterilant compounds. A chemosterilant will not be used in the same way as an insecticide such as DDT, or even parathion. It is much more probable that insecticides will be applied first to reduce an insect population to the point at which a chemosterilant can be used to eradicate the pest in the whole area. Chemosterilants cannot be used agriculturally the way insecticides are used, i.e., by individual growers. Their very nature demands that they be used over a large area and under carefully controlled conditions. This restriction poses a problem in the United States, where so many growers and farmers have individual preferences. But I believe that this problem will not be insurmountable for us, and I estimate that it will be possibly 10 years before we have the practical and safe chemosterilant we are looking for. When we find it, it will be used with powerful effect.

Insect Attractants

Our synthesis program at Beltsville has pioneered in insect attractants and can effectively continue as a long-term program. Like that of chemosterilants, the use of attractants for actual control or eradication will take a number of years to develop, and will not cover a wide spectrum of insect species. Attractants are specific, and we must find them one by one. I am not now speaking of bait materials such as the protein hydrolysates. But there will be much

research in this new field—of this there can be little doubt. Male attractants and chemosterilants are just made for one another, and we shall certainly explore the obvious combinations here.

Biological Control Agents

Biological control by means of parasites, predators, and pathogens promises to be exploited to a greater extent than in the past; it will definitely be a long-term development. In my mind, it does not conflict with development of insecticides. The two approaches may very well be used most effectively together. Insecticides will continue as our mainstay. I believe that the use of insecticides and other pesticides in agriculture is a practice as well established and as important as the use of chemical fertilizers. This condition will prevail for many years ahead.

Van Evera Heads Academy in 1962

Benjamin D. Van Evera, dean for sponsored research at George Washington University, was installed as the Academy's president for 1962 at the close of the annual meeting on January 18. He succeeds Philip H. Abelson, the 1961 president.

The following other officers, elected in the mail balloting conducted last December, will work with Dean Van Evera in the guidance of Academy affairs: Heinz Specht of the National Institutes of Health, president-elect; George W. Irving, Jr., of the Agricultural Research Service, secretary; and Malcolm C. Henderson of Catholic University, treasurer.

A native of Davenport, Iowa, Dean Van Evera received the B.S. degree from Coe College, Iowa, in 1923, and the M.S. degree from Iowa State College in 1925. Some years later—in 1937—he received the Ph.D. degree in chemistry from the State University of Iowa; and Coe College gave him an honorary D.Sc. degree in 1952.

Dr. Van Evera has spent most of his professional career as a science teacher and administrator at George Washington University. He joined the University's Chemistry Department in 1925, as an instructor of chemistry, and advanced through the professorial ranks to become full professor in 1938. He served as the Department's executive officer from 1931 to 1942.

Dr. Van Evera's teaching duties were interrupted during World War II, when he served as administrative director of the Allegany Ballistics Laboratory, which conducted research on propellants and rockets, including the famous bazooka; this work was done under a contract between the University and OSRD. In 1946 he resumed his full-time duties at the University, as coordinator of all scientific activities as well as professor of chemistry. And in 1957, he was appointed to his present post in charge of sponsored research.

In 1953, at the behest of ICA and NRC, he undertook a world-wide survey of fertilizer plants for the Indian Government, acting as a consultant under provisions of the "Point Four" Program.

Dr. Van Evera served as president of the Chemical Society of Washington in 1947, and was an associate editor of the *Journal of Chemical Education* from 1944 to 1955. In 1956 he received the honor award of the American Institute of Chemists for outstanding achievement in the field of chemical education, both as teacher and as administrator. He is a member of AAAS; AIC; the American Chemical Society; the American Association of University Professors; the American Society for Industrial Security; the Cosmos Club; and Alpha Chi Sigma, Phi Lambda Upsilon, Sigma Xi, and Omicron Delta Kappa.

Report of 1961 Committee On Policy and Planning

During the Academy year the Committee —consisting of Paul D. Foote, Wayne C. Hall, A. T. McPherson, Waldo L. Schmitt, Arnold M. Sookne as secretary, and the undersigned as chairman—met nine times, usually just preceding the monthly meeting of the Board of Managers. President Abelson, President-elect Van Evera, and Secretary Specht were often present, *ex officio*, and took part in the discussions. At each following meeting of the board, the chairman of the Committee reported on its discussions.

Affiliates

Traditionally, the Committee on Policy and Planning makes recommendations to the Board on applications from local scientific and technological societies for affiliation with the Academy. The 1961 Committee received inquiries or applications from four such societies:

1. National Capital Astronomers
2. Washington Section of the Institute of Food Technology
3. Baltimore-Washington Section of the American Ceramic Society
4. District of Columbia Psychological Association

Because it is a society composed mostly of amateurs, the National Capital Astronomers was not recommended for affiliation. It was recognized, however, that there should be a category of affiliation with the Academy for societies of amateurs, and a category of membership for individual amateurs. Recommendations for changes in by-laws to accommodate amateur societies and individuals in the Academy remain to be made.

Affiliation of the Washington Section of the Institute of Food Technology with the Academy was recommended.

Inquiries from the ceramists and the psychologists were received too late in the year for the 1961 Committee to make recommendations to the Board. These will have to be made by the 1962 Committee.

Operational Policies

In addition to questions of affiliation, the Committee discussed all sorts of problems on Academy operations, many of them involving income and expenditures. Indeed, the Committee acted as an executive committee usually does. The following paragraphs are arranged by subject rather than by chronological sequence.

Academy Staff. Under present dues, it its not possible to employ office help and maintain the *Journal* without spending more than the current income. Desiring to reduce the impending deficit as much as possible, the Committee recommended giving up the services of Mrs. R. R. Fell, a full-time employee, as of March 31, 1961. The office at 1530 P Street, provided by the Carnegie Institution without charge, was retained and occupied by employees of the Joint Board working on educational projects supported by NSF.

Later the Committee recommended that an effort be made to find a retired member of the Academy who would serve part time as its executive director. The Committee examined a list of retired members and selected about a dozen names for consideration. The Committee did not specify the terms of employment, which were contingent upon the outcome of the vote on the question of increasing dues; but the Committee did recommend some compensation, clerical help, and parking privileges. The Committee expects the executive director not only to oversee the work of the Acad-

emy's office, but to represent the Academy in its relations with other organizations and to raise funds for it.

Dues. On the question of increasing dues, the Committee recommended an increase from $6.00 to $10.00 for resident members and from $5.00 to $7.50 for nonresident members, and that the question be put to a vote of the members at the time of the annual election of officers in December. It was recommended that a message from the President on the activities of the Academy and on the need of increased dues to support them should be published in the December issue of the *Journal;* further, that a reprint of this message should accompany the ballot on this question.

Qualifications for Membership. It was recognized that there should not only be an increase in dues but also a great increase in membership to provide more income and to increase participation and interest in the work of the Academy. President Abelson favored a vigorous membership drive, with particular emphasis on election to the Academy of officers of the affiliated societies. The Committee favored giving greater weight than heretofore to nonresearch attainments in science and engineering; e.g., to administrative, editorial, journalistic, and developmental accomplishments. The Committee offered comments and criticisms on the letter on membership to delegates of affiliated societies drafted by the chairman of the Committee on Membership.

Categories of Members. From time to time the Committee talked about broadening the base of membership in the Academy. It finally recommended that two principal classes of members should be established—regular members and fellows; that all present members should automatically become fellows when the change took place; that present qualifications for membership should become the qualifications for fellows to be selected *de novo* or from the ranks of regular members; and that any unobjectionable person sufficiently interested in the purposes of the Academy to pay its dues should be admitted to ordinary membership. Revision of the Bylaws necessary to legalize this change in the structure of the Academy was drafted by Mr. Sookne. He also proposed a category of corporation members. In connection with future solicitation of members, Dr. Schmitt suggested the preparation and use of an attractive leaflet of information about the Academy.

Joint Directory. For the purpose of aiding the selection or solicitation of new members and for inducing consciousness of membership and its privileges and obligations among members, the Committee agreed that a study should be made of the feasibility of preparing and publishing a joint directory of the members of the Academy and its affiliated societies. The Committee assisted in setting up a Feasibility Committee. This committee reported to the Board that the affiliated societies would cooperate and that, given sufficient funds (an estimate was made), the Academy could do the job. The Policy and Planning Committee met to discuss and act on this report. The Committee urges the Board to authorize the preparation and publication of the joint directory, using Academy funds as may be necessary, with the understanding that every effort will be made to obtain funds from other sources to reduce to a minimum the use of the Academy's reserves. Dr. Foote declared that he would personally contribute $1,000 to the cost of the directory, if the Academy could obtain $9,000 from commercial or other sources. The Committee also favored including in the directory, photographs of members of the Academy and of officers of the affiliated societies, provided that each member who chose to permit his picture to be used would pay all costs.

Reception of New Members. To increase the prestige of present membership or future fellowship in the Academy, the Committee recommended that special attention should be paid to new members or fellows

at the regular meetings of the Academy. Their citations might be read, and new members or fellows introduced by prearrangement with their sponsors. The Committees on Meetings and Membership might collaborate in designing a reception ceremony for new members or fellows that would indeed "recognize" them and their accomplishments.

Meetings. The Committee had little to say about regular and special meetings of the Academy except to applaud the extraordinarily interesting and important events arranged by President Abelson and his meetings chairman, Francois Frenkiel. With respect to meetings of the Board of Managers, the Committee felt that some improvements could be made. The order of business is long and contains much tiresome routine material, which may account for the poor attendance of delegates. It was suggested that an agenda, or program, might be sent to members of the Board and Delegates prior to each meeting, indicating the Committee reports to be heard, an important question to be discussed and acted upon, and a special report on some topic of interest.

Since typed biographical information is provided by the Membership Committee about each candidate for membership prior to action, including a citation indicating his accomplishments, it was suggested that the reading of names and citations by the Membership Chairman at each meeting be discontinued, and that instead the Board be asked whether there were any objection to the recommendations of the Membership Committee. Hearing none, the President would declare the candidate elected. Any objection would lead to reconsideration by the Membership Committee and special action by the Board.

Regarding special topics for presentation at Board meetings, President Abelson suggested that the Board might like to hear about the characteristics of the more important state and municipal academies of science of the United States. Accordingly, printed information obtained by President Abelson was distributed among the members of the Committee, each of whom agreed to attend a meeting of the Board according to a certain schedule and present briefly the results of his study of two academies of his choice.

The Committee discussed a suggestion to limit attendance at monthly Board meetings to the officers, elected members of the Board, and invited chairmen of committees, and to hold a carefully planned annual meeting of the Board for the benefit of Delegates, dealing with relations between the Academy and its affiliated societies. This suggestion did not win the approval of the Committee, which felt that such a change might weaken the bonds between the Academy and the societies. Instead, the Committee recommended that Board meetings should be planned so as to reduce routine business to a minimum, in order to allow time for discussion of significant questions of policy.

Other Proposed Changes in Present Practices. The Treasurer advocated a change in fiscal year from the calendar year to the year ending June 30. The Committee favored such a shift, but did not think through the changes that might be associated with it, such as the date of the annual meeting and the accession of new officers. This needs more attention, and a draft of the necessary amendments to the Bylaws should be prepared.

The Committee endorsed a proposal by Past-president Wood, that the immediate past-president remain an officer of the Academy and be an ex-officio member of the Board. The necessary amendment to the Bylaws has not been prepared.

The Committee agreed with President Abelson that the present procedure for filling orders for back issues of the *Journal* is excessively costly in time and money. President Abelson promised to have his office manager look into the matter and recommend a better procedure, which might require the services of a commercial sales organization. The 1961 Committee did not

receive a report on this question.

The Bylaws require that the president-elect and other officers of the Academy be nominated by a council of Delegates chaired by the Delegate from the senior affiliated society, i.e., the Philosophical Society. As most Delegates do not have an intimate knowledge of those who have served the Academy most faithfully and effectively, it is well to prepare information for the Delegates about suitable candidates. At the request of President Abelson, the Committee provided information for the Delegates. Of course, such a task could be done by a special committee of knowledgeable Delegates or other appropriate members.

External Relations

The Committee agreed with President Abelson that the Academy should cooperate fully with other related organizations and should take a public position through meetings or publications on questions of importance to scientists and the public. Along these lines the Committee touched upon the following subjects:

The Committee recommended that the Academy keep in touch with the activities of the Science Bureau of the Metropolitan Washington Board of Trade. Mr. Sookne undertook to serve as liaison between the two organizations. The chairman of the Committee had a luncheon conversation with Gordon Kennedy, Jr., manager of the Science Bureau, as a result of which he wrote for the *Journal* a column on the work of the Science Bureau and its connection with the Academy.

The American Association for the Advancement of Science raised the question as to whether it is distributing small research grants to the academies of the United States in the most effective way. On the recommendation of the Committee, President Abelson advised Dr. Wolfle to continue the present equitable distribution of funds, and that the Academy would use its allotment as might seem best to the Committee on Grants in Aid.

The Committee thought that the Academy should exert public leadership on present requirements for civil defense, including training on measurement of radioactivity. This was done by President Abelson and his associates with great success and acclaim.

Other subjects suggested for Academy attention were the possibility of including facilities for scientific meetings in plans for the National Cultural Center: needs of the National Zoo and the administrative agency that might best provide for those needs: and legislation concerning the care and use of laboratory animals for experimental work and teaching.

—Frank L. Campbell, Chairman

Dues Increase Voted In Annual Elections

Increase in 1962 dues from $6 to $10 for resident members was approved by the membership in the annual elections conducted during December. A Bylaws amendment permitting the change was passed by the precise two-thirds majority—288 to 144—required for such amendments.

At the same time, dues for non-resident members were increased from $5 to $7.50 per year.

Another Bylaws amendment, permitting affiliation with the Academy of the Washington Section, Institute of Food Technologists, was passed by a vote of 384 to 50.

In elections for officers, Heinz Specht, George W. Irving, Jr., and Malcolm C. Henderson were unopposed for the positions of president-elect, secretary, and treasurer, respectively. They took office, together with President Benjamin D. Van Evera, at the close of the annual meeting on January 18.

In contested elections, Russell B. Stevens and Harold H. Shepard were named managers-at-large for the three-year terms 1962-64. Leo Schubert was unopposed as manager for an unexpired two-year term, 1962-63.

Summary Annual Report of Treasurer For 1961

Washington Academy of Sciences

Receipts

Dues	$ 5,707.75
Journal subscriptions and reprints	2,859.29
Sales of *Journal* back numbers	617.00
Sales of Monograph No. 1 and Index	53.70
Interest, dividends, and capital gains (not counting 60 shares taken in stock)	3,944.43
Fiscal services to Joint Board on NSF grant administration	200.00
Miscellaneous receipts (meetings, grants, gifts, etc.)	1,234.87
Total	$14,617.04

Expenditures

Journal (printing, mailing, etc., for 4 1960 and 7 1961 issues)	$ 6,747.06
Meetings Committee	2,031.62
Headquarters office expenses including Social Security	1,639.06
Secretary	2,254.06
Treasurer	174.20
Annual dinner	180.00
Grant, Joint Board on Science Education	500.00
Grants-in-aid, WAS Committee on Encouragement of Science Talent	309.50
Grants, reimbursable	675.89
AAAS academy conference	21.64
Science calendar	25.00
Debits, memos, and refunds	65.21
Total	$14,623.24

Excess disbursements over receipts, $6.20

Summary of Cash Balances

	12/31/60	*12/31/61*	*Decrease*
Washington Academy of Sciences	$ 5,686.90	$ 5,680.70	$ 6.20
Washington Junior Academy of Sciences	781.91	403.25	378.66
NSF grant administration (Joint Board)	19,856.38	10,077.46	9,778.92
Totals	$26,325.19	$16,161.41	$10,163.78

Summary of Receipts and Expenditures, 1961

	Receipts	*Expenditures*	*R less E*
Washington Academy of Sciences	$14,617.04	$14,623.24	$ −6.20
Washington Junior Academy of Sciences	3,798.31	4,176.97	−378.66
NSF grant administration (Joint Board)	26,775.00	36,553.92	−9,778.92
Totals	$45,190.35	$55,354.13	−$10,163.78

Summary of Grant, National Science Foundation to WAS (Administered by Joint Board on Science Education)

Balance in WAS checking account on 12/31/60	$19,856.38
Additions to grant during 1961	26,775.00
Total	46,631.38
Expended during 1961	36,553.92
Cash balance on 12/31/61	$10.077.46

Summary of Assets

	Market Value 12/31/60	*Market Value* 12/31/61	*Change in* 1961
Washington Academy of Sciences			
Bonds & Mutual Shares	$66,578.71	$78,117.38	+$11,538.67
Cash balance	5,686.90	5,680.70	— 6.20
Totals	$72,265.61	$83,798.08	+$11,532.47
Washington Junior Academy of Sciences			
Savings account and interest	$ 2,086.20	$ 2,149.28	+$ 63.08
Cash balance	781.91	403.25	— 378.66
Totals	$ 2,868.11	$ 2,552.53	—$ 315.58

The year-end market value of investments shows an increase of only $8,019.50 over their value on Dec. 31, 1959 (a decrease in value being shown during 1960). Investments include 60 additional shares of Washington Mutual Investment Company stock acquired in 1961 as capital gains; the market value of these 60 shares on 12/31/61 was $684.00

Although actual disbursements exceeded receipts by only $6.20, the 1961 budget anticipated setting aside a reserve of $1,000.00 toward the cost of a directory. This is not shown in above tabulations, as no actual disbursement was made.

Lest members question the necessity of the recently-voted increase in dues, it should be emphasized that the comparatively small size of our 1961 deficit was enabled by dispensing with the services of a full-time office secretary for nine months of the year. In addition to a curtailment of services by the Academy to the public, and inconveniences to officers and committees. this placed an inordinate burden of work upon the secretary and treasurer. The treasurer recommends immediate restaffing of our central office. Considering the praiseworthy ambitions of our Board of Managers, a deficit in 1962 may occur despite the dues increase.

—Norman F. Braaten, Treasurer, 1961

Summary Annual Report of Secretary for 1961

In order to summarize the activities more extensively reported by the various officers and committee chairmen at the annual meeting on January 18, the Secretary has prepared the following brief statement concerning the Academy's operations and vital statistics in 1961.

The following table shows numbers of members in the various categories as of December 31, 1961:

	Resident members	*Nonresident members*
Active	830 (+55)	159 (—21)
Emeritus	68 (+1)	68 (—1)
Patron	0	0
Honorary	0	4 (—2)
Subtotals	898 (+56)	231 (—24)
Total membership		1129 (+32)

The parenthetic figures show only the net change over last year's figures and do not indicate the actual turnover. Some 35

elected nominees (not shown in the foregoing figures) are presently accepting membership as a result of the activity of the Membership Committee and its panels in December 1961.

Six members were placed in emeritus status during the year. Thirty-one members in good standing resigned as of December 31, 1961, while four were permitted to resign as of December 31, 1960. Three members were dropped at the end of the year for nonpayment of dues, while four others were dropped earlier in the year for the same reason. (It is worth some thought to those members concerned therewith, and reading these lines, to know that at year's end we had three dues delinquents who owed for four years, two who owed for three years, 11 who owed for two years, and 28 who did not pay 1961 dues. Of the latter, by the way, one sent in a ballot on the matter of raising the dues! The other 27 cared neither to vote nor to pay.)

Deaths of members reported in 1961, and dates of death, are as follows:

Charles E. Weaver (July 17, 1958); A. T. Pienkowsky (December 31, 1960); J. S. Wade (January 1, 1961); W. E. Dove (March 22, 1961); J. H. Miller (May 24, 1961); H. G. Dorsey (May 24, 1961); A. Seidell (June 25, 1961); S. P. Doolittle (August 9, 1961); P. W. Bridgman (August 20, 1961); G. Steiner (August 21, 1961); J. W. McBurney (October 6, 1961); P. R. Heyl (October 22, 1961); Roland W. Brown (December 21, 1961); and Robert R. McMath (January 2, 1962).

During the academic year, eight regular and three special meetings were held, as follows:

February 16 (455th regular): Lawrence A. Wood, National Bureau of Standards, on "Unorthodoxy in Science" (address of retiring president).

March 16 (456th regular): Two-speaker discussion on "Recent Significant Advances in Science." Speakers: Christian B. Anfinsen, National Institutes of Health (on biology) and Joseph Weber, University of Maryland (on physics). (Meeting in honor of Washington Junior Academy of Sciences.)

April 6 (special): Herman Kahn, the Rand Corporation, on "Thinking About the Unthinkable (Living with a Thermonuclear Threat)." (Related comments by Marquis W. Childs and Frank T. McClure.)

April 20 (457th regular): Francis J. Heyden, S.J., Georgetown University, on "Astronomy Looks to its Future." (Related comments by Nancy Roman and B. F. Burke.)

May 18 (458th regular): Panel discussion, "Are Science Fairs Hindering Science Education?" Moderator: Francois N. Frenkiel. Panelists: Philip H. Abelson, Geophysical Laboratory; Doris E. Hadary, Bethesda-Chevy Chase High School; Keith C. Johnson, D. C. Public Schools; Mary Louise Robbins, George Washington University; Leo Schubert, American University; and Burrell Wood, Science Service.

June 1 (special): Lloyd V. Berkner, Graduate Research Center of the Southwest, on "The United States' Future in Space." (Related comments by Ralph E. Lapp.)

October 19 (459th regular): T. Dale Stewart, Smithsonian Institution, on "The Last Phase of Human Evolution."

November 17 (460th regular): Roger Revelle, Interior Department, on "The Tragic Scissors of Pakistan (Problems of Lands Ruined by Irrigation)."

November 30 (special): Richard H. Bolt, National Science Foundation, on "Planning Resources for Scientific Progress."

December 14 (461st regular): Tom T. Stonier, Rockefeller Institute, on "Hazards Confronting a Metropolitan Population Subjected to a Nuclear Explosion."

January 18, 1962 (462nd regular and 64th annual): Remarks of the retiring president (Philip H. Abelson); presentation of awards for scientific achievement for 1961.

All meetings were held in the John Wesley Powell Auditorium of the Cosmos Club, except that the meetings of April 6

and June 1 were held at the Carnegie Institution.

At the 64th annual dinner meeting on January 18, 1962, the following persons received Academy awards for scientific achievement in 1961: Robert W. Krauss of the University of Maryland, in the biological sciences; John D. Hoffman of the National Bureau of Standards, in the physical sciences; Rodney E. Grantham of the Naval Ordnance Laboratory, in engineering; Lawrence E. Payne of the University of Maryland, in mathematics; Charles R. Naeser of George Washington University, in the teaching of science; and Ralph D. Myers of the University of Maryland, also in the teaching of science.

Perhaps the most significant accomplishment of the Academy during 1961 was the conduct of an Institute on Isotopes and Radioactivity, held at the Carnegie Institution of Washington during the week of October 30-November 3. Conceived by Philip H. Abelson, Academy president for 1961, and implemented through the Joint Board on Science Education, the Institute was designed to acquaint secondary school science teachers of the Washington area with the role of radioactive isotopes in science and civil defense. About 140 teachers from parochial, private, and public schools were released from their classrooms to take this intensive course; their regular classes were met by scientists and engineers who had volunteered through the Joint Board to substitute for them.

The morning lectures and afternoon laboratory curricula were organized by Ralph T. Overman of the Oak Ridge Institute of Nuclear Studies. The lectures were presented by Dr. Overman and a number of other prominent specialists in the field. The laboratory sessions, concerned with tracer experiments and measurement of radioactivity, were conducted by physicists from the National Bureau of Standards and the Geophysical Laboratory, and members of the Science Department of the D. C. Public Schools. The teachers who attended the Institute were avid and effective students, and indicated deep appreciation of the course; many expressed the hope that an activity of this nature might be repeated in future years. (For a detailed report on the Institute, see the *Journal* for December 1961, pages 133-137.)

The Academy's activities in science education, conducted through the Joint Board on Science Education with the support of funds from the National Science Foundation, have continued to be highly successful in improving the teaching of science and in guiding not only high school students, but also their teachers and counselors as well as college representatives, in more effective instruction in science. The Academy seeks to continue some of these efforts on a diminished grant level, while turning over to school staffs the matter of further experimentation with curriculum content after its well-received introduction.

Volume 51 of the Academy's *Journal* appeared during the year, in eight issues having a total of 148 pages. It contained a variety of articles by leading area scientists, reviewing the status of research in a number of important fields; special reports on science education and other major Academy programs; and news concerning the Academy's organization, plans, and accomplishments.

Activities of the Junior Academy continued to amaze the Senior Academy members, not only because of their erudite nature but also because of the organization's state of solvency.

—Heinz Specht, Secretary, 1961

Committee Reports on Directory Feasibility

Several months ago the Board of Managers appointed a special committee, under the chairmanship of Robert W. Krauss, to study the feasibility of publishing a joint directory of the Academy and its affiliated societies. The following is a slightly-edited version of the committee's report, contained in a letter of January 3 from Dr. Krauss to President Philip H. Abelson.—ED.

This letter constitutes a report of the Washington Academy of Sciences Commit-

tee on a Joint Directory. The committee has been active during the fall in an attempt to determine the feasibility of preparing a directory containing the names of all of the members of the societies affiliated with the Academy as well as those who are Academy members.

In order to obtain an accurate estimate of the interest of the affiliated societies, a letter was sent to the executive officer of each. It asked three questions aimed at determining the willingness of the societies (1) to have their membership included in the directory, and (2) to financially support the publication costs. It also asked for the number of members in each society. In almost all cases your chairman or a committee member talked with one or more of the officers of each society to explain the interest of the Academy in such a directory, and to discuss the views of the society with regard to feasibility, format, financing, etc.

Only two societies did not wish to have their entire membership included in a directory. In the case of both the Medical Society of Washington and the National Geographic Society the reasons seem sound, and their omission would not limit the usefulness of such a directory. The willingness of the societies to contribute financially to the directory was not overwhelming. A total of $388 was pledged to this end. However, it is fairly certain that once a directory is a reality, with obvious usefulness to the affiliates, a larger contribution would be forthcoming. It did not seem wise at this stage to attempt to urge a larger contribution. The membership total for all of the societies, excluding the Medical Society, was 17,600.

The committee and consultants assembled for lunch at the University of Maryland on December 12 to discuss the results of the survey and to make recommendations to the Academy. The consensus was as follows:

1. The Academy should proceed with the preparation of a directory. Such a project is consistent with the aims of the Academy and should be an important step in unifying and strengthening the ties with the affiliated societies. Furthermore it is a logical step in the progress of the Academy toward eventual Academy housing of service facilities for the affiliates. A well-prepared directory could not fail to add to the status of the Academy as the leader in the Washington scientific community.

2. It was felt that this directory, including at least double the membership in the last catalog, should be prepared with the aid of IBM processing equipment. This seems imperative because the committee feels that the mere listing of members would scarcely justify publication, and the processing of a carefully cross indexed manual would involve an enormous amount of effort.

Final decision as to the format was not attempted at this meeting, but it was felt that the directory should include each scientist's precise specialty, his place of employment and address, his society membership, a reference to more complete biographical listing such as American Men of Science, etc. It should also be possible for a given society to locate its membership easily. Possibly a supplementary listing, by name only, of the membership of each society would be helpful.

3. The committee strongly recommends the employment of a managing editor for the assembling of the directory. The task of obtaining the lists of members of the societies with the appropriate biographical references will be Herculean, to say nothing of reducing the data to an IBM system, and then preparing it for the printer. The task will probably take a minimum of one man year. The managing editor might well be selected from the ranks of retired scientists in the area. A person skillful in obtaining cooperation of the affiliated societies, as well as capable of directing the secretarial aspect of the work, is essential.

If the Academy desires, a directory committee could exercise general supervision of the project, but it was felt that the selection of a competent editor should

be accompanied by delegation of responsibility as well.

4. In the preparation of format for the directory, and in the arrangement for data cards to be supplied by the societies or their individual members, a representative of IBM should be consulted. Also, consultation with societies such as the American Chemical Society, which have large directory problems, should be of great help.

5. The committee discussed cost estimates. It is difficult to be sure, but the committee felt that a total cost of $10,000-$12,000 would probably be the minimum. This was broken down by reasonably sound estimates as follows:

Printing	$2.500
IBM Processing	3.000
Editor	4.000
Secretarial	2.000

Subsequent to the meeting, the chairman contacted IBM and received rather general confirmation of the IBM service charge. The printing cost is reasonably firm. What savings might be made would be in the area of salaries.

The committee is reluctant to submit a precise total cost figure, because it was felt that format, and the type of data desired, must await the appointment of an editor and detailed discussions with member societies.

6. The topic of pictures for the directory was discussed, with some opposed and some in favor of including them. Possibly group pictures of each society might serve the purpose. It was felt that a final decision on this point could be postponed.

I hope that this report will be useful to the Academy. We feel that it is about as far as we can go in a feasibility report. If there is further information that we can provide, please let me know.

—Robert W. Krauss, Chairman
Committee on Joint Directory

THE BROWNSTONE TOWER

This is written with the knowledge that the members of the Washington Academy of Sciences have voted to increase dues from six to ten dollars per year. This is indeed good news, not only because it will permit some expansion in the program of the Academy, but because it shows that a two-thirds majority of the members believe in the Academy and want it to realize its potentialities. That the Academy has been even moderately effective without a paid staff officer is a tribute to the devotion of those who think about it and work for it at irregular intervals.

Organizations that are something more than honorary and social, that have a public mission, are most successful when the policies of the officers are carried out day after day by an alert, imaginative, and aggressive paid staff officer, who himself may influence policy. Ideally, the Washington Academy should have a full-time, young, and vigorous staff officer like Gordon Kennedy, Jr., manager of the Science Bureau, Metropolitan Washington Board of Trade, whom I had the pleasure of meeting recently. But until its membership and income are greatly increased, the Academy may have to experiment with the part-time services of a retired member.

For the past two years the officers of the Academy have been aware of the interest of the Metropolitan Washington Board of Trade in promoting science and engineering in the Washington area and have felt somewhat uneasy about it, not because of the Board's objectives, but because the Academy failed to initiate the work that Mr. Kennedy has undertaken. The Board of Trade has recognized the spontaneous growth of private research and develop-

ment enterprises in this area, a significant addition to its economy. It is right and proper that the Board of Trade should not only wish to encourage further development of this very desirable "industry" for this area, but should do something about it. The Science Committee of the Science Bureau has wisely taken the broad position that anything good for science and engineering in this area will be good for the research and development industry; e.g., encouragement of science education from bottom to top. The Academy, through the Joint Board, has been working at the bottom in secondary schools and has assisted in improving connections between bottom and top; the Science Committee has been looking at the top, at the universities of this area, wondering how their prestige in scientific research and teaching can be increased, how to cause a good student to feel that it is just as desirable to be admitted to one of our universities as to be admitted, let us say, to Cal Tech, Harvard, or MIT; or how to cause a scientist of reputation to regard one of our universities as a goal rather than as a stepping stone in his career. Money can help, of course, and one must have faith that a goal recognized can be approached more rapidly and surely than one not well defined. A Subcommittee on Education of the Science Committee, composed of scientific business men and representatives of our local universities, has the responsibility for making progress along this line.

The first major accomplishment of the Science Bureau was the preparation and publication of a "Directory of Scientific Resources in the Washington, D.C. Area" as of July 1961. This 64-page, 8.5x11-inch, paper-covered booklet was done clearly and attractively by offset printing from typed copy. It is divided into eight parts: I Research and Development Firms, Physical and Life Sciences; II Research Groups, Social and Psychological Sciences; III Documentation, Operations Research and Computer Specialists; IV Scientific Foundations and Institutions; V Federal Government Research Facilities; VI Scientific Activities of Colleges and Universities; VII Scientific Academies, Associations, and Societies; and VIII Libraries. If the Washington Academy had done this work, we would have been proud of it. Directories are important not only for the use of those listed in them but for all everywhere who need to know. I think that this directory has done and will do much to mark this city as a great research and development center of the United States. The Washington Academy, relatively, has been asleep while this great growth has been taking place. It has been barely maintaining its somewhat exclusive membership while the number of people eligible for membership under present rules has greatly increased, and the number who might be interested in unrestricted membership (i.e., the number of scientists and engineers in the Washington area) is estimated by the Science Bureau's survey to be 18,850, less than 1,000 of whom are now members of the Academy!

Fortunately an important contribution remains for the Academy to make; i.e., to prepare and publish a joint directory of the members of the Academy and its affiliated societies. This will supplement the Directory of the Science Bureau and will be another important step in the inventory of our scientific resources that we should take periodically without question. The Academy has already produced directories of its own and a joint directory. It should not be necessary to spend months in finding out whether another joint directory can or should be done; it *must* be done if the Academy is to maintain its place in the scientific life of this area and to grow in usefulness.

—Frank L. Campbell

Science in Washington

SCIENTISTS IN THE NEWS

Contributions to this column may be addressed to Harold T. Cook, Associate Editor, c/o U.S. Department of Agriculture, Agricultural Marketing Service, Room 2628 South Building, Washington 25, D.C.

COAST AND GEODETIC SURVEY

Elliott B. Roberts has been appointed chairman of the Committee on Geomagnetism and Aeronomy of the Pan American Institute of Geography and History. Captain Roberts also is the United States member of the Committee on Geophysical Sciences of the same institute.

Lansing G. Simmons presented a paper on "The Use of State Plane Coordinates" at the Annual Surveyors Institute, University of Wisconsin, on December 6.

Carl I. Aslakson reports that the preliminary precise geodetic control for the Rumford (Me.) complex of the American Telephone and Telegraph trans-Atlantic satellite communication system has been completed. Captain Aslakson is the principal engineer for the precise control network required for the installation. The field work is a joint venture of Aero Service Corporation of Philadelphia and Geonautics, Inc., of Washington. Because of the high relative accuracy required, many of these measurements will have to be repeated over periods of months and possibly years.

NATIONAL BUREAU OF STANDARDS

The following talks have been given by members of the staff:

Harriet L. Frush, "Carbon-14 and Tritium-Labeled Carbohydrates," and **Horace S. Isbell,** "Condensation, Cleavage and Re-arrangement Reactions of Carbohydrate Materials," at the AAAS meetings in Denver, December 27-29.

Churchill Eisenhart, "On the Price of Double Dealing," before the Section on Physical and Engineering Sciences, American Statistical Association, New York, December 30.

John K. Taylor, "The Joint Board on Science Education," before the American Institution of Chemists, Washington, December 12.

George C. Paffenbarger, "Silicate Cements and Direct Filling Resins: A Comparison of Properties," before the Lincoln District Dental Association, Lincoln, Neb., December 4.

William J. Youden, "Statistical Applications in the Chemical Industries," at Eastman Kodak Company, Rochester, December 5; and "Dice, Data, and Deductions." before the Rochester Society for Quality Control, Rochester, December 5.

Robert J. Rubin, "Brownian Motion and the Statistical Dynamics of Lattices," at the Polytechnic Institute of Brooklyn (Physics Colloquium), December 21.

Roger G. Bates, "Recent Developments in pH Measurement, before the St. Louis (Mo.) Society of Analysts, November 28, and the Division of Analytical Chemistry, University of Illinois, November 30.

James R. McNesby, "Thermal Decomposition and Isomerisation of Alkyl Radicals in the Gas Phase," at the Department of Chemistry, Carnegie Institute of Technology, Pittsburgh, December 2.

Bourdon F. Scribner was presented the Annual Medal Award of the New York Section for Applied Spectroscopy during the Eastern Analytical Symposium in New York City, November 15-17. Mr. Scribner's unanimous selection was in recognition of his outstanding accomplishments and efforts toward the advancement of spectrochemical analysis.

Hans P. R. Frederikse, chief of the Solid State Physics Section, is spending a year at the Philips Research Laboratories in Eindhoven, the Netherlands, partly on a Guggenheim fellowship and partly under the Training Act. Dr. Frederikse and family left the States August 31, and will return next September.

Franz L. Alt, coordinator of special international programs, made a visit to India, Pakistan, and Israel in September in connection with NBS research projects abroad. These projects are financed by an appropriation of $1,000,000 in U.S.-owned foreign currencies.

Elizabeth E. Sager, chemist in the Solution Chemistry Section, retired on December 8 after 30 years of service at NBS. Her friends and associates held a tea in her honor on December 7.

Thomas G. Digges, chief of the Thermal Metallurgy Section, has retired after 42 years' service.

James I. Hoffman, physical science administrator and until his recent illness chief of the Metallurgy Division, retired January 5 after 43 years and 8 months of service.

HARRIS RESEARCH LABORATORIES

Milton Harris spoke on "The Role of the Scientist in Society" before the Alpha Chi Sigma tetra-chapter banquet at the W. R. Grace Research Center, Clarksville, Md., on December 9.

Alfred E. Brown spoke before the D. C. Chapter of the American Institute of Chemists on December 12, on "Science Education in Washington."

NATIONAL INSTITUTES OF HEALTH

Clem O. Miller, formerly an executive secretary in the Division of Chemistry and Chemical Technology, NAS-NRC, has been appointed an executive secretary in the Research Fellowships Section of the Research Training Branch, Division of General Medical Sciences, NIH. In his new post, Dr. Miller will have broad responsibility in the various fellowship programs supported by the Division, with particular emphasis toward strengthening the programs in the areas of the physical sciences.

USDA, BELTSVILLE

James H. Turner of the Beltsville Parasitological Laboratory was married to Elizabeth Jane Gross in College Park, Md., on November 22. After their wedding trip to Chicago, where Dr. Turner presented a paper at a meeting of the American Society of Animal Production, they left for Sydney, Australia. Dr. Turner, as the recent recipient of a Fulbright Research Award, will be investigating internal parasitisms of sheep at the McMaster Animal Health Laboratory through 1962.

Clarence H. Hoffmann, assistant director of the Entomology Research Division, was speaker for the Agricultural and Mechanical College of Texas Graduate Lecture Series on December 4, at College Station, Tex. The title of Dr. Hoffmann's paper was "Research on New Approaches to Insect Control."

USDA, WASHINGTON

Herbert L. Haller, assistant to the administrator, Agricultural Research Service, received the 1961 Charles F. Spencer Award for outstanding achievement in Agricultural Chemistry and an honorarium of $1,000 in Kansas City, November 17. The award is administered by the Kansas City Section of the American Chemical Society. Dr. Haller specialized for 30 years in agricultural chemistry, especially in the development and use of insecticides.

A future article by Arthur W. Palmer. "The Growth of Cotton Fiber Science in the United States," appearing in the appendix to the 1960 Annual Report of the Smithsonian Institution, pays tribute to **Robert W. Webb** for his life's work and accomplishments in connection with cotton fibers. Dr. Webb pioneered in the science of cotton fiber technology, and the results of his investigations led to significant changes in the cotton industry.

UNCLASSIFIED

Jose A. B. Nolla and **Frederick L. Willman** were guest speakers on the Symposium on Tropical Plant Pathology at the 53rd Annual Meeting of the American Phytopathological Society, Biloxi, Miss., on December 11. Dr. Nolla was formerly director of the Agricultural Experiment Station at Rio Piedras, P. R., and now teaches at the University of Puerto Rico at Mayaguez. Dr. Willman is head of the Department of Plant Pathology at the Rio Piedras Station.

DEATHS

Roland W. Brown, a retired paleontologist and geologist with the Geological Survey, died December 21 at the age of 68. A native of Weatherly, Pa., Dr. Brown received the B.A. degree from Lafayette College in 1917. Following two years of Army service in World War I, he took graduate work at Johns Hopkins University and received the Ph.D. degree in paleobotany in 1926. He joined the Geological Survey in 1929 after teaching for several years at Pennsylvania State Forestry School and Yale University.

AFFILIATED SOCIETIES

Acoustical Society of America, Washington Chapter

The January 15 meeting featured a talk by R. A. Darby of the Naval Engineering Experimental Station at Annapolis, on "Practical Applications of Impedance Measurements in Naval Noise Reduction Problems."

American Meteorologial Society, D. C. Branch

Brig. Gen. Norman L. Peterson, Air Weather Service, MATS, discussed the current program of his unit and some of the educational requirements for the space age in a talk given January 17, entitled "Air Weather Service Future Outlook."

American Society of Civil Engineers, National Capital Section

"A Layman's Approach to Water Resources Planning," as it applies to present and future development of the Potomac River Basin, was presented by William E. Davies of the Geological Survey at the January 9 dinner meeting.

On January 23, the luncheon group was addressed by Ellis L. Armstrong, Better Highways Information Foundation, on the topic "Land, Water, and People." Mr. Armstrong spoke from the vantage point of his experience as project engineer on the power portion of the St. Lawrence Seaway Project and as Commissioner of Public Roads.

American Society of Mechanical Engineers, Washington Section

Two meetings, as usual, were held during January. On January 11, William E. Benson of NSF discussed the experimental tests, design, and operation of equipment for core drilling in deep water as "Phase I—Project Mohole." On January 25, James M. MacDonald of General Electric spoke on "Project Engineering"—the development of a product from the inception of the idea until the time it reaches production.

Botanical Society of Washington

John J. Wurdack, Smithsonian Institution, spoke on January 2 at the regular meeting of the Society. His topic was "Phytogeography of the Guayana Highland," a study of the highly endemic flora of certain areas in northern South America.

Chemical Society of Washington

Three concurrent panel discussions comprised the January 11 session, as follows: Agricultural and Food Chemistry; Chemotherapy; Macromolecules in Biological Systems. Each included two contributions in the form of prepared papers, with introduction by a moderator. Technical group meetings in the areas of inorganic and analytical chemistry were held at 5 o'clock, just prior to the social hour and dinner.

Geological Society of Washington

The following program was presented on January 10: R. L. Nace, "A Rational Approach to Site Selection in the Atomic-

energy Industry"; Henry Faul, "Measured Ages and Theories of Orogany (Continuous vs. Episodic)"; and J. S. Brown, "St. Joseph Land—Ore Leads and Isotopes."

On January 24, D. B. Stewart spoke on "A Month at the Hawaiian Volcano Observatory," D. E. Rawson on "Petrology of the Underground Nuclear Explosions, Nevada Test Site," and W. A. Fischer on "Some Experiments in Spectral Reflectivity."

Helminthological Society of Washington

On January 19, the Society met for an open meeting at the McCort-Ward Laboratory of Biology, Catholic University, with opportunity to inspect the laboratories prior to the sessions.

Insecticide Society of Washington

Two papers were given at the 196th meeting on January 17: "U.S. Participation in Plant Protection Programs Overseas," by E. J. Hambleton, USDA; and "Experiences at the Agricultural Fair in Cairo, Egypt." by H. H. Shepard, USDA.

A special commemorative program is being planned for the 200th meeting of the Society.

Institute of Radio Engineers, Washington Section

At the general meeting on January 8, E. B. Carne of Melpar spoke on "Learning Systems."

Technical meetings during January included the following: January 9—"Microwaves and Communications Satellites"; January 15—"Should Creative Engineers be Burdened with Management Details?" January 16—"Introduction to Two-Channel Monopulse"; January 22—"Plasma Amplifiers and Oscillators"; January 23—"A Critical Review of Modulation Techniques"; January 30—"VOA Audio Control and Recording Facilities"; and January 31—"Health Physics."

Medical Society of the District of Columbia

In addition to a full calendar of events directly related to medical problems, the "Current Medical Events" list for January includes a talk. "Messages in Macromolecules," by R. D. Hotchkiss of Rockefeller Institute, at the Clinical Center, NIH, on January 10.

CALENDAR OF EVENTS

Events which will take place, so far as we can determine at the time of writing, are noted below. Where no indication of the program other than date appears, it will in most instances be a regularly-scheduled meeting of the society. Last-minute changes in time and place, or emergency cancellations, cannot be reflected here.

February 1—Entomological Society of Washington

Natural History Museum, Room 43, 8:00 p.m.

February 1—Society for Experimental Biology and Medicine

Gorman Auditorium, Georgetown University Hospital, 8:00 p.m.

February 2—Philosophical Society of Washington

"The Remarkable Abundance of Certain Light Elements in the Primary Cosmic Radiations," by Maurice Shapiro, NRL.

Powell Auditorium, 8:00 p.m.

February 6—Botanical Society of Washington

"Problems Related to Improvement of *Theobroma cacao* in Tropical America," by Ernest Imle, American Cocoa Research Institute.

Maloney Chemical Laboratory, Catholic University, 8:00 p.m.

February 7—Washington Society of Engineers

Powell Auditorium, 8:00 p.m.

February 8—American Society of Mechanical Engineers

PEPCO Auditorium, 10th and E Sts., N.W., 8:00 p.m.

February 10—Institute of Radio Engineers

Annual Banquet, Statler Hilton Hotel.

February 12—American Society for Metals

Burgess Memorial Lecture, "Dislocation Metallography," by John R. Low, Jr., General Electric Research Laboratory.

Ambassador Hotel. Social hour, 6:00 p.m.; banquet 7:00 p.m.

February 13—American Society of Civil Engineers

Powell Auditorium. Dinner 6:00; program 8:00 p.m.

February 14—Geological Society of Washington

Powell Auditorium, 8:00 p.m.

February 15—Institute of Radio Engineers

Meeting of Professional Group on Reliability and Quality Control. "Confidence Limits," by Mrs. Rosenblatt.

February 16—Philosophical Society of Washington

Robert W. Berliner, National Heart Institute.

Powell Auditorium, 8:15 p.m.

February 19—Acoustical Society of America

National Bureau of Standards, 8:00 p.m.

February 19—Institute of Radio Engineers

"Electronics in Astronomy."

Natural History Museum, 8:00 p.m.

February 19—Society of American Military Engineers

YWCA, 17th and K Sts., N.W. Luncheon, noon.

February 20—American Institute of Electrical Engineers

"Electrical Insulation—A Dynamic Technology," by J. B. Alfers, Bureau of Ships.

Shoreham Hotel, 8:00 p.m.

February 20—Columbia Historical Society

"Life in Georgetown, 1820-1840, as Told in Personal Correspondence of the Day," by Guy Castle.

Heurich Mansion, 8:00 p.m.

February 21—Insecticide Society of Washington

Symons Hall, University of Maryland, 8:00 p.m.

February 21—Institute of Radio Engineers

Meeting of Professional Group on Engineering Writing and Speech. "Government Evaluation of Your Technical Proposals."

National Housing Center, 1625 L St., N.W., 8:00 p.m.

February 21—Washington Society of Engineers

Powell Auditorium. 8:00 p.m.

February 22 — American Society of Mechanical Engineers

PEPCO Auditorium, 10th and E Sts., N.W., 8:00 p.m.

February 27 — American Society of Civil Engineers

Luncheon meeting, YWCA, 17th and K Sts., N.W., noon.

February 27 — Society of American Bacteriologists

Walter Reed Medical Center, 8:00 p.m.

BOARD OF MANAGERS MEETING NOTES

The Board of Managers held its 542nd meeting on December 5 at the National Academy of Sciences, with President-elect Van Evera presiding.

The minutes of the 541st meeting were approved with minor corrections.

Meetings Committee. For Dr. Frenkiel, the Secretary announced that at the next Academy meeting on December 14, Tom T. Stonier of Rockefeller Institute would lecture on "Hazards Confronting a Metropolitan Population Subjected to a Nuclear Explosion."

Membership Committee. For Dr. Robbins, Mr. Allen presented the names of seven nominees for First Reading.

Committee on Awards for Achievement. In the absence of Dr. Bekkedahl, no report was available on the award winners for

scientific achievement in 1961, to be honored at the annual meeting on January 18. (It was subsequently reported that they were Robert W. Krauss (biological sciences); Rodney E. Grantham (engineering); John D. Hoffman (physical sciences); Lawrence E. Payne (mathematics); and Charles R. Naeser and Ralph Myers (teaching of science). (See complete story in the January *Journal*, page 1.)

Policy and Planning Committee. Dr. Campbell reported on recent Committee discussions of three subjects, as follows:

(1) Assistance in the Academy office: The Committee feels that a part-time paid staff officer, preferably a retired member of recognized standing, should be appointed to direct the affairs of the office and carry out the Academy's policies. He should have clerical assistance to carry out some of the functions now handled by the Secretary and Treasurer. Various emeritus members of the Academy have been considered for the post.

Following a lengthy discussion of this suggestion, Dr. Van Evera concluded that the Board's reaction was generally favorable, although any action would have to await a favorable outcome of the pending vote on the dues increase.

(2) Broadening the base of membership: The Committee feels that there should be two classes of members—"regular" and "fellow." Qualifications for fellows would be the same as for present Academy members: if the proposal were adopted, present members would automatically become fellows without further screening. Following a lengthy discussion, the Board agreed that the proposal should be further investigated.

(3) Shifting of fiscal year: The Committee has considered a suggestion by the Treasurer (Mr. Braaten), that the Academy's fiscal year be changed from a calendar year basis to some other more suitable basis, such as the end of May. This, Mr. Braaten felt, would considerably lessen the burden on incoming Treasurers. Here again there was considerable discussion, at the close of which Dr. Van Evera expressed the view that the Board was not yet ready to come to a decision in the matter.

Committee on Encouragement of Science Talent. In the absence of Dr. Brenner, the Secretary reported that some progress on a year-end meeting had been made, and the publication of transactions was to be undertaken. Dr. Van Evera suggested that a new project for the Junior Academy might be to undertake the publication of science notes, such as the Chicago Academy puts out for junior consumption; he felt that the world was getting too full of journals, but that this type of educational matter was really needed.

Election of Members. Following the Second Reading of their names by Mr. Allen, 35 nominees were elected to membership in the Academy, as follows:

Isidore I. Adler, Harvey Alter, George T. Armstrong, Maurice Bender, F. Marilyn Bozeman, Benjamin F. Brown, Robert J. Byrne, Earl R. Callen, David L. Chaney, Paul J. Claffey;

Oscar P. Cleaver, E. Carroll Creitz, Frank Cuttitta, Norman J. Doctor, Raymond L. Driscoll, Nelson T. Grisamore, Zaboj V. Harvalik, George H. Hass, George E. Jay, Jr., Robert Meyrowitz;

Fathollah K. Mostofi, James W. Osmun, George Phair, Howard Reynolds, John C. Rose, Robert Schaffer, Milton D. Scheer, Anthony W. Schrecker, Kurt H. Stern, Murray Strasberg;

William G. Stroud, Ira R. Telford, Robert S. Tipson, Eugene W. Weber, Werner K. Weihe.

Treasurer's Report. Mr. Braaten reported on his efforts to reach dues-delinquent members by mail and by phone. He had reduced the list to workable proportions, but still there remained four members who were 4 years in arrears, two members 3 years in arrears, 12 members 2 years in arrears, and 33 current delinquents. Membership of the latter group was not presently in question; however, they would lose their voting privilege when the ballots were counted. Various Board members agreed to approach some of the delinquents

before final action was taken to drop them from the rolls.

New Business. Mr. Rappleye pointed out that his term as elected member of the Board would terminate at the close of the calendar year, marking 19 years of service as Treasurer and three years as a Board member. He looked back on his service with satisfaction but some relief, since he felt himself heavily involved in work as editor of the *Journal of Mapping and Surveying,* as well as in sundry volunteer civic jobs. Dr. McPherson moved to express the appreciation of the Board and the membership for Mr. Rappleye's distinguished service to the Academy. The motion was passed by acclaim.

JOINT BOARD ON SCIENCE EDUCATION

The Joint Board is currently in the midst of its annual appeal for financial support of its program. Last year, 75 technical societies, business firms, and industrial organizations contributed $5,350; this year, a total of $7,000 must be obtained to finance the program.

The increased budget is due to an increased demand for JBSE services, to expansion of the services available, and to increasing costs of some of the programs. Practically all funds are used for direct support of activities; less than five percent is devoted to essential administrative purposes.

The accomplishments of the Joint Board result from the volunteer efforts of a large group of individuals. Their efforts are intended to serve some 2,400 science and mathematics teachers, and directly or indirectly reach an estimated 100,000 students. When viewed in this light, the financial requirements of the program are very modest.

If the increased costs of the program are to be met, it must come largely from the present contributors, since the Board is now appealing to most of those interested in promoting science education. Many organizations are contributing generously. Others are giving only token support. As a means of informing contributors, "Summary Report — 1961" has been prepared. This has been sent to all previous contributors; extra copies are available in the Joint Board office. It is hoped that all will want to increase their contributions to ensure the continuing success of the Joint Board's program, which is recognized as one of the outstanding science educational efforts in this country.

WASHINGTON JUNIOR ACADEMY OF SCIENCE

The Junior Academy's second annual science club workshop was held at Georgetown University on January 6. Approximately 200 students and adults attended.

The program for the day, arranged by Mona Dickson, the WJAS program chairman, consisted of a short general meeting followed by the formation of six simultaneous discussion groups for consideration of science club problems. A student chairman and secretary, and an adult advisor were designated for each group.

One group discussed the organization of science clubs, including the formation of special-interest clubs. Membership requirements were discussed by another group. They concluded that admission should be based on interest rather than on grades. While scholarship should be encouraged by clubs, it was felt that election to membership in the Junior Academy should be based on scientific achievement rather than election to club membership.

The nature of club meetings provided much discussion by a third group. All agreed that talks by local scientists are stimulating, and are best when presented with demonstrations or when illustrated by slides or films. Field trips are considered to be worth-while, but planning is of prime importance. There is a need for well-planned trips—geology trips, for example—which have been developed by specialists of the area.

A fourth group considered the ways in which clubs can stimulate research interests in their members. One such method is

concerned with a club research project — the development of a nature trail was mentioned as an example—in which all members participate. Reports by members on their individual research projects are especially stimulating. Arrangements whereby school laboratories may be open on Saturday mornings have been helpful in providing facilities for research work, which is often a problem for students. A valuable club activity is the collection of books and scientific publications to provide source material for student investigations.

Sources for club programs was the subject of another group discussion. The Joint Board is prepared to furnish speakers on a wide variety of subjects, and their services should be utilized more fully. The school contact for each school should be invited to participate in club meetings, and he should be called upon for advice and help on a wide variety of club activities. The Directory of the Joint Board contains an extensive list of field trips and laboratories that may be visited.

The role of the science club in planning science fairs was discussed by the final group. All agreed that the school fair was a major responsibility of the club. Students should be stimulated to prepare projects for exhibition. Club-sponsored workshops on the preparation of exhibits are important. All details for the school fair are usually the responsibility of the local club. Careful planning of all details on an adequate time schedule is a necessity for a successful fair.

The workshop closed with an assembly in which reports from the several discussion groups were presented. In conclusion, Robert B. Hobbs, vice-chairman of the Joint Board, described the services of his organization and assured the students of the support of the scientists of the area in science club activities.

SCIENCE AND DEVELOPMENT

Geological Survey engineers are making a study of the time of travel of water in the Potomac and Ohio rivers. Information on travel time of water is needed in case a harmful amount of a contaminant, such as radio-active material, is introduced into a stream. It would enable downstream users to know how soon the harmful material would reach them and the kind of action needed to protect their water supply. Reports on this study, in Geological Survey Circulars 438 and 439, explain graphical procedures for estimating time required for water to travel between different points along the Potomac and Ohio rivers at various flows ranging from low water to high water. The reports also give the flows most likely to occur in each calendar month.

Bibliographies of Red Chinese agricultural literature have been issued by the Department of Agriculture Library. The first, "Communist Chinese Periodicals in the Agricultural Sciences" (Library List No. 70), was published in December 1960. The second, "Communist Chinese Monographs in the USDA Library" (Library List No. 71), was issued in June 1961. It lists 893 titles, and was prepared under a grant from the National Science Foundation. Both lists were compiled by Leslie T. C. Kuo and Peter B. Schroeder, members of the USDA Library Oriental Staff.

A pilot plant has been developed at the Department of Agriculture Research Center, Beltsville, Md., that is able to remove 98 percent of strontium-90 from contaminated milk at the rate of 100 gallons per hour. The process is simple and has no significant effect on the milk's chemical composition, physical stability, or flavor. It is based on the principle of ion exchange. The milk is slightly acidified with dilute citric acid and filtered through a bed of resinous material charged with a concentration of metallic salts similar to that found in milk. The strontium ions in the milk change places with calcium ions in the resin. The purified milk is then restored to its original acidity and pasteurized and homogenized as usual. Milk produced in the United States today

is safe to use. But in case of greater contamination from accelerated nuclear testing or a nuclear attack, we have a standby process for insuring a safe supply of this vital food. The pilot plant was developed under a cooperative program supported jointly by the Public Health Service, the Atomic Energy Commission, and USDA.

The David Taylor Model Basin was authorized by Congress in 1936. It is named after Rear Admiral David Watson Taylor, USN, who was chiefly responsible for obtaining the model basin facility which was authorized in 1896 and built at the Washington Navy Yard. The David Taylor Model Basin occupies 186 acres. It includes a towing tank, administration and laboratory buildings, and shops. It also operates a Field Station at Bayview, Idaho, the hydrodynamic research facilities at Langley Field, Va., and a mobile noise-measuring barge based at Charleston, S.C. The 1960 staff was composed of 1,359 civilians and 43 military personnel. Organizationally, the Taylor Model Basin is divided into four laboratories — Hydromechanics, Aerodynamics, Structural Mechanics, and Applied Mathematics, and four departments—Administration, Industrial, Supply, and Public Works.

Research on the development and testing of sonar transducers—underwater "loud speakers"—is being conducted in the Physics Department of American University. It is supported by a contract with the Office of Naval Research. An attempt is being made to determine what characteristics of sound fields in air may also be applied to the nature of sound fields in water. The fundamental laws for movement of sound waves in water and air are much the same; but it is necessary to find out exactly what similarities occur, and in what proportion, so the transducers may be tested accurately. This basic research is of interest to the Navy Department because of its concern with underwater sounds.

The International Union of Pure and Applied Chemistry has adopted a new basis for the expression of atomic weights. The exact number 12 has been chosen as the assigned atomic (nuclidic) mass of carbon 12, the principal isotope of carbon. This action, taken in August 1961, parallels the 1960 action of the International Union of Pure and Applied Physics, and eliminates the confusing difference that has existed between the atomic weights used by chemists and physicists.

Prior to about 1930, both physicists and chemists had used natural oxygen with an atomic weight of 16 as the basis for fixing the scale of atomic weights. However, the discovery that natural oxygen is a mixture of three isotopes, and a slightly variable mixture at that, led physicists to assign the number 16 as the atomic mass of oxygen isotope 16, whereas chemists continued to use 16 as the atomic weight of natural oxygen. This dual basis, of course, led to two tables of atomic weights, differing by some 275 parts per million.

Proof that a lethal toxin is produced in the blood of an animal as the result of a burn or scald has been established through experiments at American University and the Marine Biological Laboratory at Woods Hole, Mass. Working primarily with the Fundulus—a plentiful, easily-obtained salt water fish about the size of a large goldfish—Albert B. Chaet and coworkers found that when the blood of scalded fish was injected into healthy ones, 51 percent of the healthy fish died. The incidence of fatality was even higher—running to 85 percent in many cases—when similar experiments were performed with starfish, marine worms, and crayfish.

The course of explosives research at the Naval Ordnance Laboratory is being "shaped" to some extent by a batch of ordinary rubber volleyballs. Scientists in the Chemistry Research Department have discovered that these hollow and flexible playthings make excellent molds in which sensitive powdered explosives can be compressed into solid

spherical charges of even density. The compressing is done in a water-filled hydrostatic press which subjects the molds to equal pressure from all sides. In this manner. charges of almost any density can be compressed.

As part of the NOL explosives research program. the charges are detonated several feet off the ground to determine whether the resulting airblasts vary with the charge densities in a determinable manner. If this is the case. scientists hope to fire the small round charges under laboratory controlled conditions as a means of providing answers to questions raised about larger charges fired at high altitudes.

Maryland University's Physics Department will change its name to "Physics and Astronomy" to recognize the introduction of a new program in astronomy. Beginning last fall. Astronomy 1. two seminars. and two advanced courses are being offered each semester by way of a preliminary build-up for graduate-level courses. Astronomy 1 has proved extremely popular, showing a registration of 194 students in the fall of 1961.

The University of Maryland has received a contract providing $912,000 for research activities in the field of the science of materials. Solid state physics. molecular structure, and the behavior of materials under conditions of stress will be studied intensively by scientists in the Departments of Physics. Chemistry. and Molecular Physics in a joint effort sponsored by the Advanced Research Projects Agency of the Department of Defense. The contract begins next fall and will extend for four years, providing additional faculty and research personnel and making possible the purchase of special experimental apparatus for research on material. Both basic and applied studies will be conducted.

Dedication ceremonies for the new National Library of Medicine building in Bethesda were held December 14. A general symposium on "Books and Medicine" was held the following day in the main reading room of the new building.

American University has rescheduled its Seventh Institute on Research Administration for April 23-27. It had previously been planned for last October. The Institute, sponsored by the University's School of Government and Public Administration, is designed to report and evaluate current thinking and methods for achieving maximum productivity from a critical national resource—the basic research scientist.

Starting in January, mathematicians in both the United States and the Soviet Union are being given greatly increased access to each other's published research literature. Under the terms of a journal exchange agreement between the American Mathematical Society and the Library of the USSR Academy of Sciences, each country is honoring requests of the other for subscriptions to normally difficult-to-obtain mathematical journals and book series.

EDITORIAL COMMENT

Dean Van Evera's accession to the presidency of the Academy is a source of particular pleasure to those Washington chemists who—like your secretary and your editor—were introduced to science in George Washington's Chemistry Department during the pre-Depression days, when Van was a rising young instructor. We knew him well as an inspiring teacher and a wise counselor, and had some inkling of what later became apparent—that above all he was a molder of character. Van has a long memory, and the friendly contacts thus begun have lasted through the years, even unto the second generation. (He has been known to annotate an examination paper. "I flunked your father for this same mistake. 25 years ago.") They have put us in a position to know that the distinctions that have come Van's way have been well-merited indeed.

Delegates to the Washington Academy of Sciences, Representing the Local Affiliated Societies*

Philosophical Society of Washington	Lawson M. McKenzie
Anthropological Society of Washington	Regina Flannery Herzfeld
Biological Society of Washington	Herbert Friedmann
Chemical Society of Washington	John L. Torgesen
Entomological Society of Washington	William E. Bickley
National Geographic Society	Alexander Wetmore
Geological Society of Washington	Margaret D. Foster
Medical Society of the District of Columbia	Frederick O. Coe
Columbia Historical Society	U. S. Grant, III
Botanical Society of Washington	Harold T. Cook
Society of American Foresters	Harry A. Fowells
Washington Society of Engineers	Howard S. Rappleye
American Institute of Electrical Engineers	William A. Geyger
American Society of Mechanical Engineers	William G. Allen
Helminthological Society of Washington	Doys A. Shorb
American Society for Microbiology	Mary Louise Robbins
Society of American Military Engineers	Delegate not appointed
Institute of Radio Engineers	Robert D. Huntoon
American Society of Civil Engineers	Joseph M. Caldwell
Society for Experimental Biology and Medicine	Kathryn Knowlton
American Society for Metals	John A. Bennett
International Association for Dental Research	Gerhard Brauer
Institute of the Aerospace Sciences	Francois N. Frenkiel
American Meteorological Society	Jack Thompson
Insecticide Society of Washington	Milton S. Schechter
Acoustical Society of America	Richard K. Cook
American Nuclear Society	George L. Weil

*Delegates continue in office until new selections are made by the respective affiliated societies.

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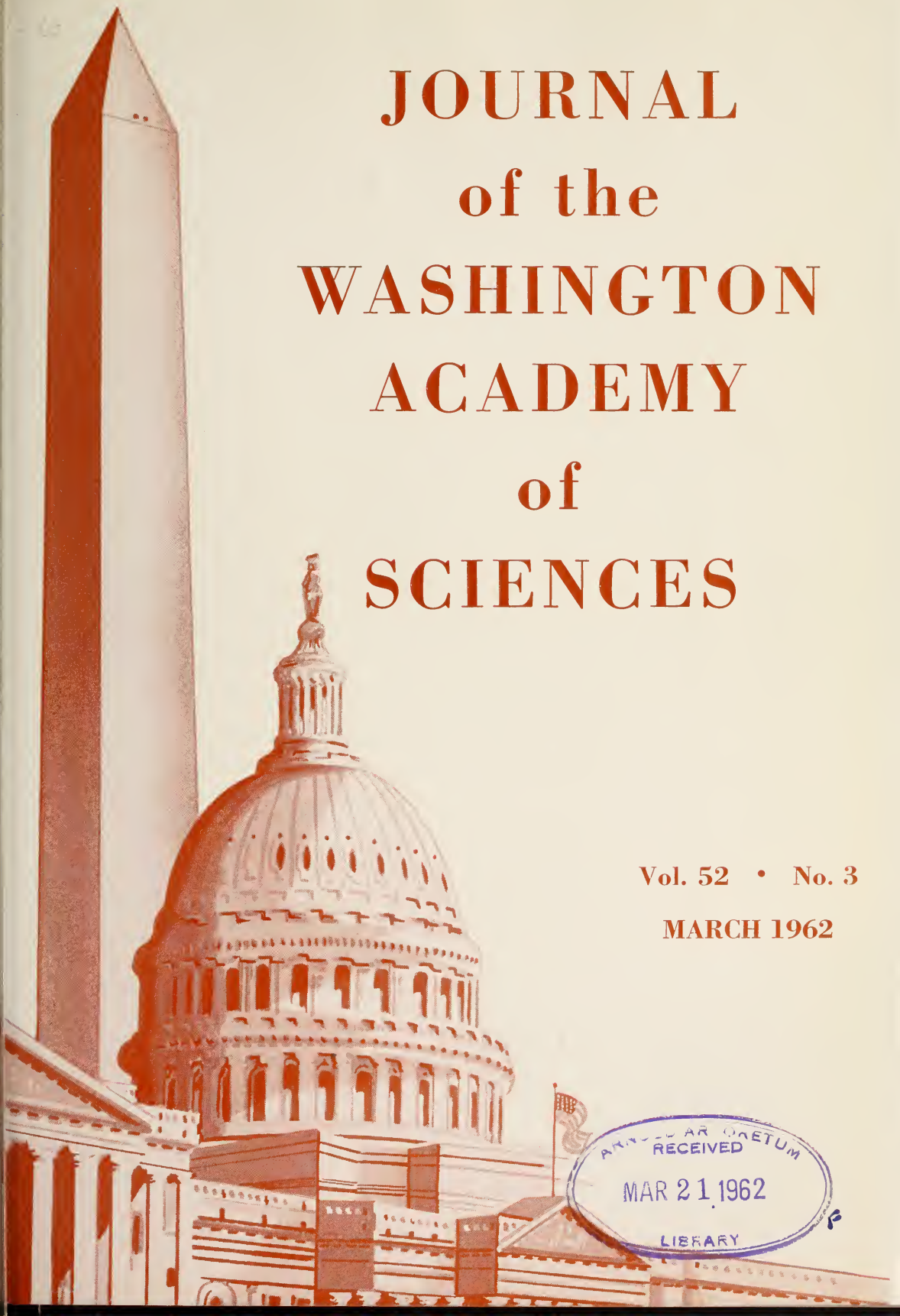

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MARCH 1962

JOURNAL OF THE WASHINGTON ACADEMY OF SCIENCES

Editor: Samuel B. Detwiler, Jr., Department of Agriculture

This Journal, the official organ of the Washington Academy of Sciences, publishes historical articles, critical reviews, and scholarly scientific articles; notices of meetings and abstract proceedings of meetings of the Academy and its affiliated societies; and 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 Geology of Washington, D. C., and Vicinity*

Paul M. Johnston

U. S. Geological Survey

Anyone who has seen the Potomac River at Washington could not fail to be struck by the contrast of the river and its setting below and above the city. Downstream, the Potomac is a placid estuary, a mile or more wide; bluffs on both sides rise 150 feet above the tide. Upstream, the channel is less than 1,600 feet wide, narrowing in places to less than 200 feet; here the torrent rushes between 300-foot rocky bluffs or dashes headlong among the rocks, dropping a hundred feet in 4 miles.

A closer look at the bluffs downstream from the city shows that they are made up of unconsolidated rocks—sand, gravel, and clay—but upstream the channel and the bluffs are carved from solid rock.

Washington lies astride the "Fall Line," called that because it marks the location of falls and rapids in the rivers of eastern United States. At Washington the Potomac River leaves the rock-ribbed Piedmont to flow across the Coastal Plain (see map).

At river level the change in the rocks is readily seen, but on the uplands, away from the river and its tributaries, the change is not so apparent. The hard rocks of the Piedmont have been converted to residual sand and clay, weathered to great depths from many thousands of years' exposure to the elements. Only the most resistant rocks crop out on the uplands. The Coastal Plain deposits feather out upon this upland surface and mingle with the Piedmont residuum, generally with little change in topography.

At the Fall Line, which bisects the area from northeast to southwest, the hard rocks of the Piedmont pass under the sediments —clay, sand, and gravel—of the Coastal Plain. The bedrock surface dips to the southeast at an average rate of about 125 feet per mile. The thickness of the Coastal Plain sediments ranges from nothing at the Fall Line to 1,800 feet at the southeast corner of the area. These sedimentary rocks, generally unconsolidated, form a southeastward thickening wedge in which the beds, from bottom to top, dip at succesively lower angles than the bedrock surface (Darton, 1947). Their ages range from Cretaceous at the bottom, through Pleistocene and Recent at the top.

This is a greatly simplified version of the structure of the Coastal Plain. In the Washington area, the Coastal Plain deposits, displaying the effects of subaerial and nearshoreline environment, were laid down under variable conditions, so that the beds are not continuous; parts have been cut out and replaced by other sediments by the ancient streams.

The formations of the Piedmont include both metamorphic and igneous rocks (see geologic column). The largest area is underlain by the Wissahickon Formation—schist, phyllite, and quartzite—metamorphic rocks derived from shale and sandstone. Variations of the Wissahickon are the Laurel Gneiss of Chapman (1942) and

*Adapted from an address before the Geological Society of Washington, September 27, 1961. Publication authorized by the director, U. S. Geological Survey.

the Sykesville Formation of Jonas (1928), both of which also include altered intrusive granitic rocks. All the Piedmont formations in the area have been intruded by mafic (dark colored) and felsic (light-colored) igneous rocks. More simply stated, the rocks underlying the Piedmont are composed of the Wissahickon Formation in various stages of alteration plus granitic and basaltic rocks, most of which are altered at least to some extent.

The history of the Piedmont rocks begins with the deposition of sediments in the sea more than 350 million years ago. After consolidation, the rocks were raised above the sea and invaded by ferromagnesian magmas, which in some places reached the surface and resulted in volcanic activity. Subsequently, in later Paleozoic time strong compressive forces, acting in a northwest or southeast direction, buckled the earth's crust and compressed the beds into tight folds. During and after this mountain-building activity, another series of intrusions took place, involving both felsic and mafic magmas, producing both granite and gabbro.

Still later, a long period of erosion cut down the ancient mountains nearly to base level before the region again sank beneath the sea. Sediments deposited in Triassic time upon the eroded surface in the region just west of the map area were invaded by another series of mafic intrusions (Triassic trap or diabase). At the close of the Triassic, tilting and faulting took place and low mountains were formed, but there is no evidence of further extensive folding in this area (Moore, 1933).

During the Jurassic this region probably remained above sea level; no Jurassic sediments have been recognized. Erosion reduced the region to a peneplain; eastward tilting brought its eastern part beneath the sea, and stream cutting increased in the western part. Cretaceous and younger sediments in the Coastal Plain were deposited in and near the sea, which during Pleistocene time rose and fell with the advance and retreat of the ice (Cooke, 1952). However, the ice never advanced south of central Pennsylvania and northern New Jersey.

In the following section, the geologic formations underlying the Washington area are described and their major localities outlined. The formations are not shown on the map because of its necessarily small scale.

GEOLOGIC FORMATIONS OF THE PIEDMONT

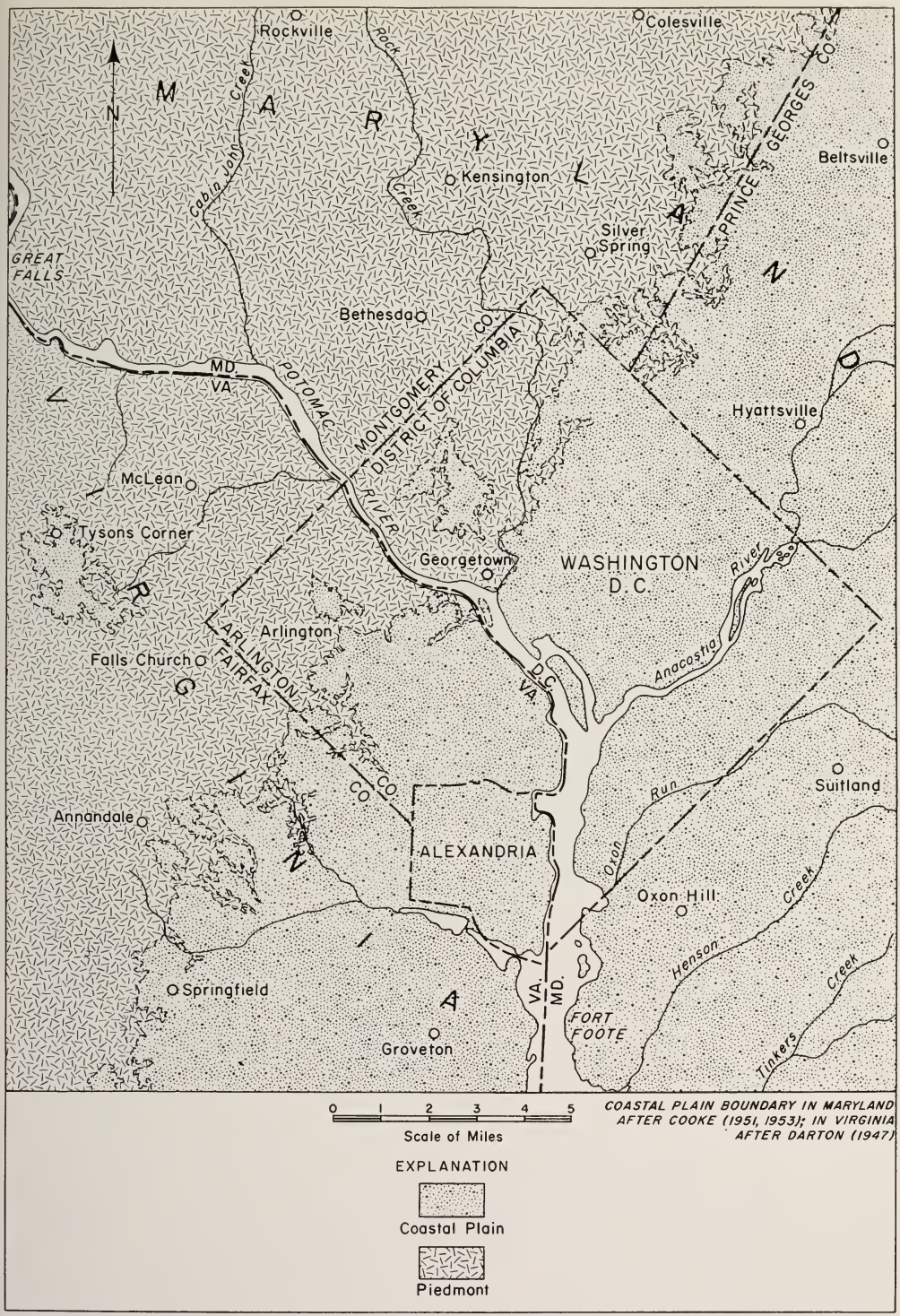
Lower Paleozoic (?) Rocks

Wissahickon Formation. The Wissahickon Formation was named from exposures along Wissahickon Creek in Philadelphia. Similar rocks have been mapped as Wissahickon from Pennsylvania on the north to Alabama on the south. The formation passes beneath the Coastal Plain on the north and south and in some places on the east. West of Washington it grades into other formations or is concealed beneath rocks of Triassic age. It occupies roughly most of the map area northwest of the northwest District of Columbia line extended.

In the Washington area the Wissahickon is composed of quartz-mica schist, phyllite, and quartzite. The schist grades into finer grained phyllite on one hand and into quartzite on the other. Quartz forms the bulk of the schist which contains abundant sericite and more or less biotite and chlorite. In some places the biotite or chlorite content is as high as 30 percent; in many places clinozoisite-epidote is present in considerable amounts. Minor accessory minerals are garnet (almost always present), ilmenite, magnetite, sphene, and tourmaline.

The fresh, unweathered schist and phyllite are various shades of gray, bluish-gray, or greenish-gray, commonly with a silvery luster on cleavage surfaces resulting from the abundant sericite.

The quartzite in the Wissahickon is massive to somewhat schistose, and very fine to coarse. Some of the quartzite contains appreciable biotite—5 to 20 percent—and



MAP OF WASHINGTON, D. C. AND VICINITY SHOWING THE COASTAL PLAIN AND PIEDMONT

(or) chlorite—5 to 10 percent. Colors of the fresh rock are generally dark gray but range from nearly white to very dark, almost black. The darker, finer grained quartzite in hand samples resembles ferromagnesian rock and may be mistaken for an intrusive.

The schist and phyllite of the Wissahickon weather readily, producing a buff-colored, reddish, yellow, or drab micaceous clayey, silty soil; the quartzite is somewhat more resistant, but weathers to a fine silty to medium-grained sandy soil, similarly colored.

Rocks of Unknown Age

Serpentine. Serpentine occurs in various places in the Piedmont in large and small bodies. Only one body of any size has been recognized in the map area, this west of Rockville. The predominating rock, as observed in a quarry, is a gray to black serpentine cut in some places by fine veinlets of calcite.

Mafic Rocks. The formation designated mafic rocks occurs in two large bodies and many small ones in the Washington area. One large body occurs east of Rockville; and the second begins southeast of Rockville as a sliver in the Wissahickon and widens in a southerly direction toward the Potomac River, interfingering with other formations. Smaller bodies of mafic rocks occur in Virginia in the vicinity of McLean and elsewhere, scattered throughout the Piedmont part of the area.

The mafic rocks encompass a variety of types including tonalite, coarse black gabbro that is more or less altered, chlorite schist, biotite schist, talc schist, and soapstone. Some bodies of quartz diorite contain so many mafic inclusions that they were mapped with the mafic rocks.

Biotite schist, chlorite schist, and hornblende schist developed from flows or intrusives of relatively small size may be seen in most of the bedrock formations of the Washington area except in the younger granites.

In most places these mafic rocks weather to a dark brown or reddish soil, but where much iron has been leached out a pale greenish soil may result. Weathering proceeds to various depths; schist with little quartz weathers more readily than the more massive siliceous types.

Laurel Gneiss of Chapman (1942). The Laurel Gneiss of Chapman (1942) was originally named the Laurel migmatite by Cloos and Broedel (1940) after its type locality near the town of Laurel in Prince Georges County, Md. Chapman (1942), in a study of the Laurel at its type locality, concluded that it was derived from the Wissahickon "under conditions of stress, high temperature and abundant water." He therefore suggested that the nongenetic name of gneiss be assigned to the formation; this is the name used on the Montgomery County map (Cloos and Cooke, 1953).

The Laurel Gneiss underlies the area just west of the Prince Georges-Montgomery County line and trends in a southwesterly direction, its west side grading into the Wissahickon, its east side concealed beneath the Coastal Plain. On the south it is truncated by the Wissahickon in the District of Columbia. The Laurel could not be traced in Virginia, but it may make up part of the area mapped as the Sykesville Formation of Jonas (1928) south of the Potomac.

In outcrop, the Laurel Gneiss has much the same appearance as the Sykesville. The two formations weather similarly. The Laurel generally has a lighter color and a more uniform grain than the Sykesville.

Sykesville Formation of Jonas (1928). The Sykesville Formation was first named the Sykesville Granite by Jonas and shown on the Carroll County, Md. map (1928) as schistose biotite-quartz monzonite. The formation was later described in detail by Stose and Stose (1946). On the Montgomery County map (Cloos and Cooke, 1953) the designation "Sykesville Formation" is used, and it is described as "granitic-looking schistose rock with numerous inclusions, quartz pebbles, garnets, grading into schist east and westward. Probably

granitized schist."

The Sykesville Formation of Jonas (1928) underlies a discontinuous area east and southeast of Rockville, where it has a maximum width of a little more than a mile, pinching out about 5 miles farther to the southeast. Lenticular bodies aggregating nearly a mile wide occur along Cabin John Branch and extend across the Potomac, south of McLean. These bodies, which are entirely enclosed within the Wissahickon Formation, merge south of the river and appear to plunge beneath the Wissahickon south of McLean. A smaller lenticular body of Sykesville rocks lies athwart the Potomac River about 2 miles downstream from Great Falls. It splits into two sections and apparently dies out about a mile south of the river.

The major body of Sykesville rocks parallels the Coastal Plain in a belt 2 to 4 miles wide in Virginia, extending northward across the Potomac River about 3½ miles. On the southeast its margin is concealed beneath the Coastal Plain. On the south it passes with a gradational contact into granite.

In the Washington area the Sykesville Formation of Jonas (1928) appears to be a modified facies of the Wissahickon which, before intrusion of the "Sykesville Granite" contained, along with schist and quartzite, a large component of mafic rocks, probably both intrusive rocks and interbedded flows. Granitic magmas were intruded into the Wissahickon. The resulting intrusive rocks include quartz diorite, biotite granite, granodiorite, and quartz monzonite. These granitic rocks are a very dark gray and contain inclusions of dark gray to black biotite schist or chlorite-epidote-quartz schist, sericite-quartz schist, and quartz fragments. It may be that the original magma was of felsic composition, but because of assimilation of ferromagnesian rocks it took on a darker, mafic aspect. Included in the Sykesville Formation of Jonas (1928) are muscovite or sericite-biotite-quartz schist and gneiss, quartzite, epidote quartzite, and muscovite-biotite quartzite. Rocks of the Sykesville Formation, in spite of their dark-colored appearance, are highly quartzose.

The Sykesville Formation of Jonas (1928) does not weather as deeply as the Wissahickon. Soils produced are light and springy and drain readily. When wet they are light brown, and they dry to a still lighter shade. In areas of abundant mafic inclusions the soil may be dark brown or red, approaching in appearance soils derived entirely from mafic rocks.

Granitic Rocks. Granitic rocks are widely distributed; they range from small bodies covering a few square feet to large linear or irregularly-shaped bodies 6 to 10 square miles in area. Granite and aplite dikes up to several feet in width can be seen in many places.

Included in the granitic rocks are the Kensington Granite Gneiss of Cloos (1951), the Bear Island Granodiorite of Cloos (1953), and the rocks mapped only as granite in Virginia.

The only large body of Bear Island Granodiorite of Cloos (1953) in the area strikes northwestward across the District line southwest of Bethesda. This body is about 4 miles long and has a maximum width of about a half mile.

Three large bodies of Kensington Granite Gneiss of Cloos (1951) extend north from Georgetown in a strip about half a mile wide. Two other bodies, one half and three quarters of a mile wide and about 1½ miles long, strike northward from the Potomac River 1½ and 5 miles, respectively, upstream from Georgetown.

In Virginia the rocks mapped as granite occur in three large bodies and many small ones. The largest underlies an area about 3 by 4 miles in the southwest corner of the map area. The second largest, near Falls Church, is about 4 miles long and 2 miles wide. A smaller granite body lies between these two larger areas, about 1 to 3 miles northwest of Annandale. Many small bodies of granite are scattered over the Piedmont.

Geologic Column of Washington, D. C. and Vicinity

Alluvium and Coastal Plain Deposits

		District of Columbia and Montgomery County, Md.	Prince Georges County, Md.	Virginia
Quaternary	Pleistocene and Recent	*Recent alluvium.* Gravel, sand, silt, and clay		*Recent alluvium and artificial fill.* Gravel, sand, silt, and clay. Artificial fill material
		Colluvium (slope wash). Sand, silt, and clay containing quartz fragments; on uplands and hillsides in Piedmont.		*Colluvium (slope wash).* Sand, silt and clay containing quartz fragments; on uplands and hillsides in Piedmont.
		Pamlico Formation and Recent alluvium. Gravel, sand and silt. Includes artificial fill.	*Pamlico Formation and Recent alluvium.* Gravel, sand and silt. Includes artificial fill.	
	Pleistocene	*Terrace Gravels.* Remnants of gravel terraces bordering the Potomac River and larger streams.		*River Terrace deposits* at various levels. Gravel, sand and loam; basal part generally unsorted boulders, pebbles and sand.
		Wicomico Formation. Gravel, sand and silt. Local basal deposits of carbonaceous clay containing tree stumps and other woody debris.	*Wicomico Formation.* Gravel, sand and silt. Local basal deposits of carbonaceous clay containing tree stumps and other woody debris.	
		Sunderland Formation. Coarse gravel, boulders, cross-bedded sand, silt and clay.	*Sunderland Formation.* Coarse gravel, boulders, cross-bedded sand, silt and clay.	
Tertiary	Pliocene (?)	*Brandywine Gravel.* Predominantly well-rounded, polished pebbles of quartzite, sandstone, and chert with quartz sand.	*Brandywine Gravel.* Predominantly well-rounded, polished pebbles of quartzite, sandstone, and chert with quartz sand.	
		Bryn Mawr Gravel. Coarse, poorly sorted pebbles in red sand and silt	*Bryn Mawr Gravel.* Coarse, poorly sorted pebbles in red sand and silt	*Bryn Mawr Gravel.* Coarse, gravel in red clayey silt matrix. Thin, iron cemented gravel beds
	Miocene		*Chesapeake Group.* Light gray diatomaceous earth and fine yellow sand	*Chesapeake (?) Group.* Red and yellow silty sandy clay, thin white clay at base

Alluvium and Coastal Plain Deposits *(Contd.)*

	District of Columbia and Montgomery County, Md.	Prince Georges County, Md.	Virginia
Tertiary — Eocene — Pamunkey Group		*Nanjemoy Formation.* Massive pink clay overlain by fine gray micaceous glauconitic sand	
Tertiary — Eocene — Pamunkey Group		*Aquia Greensand.* Coarse to fine green glauconitic sand locally lime cemented	
Tertiary — Paleocene		*Brightseat Formation.* Fine, dark gray micaceous sandy clay	
Cretaceous — Upper Cretaceous		*Monmouth Formation.* Fine black micaceous glauconitic sand	
Cretaceous — Upper Cretaceous — Potomac Group	*Patapsco Formation and Arundel Clay.* Dark gray clay, containing lignitized wood and saurian bones. Overlain by massive maroon clay and varicolored sand and clay	*Patapsco Formation and Arundel Clay.* Dark gray clay, containing lignitized wood and saurian bones. Overlain by massive maroon clay and varicolored sand and clay	*Patapsco, Arundel and Patuxent Formations,* undifferentiated. Upper beds chiefly pink, red and gray clay with interbedded sand lenses that grade into clay lenses; basal part gravel, sand, or arkose in some places
Cretaceous — Lower Cretaceous — Potomac Group	*Patuxent Formation.* Large round pebbles, fine white, pink or yellow sand and thin lenses of white or iron-stained clay	*Patuxent Formation.* Large round pebbles, fine white, pink or yellow sand and thin lenses of white or iron-stained clay	

Piedmont Area

	District of Columbia and Maryland	Virginia
Age Unknown	*Bear Island Granodiorite* (Cloos, 1953). Light colored, discordant, mostly unfoliated	*Granite.* Includes granite, granodiorite, quartz monzonite, and quartz diorite. Sheared in places, elsewhere undistorted. Commonly somewhat altered. Probably in part equivalent to Bear Island Granodiorite and Kensington Granite Gneiss of Maryland
Age Unknown	*Kensington Granite Gneiss* (Cloos, 1951). Highly foliated, coarse; intrusive into the schist complex and mafic rocks	

Piedmont Area (*Contd.*)

	District of Columbia and Maryland	Virginia
Age Unknown	*Sykesville Formation* (Jonas, 1928). Granitic-looking schistose rock with numerous inclusions, quartz pebbles, and garnets, grading into schist eastward and westward	*Sykesville Formation* (Jonas, 1928). Quartz-mica schist and gneiss, and quartzite; intrusive granitic rocks containing inclusions of biotite schist, chlorite-epidote schist, quartz-mica schist, and quartz fragments. May include Laurel Gneiss in Virginia
	Laurel Gneiss (Chapman, 1942). Very similar to the Sykesville Formation. Grades into Wissahickon Formation. Contains garnets and staurolite	
	Mafic Rocks. Tonalite with inclusions, meladiorite, gabbro, amphibolite, and undifferentiated mafic rocks	*Mafic Rocks.* Coarse black gabbro, chlorite schist, chlorite-quartz schist, biotite schist, talc schist, and soapstone.
	Serpentine. Black, gray and dark green serpentine	
Lower Paleozoic (?)	*Wissahickon Formation.* Quartz-mica schist and phyllite with garnet and magnetite. Quartz veins, sandstone and conglomerate	*Wissahickon Formation.* Quartz-mica schist, phyllite and quartzite. More or less biotite and chlorite, clinozoisite-epidote and garnet. Accessory sphene, ilmenite, magnetite, and tourmaline

Note: Parts of table adapted from Darton (1947), Cooke (1951-1953), and Cloos (1953).

The composition of the granitic rocks differs from place to place. Included are biotite granite, muscovite granite, biotite-muscovite granite, granodiorite, quartz monzonite, and quartz diorite. Some of these rocks have been subjected to intense shearing, while others appear undistorted. Much of the rock is altered, the feldspars having been converted to sericite or clinozoisite-epidote. Most of the granitic rocks are highly siliceous; quartz ranges from 20 to 60 percent.

The larger granitic bodies display gradational contacts with the surrounding schist, and remnants of schist remain imbedded in the granite in many places.

The granite varies considerably in susceptibility to weathering. Soils developed on granite are generally light-colored and sandy; but where many dark-colored inclusions or schist bodies are in the granite, the soil tends to be reddish and clayey.

Aplite. Fine-grained white granite, or aplite, bodies intrude all the Piedmont rocks. They can be seen in many places in the form of dikes, sills, and irregular bodies that range from a fraction of an inch to tens of feet across. Exposures are deeply weathered, except in stream channels, and resemble granulated sugar. They do not form prominences, and may be concealed because of deep weathering and movement of slope wash.

All the aplite bodies are white, composed of fine-grained quartz and feldspar. In some places minor amounts of tourmaline and white mica are accessory minerals.

Quartz Veins. Quartz veins from a fraction of an inch to tens of feet across occur in all the Piedmont rocks of the Washington area. Some of the larger veins may be traced for a half mile or more, the smaller ones only a few feet.

GEOLOGIC FORMATIONS OF THE COASTAL PLAIN

Lower and Upper Cretaceous Series—Potomac Group

In Maryland, the Potomac Group of Early and Late Cretaceous age is divided into three formations; (1) the Patuxent Formation (Lower Cretaceous), (2) the Arundel Clay, and (3) the Patapsco Formation (Upper Cretaceous). In nearby Maryland, the Arundel and the Patapsco are not separated, but are considered together. In the Virginia part of the area, the Potomac Group is considered as a unit. The following descriptions of the formations are in part adapted from Cooke (1952).

Patuxent Formation. The Patuxent Formation contains large amounts of sand, commonly mixed with more or less kaolin and mica, gravel composed of large, well-rounded, polished pebbles, and lenses of vari-colored or white massive clay.

The Patuxent is the basal formation of the Coastal Plain; it lies directly upon the crystalline basement and probably was deposited as outwash from the Piedmont. Shifting stream currents have cut out parts of some beds, replacing them with other materials, so that tracing any unit any great distance is difficult. The Patuxent is overlain unconformably by the Arundel Clay.

The outcrop of the Patuxent is a strip about 3 miles wide between the northeast corner of the map area and Georgetown. An outlier is separated from the main body by Rock Creek in the District. In Virginia the Patuxent is included in the Potomac Group, which crops out in a strip about 4 to 8 miles wide south of the Potomac River.

Upper Cretaceous Series

Arundel Clay. According to Clarke (1897), "The Arundel Clay consists of a series of large and small lenses of iron-ore-bearing clays which occupy ancient depressions in the surface of the Patuxent formation. The clays are highly carbonaceous, lignitized trunks of trees being often encountered in an upright position with their larger roots still intact. Scattered through the tough, dark clays are vast quantities of nodules of iron carbonate, at times reaching many tons in weight. . . . The largest clay lenses reach a thickness of nearly 125 feet."

The Arundel is separated from the underlying Patuxent Formation by an unconformity, and from the overlying Patapsco Formation possibly by an unconformity (Cooke 1952).

Patapsco Formation. "The basal part of the Patapsco Formation is clayey; the upper part also contains clay but is more sandy and contains many lateral transitions from clay into sand. . . . The lower clay is commonly maroon. The colors of the upper part are prevailingly lighter, especially the sand, much of which is white. Most of the beds are lenticular but a few near the top are more even and appear to have been deposited in quiet water. Possibly the basal maroon clay properly belongs to the Arundel rather than the Patapsco, and some of the upper beds may represent the Raritan . . ." (Cooke, 1952).

The Patapsco overlies the Arundel Clay unconformably, and in the Washington area is overlain unconformably by the Monmouth Formation of Late Cretaceous age.

The Patapsco Formation crops out in a band east of, and parallel to, the outcrop of the Patuxent Formation north of the Potomac River, attaining a maximum width of about 6 miles in the Washington area.

Magothy Formation. The Magothy Formation was named by Darton (1893) for exposures on the Magothy River. It is not recognized by Cooke, who believes it to be overlapped by the Monmouth in the Washington-Prince Georges County area. However, Meyer (1952) describes it as a thin band paralleling the Patapsco Formation except locally. As described by Meyer it ". . . consists essentially of light-gray cross-bedded coarse sand containing a small

amount of glauconite and pyrite, which oxidizes to iron oxide where exposed, and brown, white, or gray clay. Particles of carbonaceous matter or lignite are common throughout the formation."

Monmouth Formation. According to Cooke (1952) the Monmouth Formation in the Washington area ". . . consists chiefly of very fine sand, commonly including more or less glauconite and mica. The base of the formation consists of a gravel bed about two feet thick containing well-rounded pebbles and coarse pink quartz sand. This bed merges upward into fine micaceous sand that weathers rusty brown. Fresher exposures are colored gray-green to nearly black by the unaltered glauconite. In this condition the Monmouth closely resembles the Eocene Aquia greensand, which overlies it, but from which it can be distinguished by its characteristic fossils. Moreover, the basal Aquia is commonly coarser and contains more and coarser grains of glauconite than the Monmouth."

The Monmouth Formation unconformably overlies the Patapsco Formation and is overlain unconformably by the Paleocene Brightseat Formation, or by the Miocene Chesapeake Group. The Monmouth Formation crops out in the stream valleys of Oxon Run and Henson Creek in the southeast part of the map area.

Tertiary System—Paleocene Series

Brightseat Formation. The Brightseat was named by Bennett and Collins (1952) from exposures about 1½ miles south-southeast of the east corner of the District. At this locality it is a light gray to dark gray micaceous sandy or silty clay, indurated in places, the lower part fossiliferous (Bennett and Collins, 1952). The thickness is extremely variable from place to place and it is not everywhere present.

Eocene Series—Pamunkey Group

The Pamunkey was considered a formation by Darton (1891) from exposures on the Pamunkey River, Va. It was later divided by Clark and Martin (1901) into two formations, the Nanjemoy above and the Aquia below.

Aquia Greensand. Cooke (1952) prefers the name "Aquia Greensand" for the formation in this region because glauconite is the dominant mineral in it.

"The glauconite of the Aquia is commonly in rather large grains, particularly in the lower part of the formation. It is nearly everywhere mixed with somewhat finer sand, which is less conspicuous because of its neutral color, though it may exceed the glauconite in actual volume. The Aquia includes several local ledges of marlstone in which the glauconitic sand is cemented by lime. Fresh exposures of the Aquia are generally very dark green but this color alters to rusty-brown in time because of oxidation of the iron in the glauconite."

"The Aquia lies unconformably on the eroded surface of the Paleocene Brightseat formation or overlaps on older formations" (Cooke, 1952). In the map area it lies upon the Monmouth Formation. The Nanjemoy overlies the Aquia Greensand, probably with an unconformable relationship.

The Aquia crops out in a band parallel to the Monmouth in the valleys of Oxon Run and Henson Creek.

Nanjemoy Formation. The following description of the Nanjemoy Formation is from Cooke (1952).

"The most distinctive part of the Nanjemoy formation in Prince Georges County is a bed of pink plastic clay called the Marlboro clay member of the Nanjemoy (Clark and Martin, 1901; Darton, 1948), that lies directly on the Aquia Greensand. This is overlain by gray to green glauconitic sand very like the Aquia in appearance but commonly somewhat finer. . . . The full thickness of the overlying glauconitic sand is not known. Clark and Martin (1901) report the total thickness of the formation as 125 feet."

The Nanjemoy Formation crops out only along Tinkers Creek in the southeast corner of the Washington map area.

Miocene Series—Chesapeake Group

The Chesapeake Formation was the name given by Darton (1891) to the marine deposits of Miocene age in the Chesapeake Bay area. It now has the status of a group which has been divided into three formations (Shattuck, 1902) in descending order: The St. Marys, Choptank, and Calvert Formations. The Chesapeake Group is undifferentiated in the Washington area.

"In Prince Georges County the Miocene consists chiefly of dark-gray to light-gray clay, which weathers readily into fine fluffy sand or silt. . . . At some places the basal Miocene deposits are carbonaceous. Elsewhere they contain enough glauconite to impart a green or gray color" (Cooke, 1952).

The Chesapeake Group crops out in southeast Washington and in stream valleys in the southeast corner of the map area.

Pliocene(?) Series

Bryn Mawr Gravel. "In this area the Bryn Mawr consists of coarse, poorly sorted pebbles in red sand and silt. The bright red color distinguishes it from the pink or yellow Brandywine formation, with which it is nowhere in contact. It is further distinguished by its altitude, being everywhere higher. In the District of Columbia it ranges in altitude from approximately 350 to 410 feet above sea level, and near Tysons Crossroads in Fairfax County, Virginia, red gravel, presumably Bryn Mawr stands as high as 518 feet" (Cooke, 1952).

Brandywine Gravel. The Brandywine is described by Cooke (1952) as ". . . predominantly well-rounded, polished pebbles of quartzite, sandstone and chert mingled with fairly clean quartz sand. The pebbles are not well sorted as to size, but the size decreases toward the southeast and the gravel becomes progressively somewhat better sorted. The gravel is commonly overlain by silt. . . .

"The main body of the Brandwyine lies unconformably on the Chesapeake group, (capping the uplands southeast of the District). Outliers at the U. S. Soldiers Home, and on northern Sixteenth Street, in the District of Columbia, overlap the Miocene and lie on the Patuxent formation and crystalline rocks."

In Virginia the Brandywine, as limited by Cooke (1931) was mapped with River Terrace deposits by Darton (1947).

Quaternary System—Pleistocene Series

Sunderland Formation. "The Sunderland consists of coarse gravel, including cobbles (boulders) a foot or more in diameter, cross-bedded sand, silt and clay. The color ranges from orange-red to pink, yellow, and blue-gray. The maximum thickness of the Sunderland is probably about 40 to 50 feet. Variations in altitude of the Sunderland seem to be caused by inequalities in the valley floor on which it was deposited . . ." (Cooke, 1952).

The Sunderland crops out near the east corner of the District of Columbia, in southeast Washington, in Maryland at Oxon Hill, and near Fort Foote.

The Sunderland Formation was not differentiated in Virginia but was included by Darton (1947) in the River Terrace deposits.

Wicomico Formation. "In this area (Prince Georges County) the Wicomico consists of a coarse gravel bed at the base and finer sand and silt above. The color of the silt ranges from yellow to drab to dirty white. There are also local deposits of carbonaceous clay containing tree stumps and other woody debris. The Wicomico formation rarely exceeds 30 feet in thickness" (Cooke, 1952).

In the District of Columbia the Wicomico extends from Florida Avenue to the White House and from Rock Creek to the Anacostia River. A narrow strip along the left bank of the Potomac and Anacostia Rivers broadens up the branches of the Anacostia. Other Wicomico outcrops occupy the valleys of Henson Creek and Tinker Creek.

The Wicomico Formation was not differ-

entiated in Virginia, but was included by Darton (1947) in the River Terrace deposits.

Pamlico Formation. "In this region (Washington) the Pamlico is entirely fluviatile and estuarine. It consists chiefly of gravel, sand and silt. The deposits probably do not exceed 30 feet in thickness.

"The Pamlico formation occupies the valley floors of all streams except the very smallest below an altitude of 25 feet. . . . The area mapped as Pamlico includes also tidal marsh and other alluvial deposits of Recent age as well as artificial fill . . ." (Cooke, 1952).

In Virginia the Pamlico Formation is undifferentiated and is included in the Recent Alluvium and artificial fill.

Late Pleistocene and Recent Alluvium

Colluvium. In addition to the deep residual weathered mantle of the Piedmont, large areas are covered to various depths with transported deposits, sometimes called colluvium. Characteristically, the colluvium is composed of a pavement of angular weathered quartz fragments up to 6 inches long, lying directly upon the weathered bedrock surface and overlain by several feet of reddish or buff colored clayey silt which generally contains scattered quartz fragments. In some sections one or more thin beds of weathered quartz fragments, more or less parallel to the bedrock surface, are the only indication of bedding which elsewhere in the section may be obscure or lacking.

Recent Alluvium. Recent alluvium is confined to stream channels and flood plains and is generally only a few feet thick, but in some places it may exceed 20 feet. It consists of clay, sand, and gravel.

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THE BROWNSTONE TOWER

Everybody who receives this *Journal* is aware of the initials DNA and RNA and of the current phrase "cracking the code," carried by both nucleic acids, that determines what proteins shall be synthesized in living cells. I was curious to find out whether my unrefreshed, antebellum chemistry would enable me to understand what is going on in this extremely active field of chemical genetics. For enlightenment I went to our own National Institutes of Health to see a young man, Marshall Nirenberg, whose name, not yet in American Men of Science or on the rolls of the Washington Academy of Sciences, is becoming known nationally and internationally as a pioneer in "cracking the code."

Organizationally, Dr. Nirenberg is a member of the staff of the Section on Metabolic Enzymes in the Laboratory of Biochemistry and Metabolism, National Institute of Arthritis and Metabolic Diseases. The chain of command begins with DeWitt Stetten, Jr., associate director in charge of research, over Leon A. Heppel, chief of the laboratory, over Gordon Tomkins, chief of the section, over Dr. Nirenberg, who has three professional associates (Heinrich J. Matthaei, Oliver W. Jones, and Samuel H. Barondes) and two laboratory assistants.

Physically, Dr. Nirenberg is to be found in D Corridor on the eighth floor, northwest wing, of the big Clinical Center. His name appears beside the door of Room 13. Arriving ahead of the time of my appointment, I retreated when I found standing room only in 13, and little of that. The hall, too, was lined with a variety of equipment that could not be accommodated in the laboratory rooms. At noon I met Dr. Nirenberg, and we went to lunch with Carl Brewer in the pleasant dining room of the new office building, No. 31, which houses the Division of General Medical Sciences, the Division of Research Grants, and extramural program staffs of the several Institutes.

At lunch Dr. Nirenberg explained his work to me. As I understand it, he and his associates were the first to report synthesis of a known protein-like substance (polyphenylalanine) in a cell-free medium containing amino acids and a synthetic RNA, the synthesis of which was directed by polyuridylic acid. This RNA was specific for the polymerization of phenylalanine. Thus it was shown how to go about the business of synthesizing other proteins from other RNA's of known composition, and eventually to relate the sequence of amino acids in the resulting protein to the sequence of basic groups in the template RNA; i.e., to decipher the code, which may be universal. Carl Brewer pointed out that the whole story of the development of concepts of the DNA-RNA role in heredity, beginning in 1953, was well told in a long article in the *New York Times* of February 2, 1962; and, of course, many other popular articles have been written about the subject. Dr. Nirenberg, whose work is outlined in the *Times* story, endorsed it. I recommend it.

Being engaged, as I am, in desk work in biology, it was refreshing to be in the presence of one who is in hot pursuit of knowledge, who has more experiments in mind than he can carry out. He is free to develop his research as he sees fit and is really not under scientific direction of those named in the second paragraph. His work is controlled by his own thinking and by results obtained by others working along similar lines. Communication is very important in such a rapidly developing subject, and there is a grapevine that carries the word among the members of the DNA-RNA fraternity. At NIH he is par-

ticularly indebted to Drs. Heppel, Singer, and Berman for advice and help.

At lunch Dr. Nirenberg was wearing his torn white laboratory coat, a symbol of his absorption in his work. I surmised that he might not count the hours he spends in the laboratory. "True," he said, and added that he lives on the campus in an apartment house built for physicians who must be close to the Clinical Center. Thus if an idea strikes him at home, he can be in the laboratory in a few minutes to try it out. He showed me around his laboratory and nearby instrument rooms. Electronics baffle me, and I could respond only to a very simple device in the hall, a large heavy thermos jug containing liquid nitrogen in which tubes containing enzymes are suspended. At such low temperatures the activity of enzymes is preserved for months.

Dr. Nirenberg was not always destined for biochemistry. He graduated from the University of Florida in 1948 not knowing what he wanted to do. He tried more than one occupation, and in 1952 took a master's degree in entomology, also at the University of Florida. His dissertation was on the Trichoptera of Alachua County—aquatic insects of no economic importance. He had taken a minor in biochemistry, and decided to work for a Ph.D. degree in that subject at the University of Michigan, under James F. Hogg. He took his doctor's degree in 1957. Since then he has worked at NIH, first on postdoctoral fellowships, then as a member of the staff. The attention he has received lately must be somewhat distracting, and he must be reluctant to give up his valuable time to instruct poorly prepared people like me in the purpose, methodology, and significance of his work. Yet he is doing so patiently and cheerfully. We hope that he may have the satisfaction of solving many of the problems now in his mind, and will enjoy both the regard of his colleagues and public recognition of his achievements.

—Frank L. Campbell

NOMINATIONS INVITED FOR WILEY AWARD

The Association of Official Agricultural Chemists invites nominations for the sixth annual Harvey W. Wiley Award for the development and establishment of methods of analytical chemistry. This award, of $500 cash, is given in honor of Dr. Wiley, father of the Pure Food Laws and a founder of AOAC.

Nominations, which must be accompanied by a biographical sketch of the nominee, a list of his publications, specific identification of the work on which the nomination is based, and an appraisal of the nominee's accomplishments—particularly the work to be recognized by the award—must be received by the AOAC secretariat prior to April 1.

Eight copies of the nominating material must be furnished. Nominations or requests for further information should be sent to the AOAC Secretary, Box 540, Benjamin Franklin Station, Washington 4.

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See inside rear cover.

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The Journal

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	LAWRENCE A. WOOD	National Bureau of Standards

1962 BUDGET APPROVED

The following budget for 1962 was approved by the Board of Managers at its meeting of February 6. For comparative purposes, actual expenses in 1961 also are shown. Also included are income figures for 1961 (actual) and 1962 (estimated).

	1962 estimated	*1961 actual*
Receipts		
Dues	$9,930	$5,708
Journal subscriptions, back issues, reprints	3,500	3,476
Interest, dividends, capital gains	4,000	3,944*
Services to Joint Board	200	200
Total	$17,630	$13,328

*Plus $684 stock.

Expenses		
Journal printing (8 issues at $725 per issue)	$5,800	$5,708 (11 issues)
Journal addressing, postage, miscellaneous	700	600 (approx.)
Part-time employee in treasurer's office at Academy headquarters	2,880	1,639
Miscellaneous office expenses (FICA, telephone, supplies)	480	0
Secretary (share of above, plus stenographic services)	500	0
Secretary (meeting notices, printing, addressing, list maintenance, miscellaneous)	2,500	2,254
Executive secretary at Academy headquarters	2,000	0
Meetings Committee (hall, refreshments, dinners)	1,700	1,661
Other committees:		
Awards for Scientific Achievement	30	28
Grants-in-Aid for Research	400	376
Encouragement of Science Talent	250	310
Science Education	500	500
Science calendar	25	25
Miscellaneous debits (transfers, taxes, etc.)	100	65
Total	$15,865	$13,166

Science in Washington

SCIENTISTS IN THE NEWS

Contributions to this column may be addressed to Harold T. Cook, Associate Editor, c/o U.S. Department of Agriculture, Agricultural Marketing Service, Room 2628 South Building, Washington 25, D.C.

HARRIS RESEARCH LABORATORIES

Louis R. Mizell has been re-elected chairman of the Washington Section of the American Association of Textile Chemists and Colorists. **Edmund M. Buras, Jr.,** was re-elected treasurer of the Section.

Louis Mizell presented a talk entitled "Programming Inventions" before the R&D Roundtable Research Management Group on January 24.

Milton Harris eulogized Raymond E. Reed, of the Toni Company, at a presentation of the Society of Cosmetic Chemists medal to Mr. Reed in New York. Both Toni and HRL are affiliates of the Gillette Company.

NAS-NRC

K. Way of the Nuclear Data Project was a member of a Panel on Nuclear Data, convened by the International Atomic Energy Agency at Vienna, December 12-15, 1961.

NATIONAL BUREAU OF STANDARDS

G. A. Ellinger has been appointed assistant chief of the Metallurgy Division to replace **T. G. Diggs,** who retired on January 5. He will also serve as chief of the Metal Reactions Section.

J. A. Bennett, formerly chief of the Mechanical Metallurgy Section, has, in accordance with his wishes, been relieved of his administrative responsibilities and will devote full time to the conduct of a laboratory program of research on fatigue in metals.

L. L. Wyman has been appointed a consultant to the chief of the Metallurgy Division, and will be assigned to the Division Office. Mr. Wyman was formerly chief of the Chemical Metallurgy Section.

H. C. Vacher has been appointed chief of the Microscopy and Diffraction Section.

The following recent talks have been given by NBS personnel:

H. C. Allen, Jr.: "NBS Materials Program"—Army Materials Advisory Committee, Aberdeen Proving Ground, Aberdeen, Maryland, January 16; **G. T. Armstrong:** "The Heats of Formation of Inorganic Fluorine Compounds—A Survey"—American Society of Mechanical Engineers, Princeton, January 22-26; **D. C. Ginnings:** "Powell Comparator Method for Determining Thermal Conductivities—a Discussion"—American Society of Mechanical Engineers, Princeton, January 25; **A. A. Maryott:** "Collision-induced Microwave Absorption in Non-dipolar Gases"—University of Toronto, Canada, January 18; **I. C. Schoonover:** "The Role of Measurement in the Development of Commerce and Industry"—Central Treaty Organization (CENTO) Science Symposium, Lahore, Pakistan, January 7; and **L. A. Wall:** "Polymer Degradation"—Celanese Corporation of America, Summit, N. J., January 5.

NATIONAL INSTITUTES OF HEALTH

Joseph J. Bunim, clinical director of the National Institute of Arthritis and Metabolic Diseases, was moderator of a discussion of the biochemical abnormalities in hereditary diseases, at a combined clinical staff meeting January 11 in the Clinical Center auditorium.

USDA, WASHINGTON

Edson J. Hambleton, in charge of Foreign Technical Programs, Plant Pest Control Division, ARS, participated in a panel discussion entitled "Entomology in the World Today" at the Eastern Branch Annual Meeting of the Entomological Society of America in Baltimore, October 31, 1961. He also traveled to Beirut, Lebanon, to be present at the annual conference of the Regional Insect Control Project, attended by personnel from the Near East and African countries. A major activity of this conference had to do with plans for U. S. expanded cooperative control of the desert locust in the Ethiopian-Somali area of East Africa.

Following the Beirut meetings, Mr. Hambleton visited with project and Ministry of Agricultural personnel in Tehran, Iran, and Ankara, Turkey, before returning to Washington.

Kenneth W. Parker recently presented a paper on "The Forest Service Range Research Program" before the Phi Epsilon Phi chapter at George Washington University.

DEATHS

Charles Gilman was killed in a plane crash in the Chilean Andes in January. Dr. Gilman had been in Chile since October, 1960, on loan from the Weather Bureau to the World Meteorological Organization of the United Nations. At the time of his death he was developing a hydrometeorological network covering all of Chile. Dr. Gilman joined the Weather Bureau in 1937. He was chief of the Bureau's hydro-meteorological section when he left for Chile. He was a native of Little Rock, Ark.

Louis Bryant Tuckerman died February 4 at the age of 82. He retired in 1949 after 30 years of service as an engineer-physicist with the National Bureau of Standards. He invented the Tuckerman optical-strain gauge, and was internationally known for his contributions to the mechanics of materials and structures. The optical-strain gauge was designed for measuring the strength of airships in connection with the failure of the dirigible Shenandoah. He cooperated with the Civil Aeronautics Board in studying the causes of aircraft accidents through analyzing the debris of crashed planes. Dr. Tuckerman was born in West Williamsfield, Ohio, and graduated from Western Reserve University. He also studied at the University of Nebraska and the University of Berlin. He received the Ph.D. degree from Johns Hopkins University.

AFFILIATED SOCIETIES

Botanical Society of Washington

The 479th meeting was addressed by Ernest Imle, research director of the American Cocoa Research Institute, on "Problems Related to Improvement of *Theobroma cacao* in Tropical America." Open house was held after the lecture, in Catholic University's new Ward Hall of Biology.

Society of American Military Engineers

Met on February 19 at the YWCA to hear Frank Turner, deputy commissioner of the Bureau of Public Roads, who reviewed his recent trip through USSR to inspect Russian roads.

Geological Society of Washington

At the 831st meeting on February 14, Irving Friedman of the Geological Survey spoke on "Deuterium in the Hydrologic Cycle"; Andrew Griscom, also of the Survey, spoke on "Geologic Mapping in Montgomery and Frederick Counties, Maryland, by Airborne Geophysical Methods"; and William D. Johnston, Jr., introduced a film by the Icomi-Bethlehem Steel Company entitled, "The Amapa Manganese Deposit, Brazil."

At the 832nd meeting on February 28, Marius Lecompte of the University of Louvain and the Belgian Royal Institute of

Natural Sciences spoke on "Modern Reefs and Paleozoic Reefs"; also, John T. Hack of USGS and L. H. Durloo, Jr., of AMS spoke on "The Geology of Luray Caverns, Va."

Society for Experimental Biology and Medicine

Met on February 1 at Georgetown Medical Center to hear three papers: "Atropine-histamine Interaction," by Gertrude Maengwyn-Davies, Sarah Eldar, and Stephen I. Oroszlam, all of the GU Schools of Medicine and Dentistry; "Biological Specificity and Molecular Forces," by Herbert Jehle of the GWU Physics Department; and "Application of Fluorescent Antibody Techniques to the Study of Anaplasma Marginale," by Philip Madden of the Beltsville Parasitological Laboratory.

Washington Society of Engineers and American Society of Civil Engineers

Collaborated on February 9 with the American Society for Testing Materials in a tour of Virginia highway projects. The group also visited Atlantic Research Corporation to hear a talk on "The Role of Materials in the Space Age" by Eugene G. Alcott, then attended a technical session on "Airports" conducted by Miles Clair, president of ASTM.

American Society of Civil Engineers

Met February 13 at dinner in Powell Auditorium, to hear Myers Van Buren describe the new bridge-tunnel currently being constructed across lower Chesapeake Bay. On February 27, a luncheon meeting was addressed by Paul C. Aebersold, director of AEC's Division of Isotope Development, who described industrial uses of radioisotopes.

The Associate Forum resumed its dinner meeting on February 20, and heard a talk on "Registration and the Professional Growth of the Engineer," by Donald Marlowe of Catholic University.

American Meteorological Society

Local members of the Society met to hear a discussion of "The Weather Bureau Meteorological Satellite Program" by Weather Bureau staff members. The discussion included a survey of the operational uses of the satellite output, as well as plans for future programs.

Institute of Radio Engineers

The annual banquet of the local section was held February 10 at the Statler Hilton. Patrick E. Haggerty, incoming national president of IRE, was speaker of the evening; and Robert Page officiated in a tribute to new IRE fellows and a presentation of outstanding university students.

On February 19, at a general meeting in the National Museum, Francis J. Heyden, S.J., of Georgetown University, spoke on "The Use of Electronics in Modern Astronomy."

Professional group technical meetings were held during February as follows: "Recent Developments in F-M Radar," by W. K. Saunders, DOFL; "Tour of Rabinow Engineering Company's New Plant," by J. Rabinow; "Microwave Advances at DOFL," by Blyde D. Hardin, James McDate, and Bob Garber, DOFL; "Confidence Limits for Reliability Estimates," by Joan R. Rosenblatt, GWU; "Radio Astronomy," by Cornell H. Meyer, NRL; "Government Evaluation of Your Technical Proposals," by Carl D. Palmer, NASA; and "Applications of Information Theory to Radar," by Merrill I. Skolnik, Electronic Communications, Inc.

Chemical Society of Washington

The 712th meeting was held on February 8 at the National History Museum, jointly with the Washington Junior Academy of Sciences. Louis F. Fieser of Harvard University spoke on "Experiences with Incendiary Munitions." Earlier in the evening, topical groups met to hear: "Problems in Evaluation of Toxicology,"

by a panel comprising Harry Hayes, NAS, Seymour L. Friess, NMRI, and O. Garth Fitzhugh, FDA; "Some Unusual Reactions of Trinitromethyl Compounds," by Mortimer J. Kamlet, NOL; and "Chemistry in the Upper Atmosphere and Space." by Robert F. Fellows, NASA.

Society of American Foresters

Held an all-day meeting on February 15, with a morning panel discussion moderated by Ralph Marquis, director of the Northeastern Forest Experiment Station. Panel members were V. L. Harper, assistant chief of the Forest Service; John Gray, North Carolina State extension forester; J. O. Artman, reports editor of TVA at Norris, Tenn.; and Charles Driver of International Paper Company. Norman Kraeft, farm director of the Mutual Broadcasting System, was the luncheon speaker. The general session in the afternoon was addressed by a panel comprising Frank W. Lara (moderator), forester at the National Wildlife Foundation, Hardy Shirley, dean of New York State University, and Albert G. Hall, forest counsel, Washington, D. C.

American Society for Metals

In February, the local membership celebrated Burgess Memorial Night with a banquet at the Ambassador Hotel. John R. Low, Jr., of General Electric spoke on "Dislocation Metallography." On March 12 the membership celebrated Sustaining Members Night and heard "Metallurgical Developments in Microelectronics" by L. McD. Schetky of Alloyd Corporation, Cambridge, Mass.

At recent technical meetings the following programs have been presented: February 21, Roy M. Gustafson of BuWeaps, on "Welding Processes"; March 1, Alfred J. Babecki of NRL, on "Welding Iron and Steel"; March 7, George E. Linnert of Armco Steel, on "Welding Stainless Steel": March 14, D. Wilcox of Reynolds Aluminum Company, on "Welding Light Metals."

American Institute of Electrical Engineers

At a general meeting on February 20, K. N. Mathes of General Electric spoke on "Electrical Insulation—a Dynamic Technology." On March 13, a ladies' night was arranged at the Naval Weapons Plant.

Helminthological Society of Washington

The 385th meeting on February 16 was held at Log Lodge, Beltsville, under the sponsorship of the Beltsville Parasitological Laboratory. A display of the Laboratory's work was presented, and two papers were given: "Excystation of Sporozoites and Locomotion of the Motile Stages of *Eimeria acervulina* and *E. Tenella*," by David J. Doran, T. L. Jahn, and R. Rinaldi; and "*Dentostomella grundmanni* n.sp., an Oxyurid (Nematoda) from *Eutamias quadrivittatus* (Say, 1823)" by M. B. Chitwood. V. S. Ershov, director of USSR's All Union Skrjabin Institute of Helminthology, was a guest of the Society.

American Society of Mechanical Engineers

At the February meeting, local section members heard John Srawley of NRL on "Fraction Mechanics and Fracture Transitions." and Earl Angulo of Goddard Space Flight Center on "Satellite Design." The meeting was preceded by a dinner at Cy Ellis' restaurant.

The ASME Women's Auxiliary held a luncheon meeting on February 15 at the Naval Weapons Plant. Kenneth Squires of NASA's Goddard Space Flight Center spoke on "A Trip to the Moon."

American Society for Microbiology

Held its regular meeting on February 27; Elmer L. Becker of Walter Reed Army Institute of Research spoke on "Some General Aspects of Gel-precipitin Reactions."

In December, a group comprising A. C. Benenson, Elvio Sadun, Nathaniel Roth-

stein, and Charlotte Campbell attended the Second Latin-American Congress of Microbiology, in San Jose, Costa Rica.

Acoustical Society of America

The local chapter met on February 19 at NBS; Malcolm C. Henderson of Catholic University spoke on "Absorption of Sound in Gases at Sonic Frequencies." The paper reported recent work in studies on the molecular structure of matter by sonic means.

CALENDAR OF EVENTS

March 21—American Society for Metals

John Huminick, Jr., Value Engineering Company, Alexandria, on "Welding Dissimilar Metals."

March 22—American Society of Mechanical Engineers

Past chairman's night. Annual elections. Program for students from Maryland, Catholic, Howard, and George Washington Universities.

March 29—American Society for Metals

John Huminick, Jr., Value Engineering Company, Alexandria, on "Welding Active and Refractory Metals."

March 29—Society of Experimental Biology and Medicine

Regular meeting.

April 5—American Society of Mechanical Engineers

Lecture on hydrofoils, sponsored by ASME Hydraulics Division. Speaker to be announced.

April 9—American Society for Metals

Silver certificates night. Panel discussion on "High Energy Forming of Metals."

April 10—Institute of Radio Engineers

General meeting. Speaker, Leslie Ball, Boeing Company. Topic to be announced.

BOARD OF MANAGERS MEETING NOTES

The Board of Managers held its 543rd meeting on January 2 at the National Academy of Sciences, with President Abelson presiding.

The minutes of the 542nd meeting were distributed and approved with the proviso that any errors, when discovered, be reported to the secretary.

Announcements. The secretary informed the Board that the affiliated societies should be made aware, if they are not already so, of the provisions in the new Bylaws with regard to the selection of delegates. It is no longer incumbent on the secretary to request the "nomination" of new representatives annually; rather, the affiliated societies have the privilege of selecting a new representative at any time, and the responsibility of making this known to the Academy officers.

Dr. Abelson announced that a Tellers Committee (N. Bekkedahl, N. F. Braaten, and S. B. Detwiler, Jr.) had been appointed to count the mail ballots currently being received, both for the election of officers and for the two Bylaws amendments which the Board had recommended to the membership.

Meetings. Dr. Frenkiel indicated that the annual dinner meeting would be held on January 18 in the Powell Auditorium. The Board agreed to a price of $3.75 for the dinner, with any overage to be subsidized by the Academy.

Dr. Frenkiel also reported that the next subsequent meeting would be held on February 15, and would be addressed by Dr. Abelson as retiring president.

Membership. Dr. Robbins presented the names of 17 nominees for membership, for First Reading.

Awards. Dr. Bekkedahl commented that selection of recipients of the Academy's annual awards for scientific achievement (January *Journal*, page 1) had been difficult because of the high caliber of the nominees. There was a general discussion by the Board of the selection of sponsors to introduce the award-winners at the annual meeting. Dr. Abelson asked Mr. Detwiler to see to it that the award presentations received suitable publicity in the daily press.

Encouragement of Science Talent. Dr. Brenner summarized the activities of the Washington Junior Academy of Sciences during the past year, with particular reference to the recent all-day meeting at the Hamilton Hotel, at which scientific papers were presented in three simultaneous sessions. He also reported that a meeting had been scheduled for Saturday, January 6, at which the presidents of school science clubs would meet with Junior Academy officers to discuss common problems in science promotion, particularly the stimulation of science fair projects. He also discussed the periodic science trips sponsored by the Junior Academy, which had provided thousands of young people with an opportunity to visit scientific demonstrations and museums in New York and Philadelphia. He also pointed out that further planning was needed in the conduct of future joint meetings of the Senior and Junior Academies for the award of merit citations, since past meetings had turned out rather awkwardly.

Joint Directory Feasibility. Dr. McPherson presented a report prepared by Robert W. Krauss, chairman of a special committee appointed some months ago to study the feasibility of preparing a joint directory of the Academy and its affiliated societies. (See February *Journal*, page 43.) This stimulated a long discussion of the Academy's responsibilities in the publication of a directory, the need for up-to-date listings of the Academy membership *per se*, and the desirability of including affiliated society memberships in such publications. At the conclusion of the discussion, the Board accepted Dr. Krauss' report. The Board then approved a motion authorizing the president to appoint a committee to implement the recommendations of this report. Dr. Abelson indicated that he would work with Dr. Van Evera, the 1962 president, in setting up such a committee.

Grants-in-Aid. Dr. McPherson reported that a grant of $60 had been made to a Fairfax High School student for a project on ion exchange resins.

Election of Members. Following the Second Reading of their names by Dr. Robbins, seven nominees were elected to membership in the Academy, as follows: Milton L. Blanc, Bert Fisk, Rolf B. Johannesen, J. Murray Mitchell, Jr., Carl O. Muehlhause, Paul H. Putnins, and Herbert C. S. Thom.

JOINT BOARD ON SCIENCE EDUCATION

The Joint Board is making plans to revise its roster of scientists and engineers who have expressed willingness to participate in science education activities. The current file contains the names of 587 scientists and engineers, most of whom have been called upon to help in some capacity. Records show that 172 lectures and demonstrations were presented during 1961; many scientists helped in additional ways—such as, for example, in science fair judging, and in serving as substitutes for teachers who attended the Radioisotopes Institute in early November.

As a first step in revising the roster, present participants will be contacted to indicate their willingness to continue. Scientific societies will be asked to furnish names of members known to be interested in science education. In addition, interested individuals are invited to make their interest known by writing to the Joint Board (1530 P Street, N.W., Washington

5): a form will be sent on which the type of service can be registered.

The Joint Board is cooperating with the Walter Reed Army Institute of Research on the occasion of the Junior Science and Humanities Symposium, to be held by the Institute March 29-30. This intensive two-day program will be devoted to the presentation of selected professional papers by local students, addresses by experts in several fields of science, and tours of research facilities. Some 50 high school science teachers and more than 175 of their students are expected to attend.

The Joint Board's participation will consist in providing 32 scientists to participate in an informal "curbstone clinic," during which students can discuss the vocational aspects and career opportunities in science. The scientists will lunch with the students, and thereafter gather with them in small groups for the informal discussions.

For the third year, the Joint Board is sponsoring a unique summer research opportunity for high school students. For conduct of this program it has received a grant of $6,046 from the National Science Foundation; additional sums will be contributed by several of the local scientific societies.

Director of the program is Leo Schubert, chairman of the Chemistry Department at American University; he serves without compensation. Associate director is Margaret Maury of Sidwell Friends School. The administration of the program, as well as the orientation lectures and concluding meetings, will be centered at the University.

After two days of orientation lectures, the students will be required to work 40 hours per week for eight weeks in research laboratories. At the end of this period, they will meet for reports on the research in which they participated. The point of view is that these students are apprentices in science; the emphasis is on the stimulation of enthusiasm for scientific research.

Many Government laboratories will cooperate with the University in the conduct of this program. The important task of liaison and encouragement will be the responsibility of Mrs. Maury, who will visit the students and laboratories on a regular basis to ascertain whether all is going well.

A subcommittee of the Joint Board as well as the local science supervisors will oversee the entire program. Evaluation reports on the past two years of operation, received from both the students and their research sponsors, indicate that the program has been a resounding success.

Forty students will participate this year. They will receive no compensation from the laboratories, but will receive a $10 weekly stipend from the grant to cover transportation and lunch expenses. Application forms may be obtained by writing to Dr. Schubert at American University. Closing date for applications is April 15.

Dr. Schubert discussed this program on February 3, before a meeting of program directors called by the National Science Foundation.

SCIENCE AND DEVELOPMENT

The University of Maryland Physics Department has received a grant of $850,000 from the National Science Foundation for expansion of its graduate research programs. The grant has been matched by funds appropriated by the Maryland General Assembly. Increased facilities that are being built include an addition to the Van de Graff accelerator, a neutron pit, and a fourth floor addition to the present physics building, which are scheduled for completion in June. Plans call for a later addition to the present physics building to provide more teaching and research facilities, and an addition to house a spiral high-ridge cyclotron. The Physics Department faculty has been increased by one-third. Sixteen students are expected to complete their Ph.D. requirements this year.

Satellites and a newly-developed ballistic camera, recently acquired by the Coast and Geodetic Survey, are expected to improve the accuracy of earth measurements tenfold. By current methods it is possible to chart a 3,000 mile distance to within 140 feet. The new system, called "Satellite Geodesy," will be accurate within 14 feet. The "tighter" geodetic control network is vitally important to surveyors, engineers, and the Nation's missile defense system. The system involves photographing artificial satellites, such as ECHO, against a star background. By using two or more ballistic cameras to record the same object in orbit, technicians will be able to compute exact positions on the earth's surface.

A Committee on Government Relations has been organized by the National Academy of Sciences to assist the president and Council of the Academy in responding to requests of the Executive Office of the President and Congressional committees, for studies and evaluation of competing scientific needs for Federal support and long-range planning of major facilities. The membership of the Committee includes senior scientists representing every branch of the natural sciences. It will serve to furnish over-all advice and to suggest steps by which the balance among competing needs can be soundly established. The Committee will limit its discussions to the needs of the scientific and technological community, without regard to existing programs and budgetary requirements.

Tangier disease, which was first discovered in two children on Tangier Island in Chesapeake Bay, offers scientists a rare opportunity to study factors affecting the transport and storage of cholesterol and other lipids (fat-like substances) in the human body. This rare familial disorder is characterized by enlarged, odd-colored tonsils and low blood cholesterol. It involves the accumulation of extremely large amounts of cholesterol esters in the tonsils and certain other tissues of the body.

In this disease, there is an almost complete absence of high-density lipoproteins from the blood serum. These are the large molecules that normally comprise one of the two major complexes that serve as carrier vehicles for all of the fats transported in blood. They are normally found in relatively stable amounts in blood of men and animals, but their specific function is unknown.

Findings in the Tangier disease studies suggest that the high-density lipoproteins may be essential to normal handling of cholesterol. Possibly it plays an important role in the normal esterification with fatty acids.

The Tangier Islanders and people on neighboring islands have cooperated closely with National Institutes of Health investigators in contributing blood samples for the study.

Resources for the Future, Inc., has just issued its annual report for the year ending September 30, 1961. This 111-page pamphlet includes an article, "Long-Range Research in Times Like These," by RFF President Joseph L. Fisher; special reports on "The Three-Dimensional Problem of Pollution," "The Long-Run Cost of Mineral Products," and "The Small Forest in Perspective"; and reviews of the year's work in water resources, energy and minerals, land use and management, etc.

A new bimonthly magazine, "APL Technical Digest," has begun publication by the Applied Physics Laboratory of Johns Hopkins University. The November-December issue carries articles on "An Airbreathing Mach 7.0 Transport," "Low-Angle Beam Riding Over the Ocean," Plasma Arc Heating for Hypersonic Wind Tunnels," and "A System for Checking Hazardous Electrical Circuits."

Delegates to the Washington Academy of Sciences, Representing the Local Affiliated Societies*

Philosophical Society of Washington	Lawson M. McKenzie
Anthropological Society of Washington	Regina Flannery Herzfeld
Biological Society of Washington	Herbert Friedmann
Chemical Society of Washington	John L. Torgesen
Entomological Society of Washington	William E. Bickley
National Geographic Society	Alexander Wetmore
Geological Society of Washington	Margaret D. Foster
Medical Society of the District of Columbia	Frederick O. Coe
Columbia Historical Society	U. S. Grant, III
Botanical Society of Washington	Harold T. Cook
Society of American Foresters	Harry A. Fowells
Washington Society of Engineers	Howard S. Rappleye
American Institute of Electrical Engineers	William A. Geyger
American Society of Mechanical Engineers	William G. Allen
Helminthological Society of Washington	Doys A. Shorb
American Society for Microbiology	Mary Louise Robbins
Society of American Military Engineers	Delegate not appointed
Institute of Radio Engineers	Robert D. Huntoon
American Society of Civil Engineers	Joseph M. Caldwell
Society for Experimental Biology and Medicine	Kathryn Knowlton
American Society for Metals	John A. Bennett
International Association for Dental Research	Gerhard Brauer
Institute of the Aerospace Sciences	Francois N. Frenkiel
American Meteorological Society	Jack Thompson
Insecticide Society of Washington	Milton S. Schechter
Acoustical Society of America	Richard K. Cook
American Nuclear Society	George L. Weil

*Delegates continue in office until new selections are made by the respective affiliated societies.

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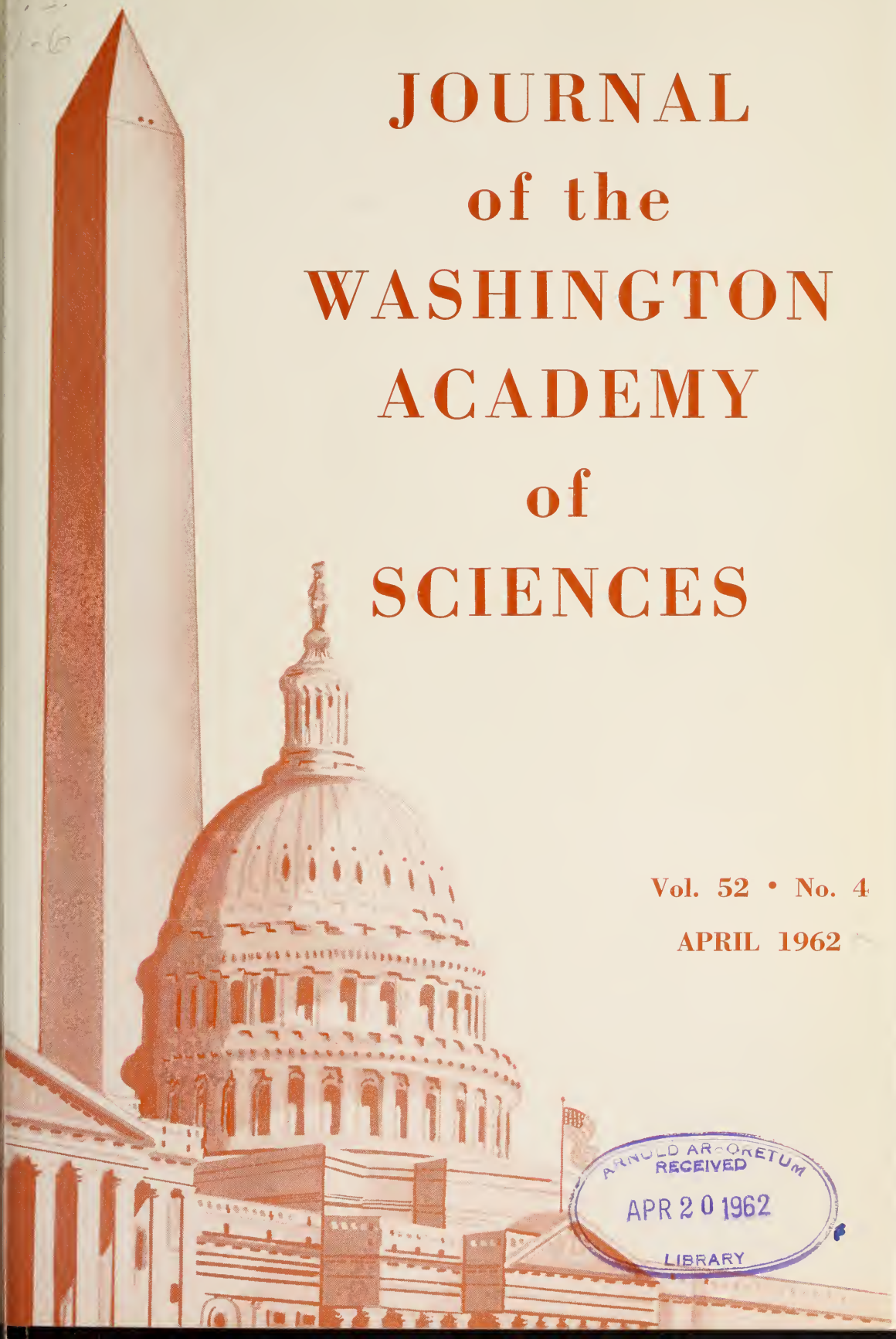

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APRIL 1962

JOURNAL OF THE WASHINGTON ACADEMY OF SCIENCES

Editor: Samuel B. Detwiler, Jr., Department of Agriculture

This Journal, the official organ of the Washington Academy of Sciences, publishes historical articles, critical reviews, and scholarly scientific articles; notices of meetings and abstract proceedings of meetings of the Academy and its affiliated societies; and 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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Advertising rates may be obtained from the Editor, care of Academy Office.

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Eradication of the Red Tick From a Wild Animal Compound In Florida*

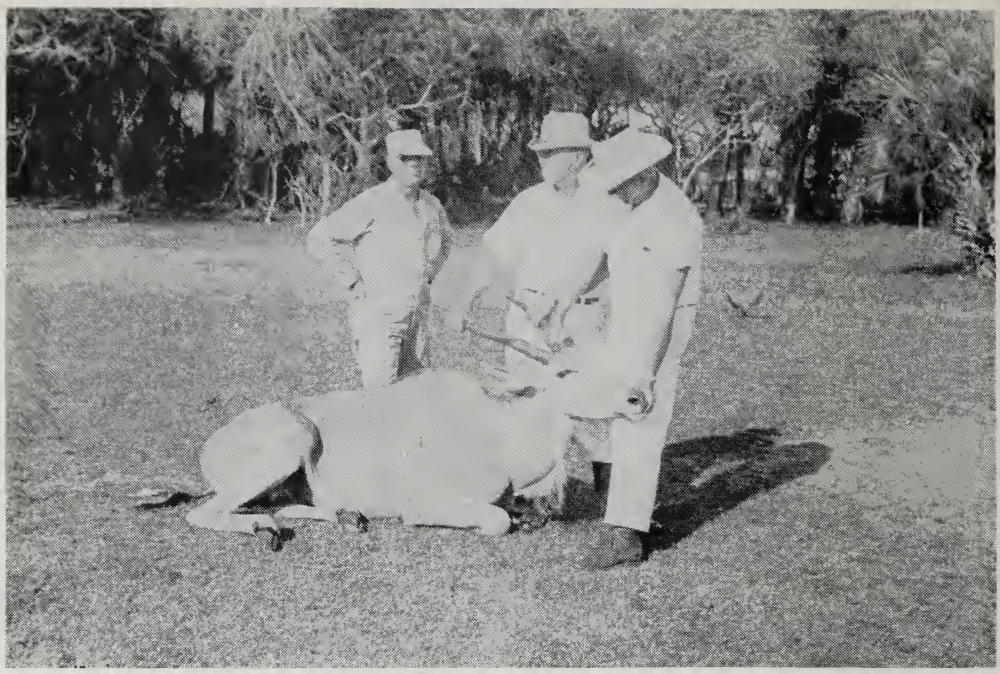
W. G. Bruce

Animal Disease Eradication Division, Agricultural Research Service, USDA

The discovery of the red tick, *Rhipicephalus evertsi* Neuman, in Florida on September 7, 1960, posed a new problem in the ever-increasing battle against arthropod pests and vectors of disease in the United States. This was the first time that the red tick, which is common in Africa, had been identified in North America. Just when and how the red tick was introduced to the United States has not been determined. Quite likely it arrived on some wild animals imported from Africa, probably eland or zebra. Judging from the number of ticks and the variety of wild animals found to be infested, the red tick had been at "Africa U.S.A." for at least three years. A review of the literature (Hoogstraal 1956) revealed that this tick was a vector of bovine piroplasmosis (cattle tick fever) and several other exotic diseases of cattle, including the highly fatal East Coast fever. Cattle tick fever had caused enormous losses in the United States until the native vectors of the disease, *Boophilus annulatus* (Say) and *B. microplus* (Canestrini), were eradicated. Prevention of the recurrence of this costly disease has consisted of maintaining eternal vigilance in keeping out the tick vectors and in destroying incipient infestations of such vectors.

The red tick was found as a result of a planned and determined effort by the Animal Disease Eradication Division, in cooperation with the Florida State Livestock Board, to seek out and destroy tropical cattle ticks (*B. microplus*) that might have escaped detection in the intensive tick eradication program in Florida. This involved the inspection of all susceptible domestic animals in peninsular Florida, and the collection and identification of all ticks found on these animals. It was during this program that one livestock inspector, working in Palm Beach County, visited the wild animal compound known as "Africa U.S.A." in Boca Raton. The compound consists of about 130 acres of grassy plains, desert-like sandy areas, and woodland, with several streams meandering through the area, all of which made a good reproduction of the African veld. Here some 350 African animals, including giraffe, camel, zebra, eland, Abyssinian ass, blackbuck gazelle, aoudad, nilghai, and ostrich, roam freely throughout the compound. It was not possible for the inspector to restrain and examine any of these wild animals for ticks; but he did get close enough to a sick eland to observe several ticks attached to the perianal area. Returning to the compound the next day, he arrived shortly after the eland had died and was then able to remove eight ticks,

* Adapted from a talk given before the Insecticide Society of Washington at the University of Maryland, October 18, 1961.



An eland immobilized for tick inspection.

which he immediately recognized as a species different from any he had ever seen. The specimens were dispatched to program headquarters, where they were identified as the red tick, *Rhipicephalus evertsi*. This identification was confirmed by Allen McIntosh, chief parasitologist of the Animal Disease and Parasite Research Division, USDA.

The red tick is widely distributed in Africa, where it infests all species of wild and domestic ruminants and equines. Domestic animals reported to be infested include cattle, sheep, goats, swine, equines (horse, ass, and mule), camels, and dogs. Infestations have been reported on a wide variety of wild animals, including zebra, giraffe, warthog, cane rat, hare, shrew, and numerous species of antelopes.

The red tick, unlike the cattle ticks (*Boophilus annulatus* and *B. microplus*), is a two-host tick. Both immature stages (larva and nymph) remain on the same host. The engorged nymphs drop from the host, molt on the ground, and as adults reattach to a new host. All stages attach to wild and domestic herbivores, but under some conditions the immature stages may attack rodents and hares.

Adult red ticks almost invariably attach in the perianal area under the base of the tail, or between the hind legs. The larvae and nymphs cluster deep in the convolutions of the inner ear surface, rarely elsewhere on the host.

The life cycle of the red tick, in Africa, is reported to be as follows:

Period	*Days*
Oviposition to hatching	28 — 70
Larvae and nymphs on host	10 — 15
Nymphal premolting period	42 — 56
Female feeding on host	6 — 10
Preoviposition period	6 — 24
Totals	92 —175

Unfed larvae can survive for 7 months. Unfed adults can survive for 14 months.

Because of the potential danger of the red tick to the livestock industry of the United States, the compound was immediately placed under Federal and State quarantine. Intensive surveys in circumjacent areas failed to reveal the presence

of the tick on domestic animals outside the confines of the compound. Neither were red ticks found on any of some 1300 native wild animals, including opossum, raccoon, rabbit, skunk, rat, bobcat, fox, squirrel, and birds, trapped in and around the compound. It became necessary, therefore, to develop and initiate procedures to eradicate the tick from the compound.

Before eradication procedures were started, a number of the wild animals, representative of the various kinds, were inspected and the incidence and relative abundance of ticks determined. This was accomplished by immobilization of the animals, so that careful inspections could be made with safety. Immobilization was effectuated by the use of "Cap-Chur" equipment consisting of a rifle (or pistol) designed for use with CO_2 to propel a projectile syringe, containing an immobilizing agent, into the muscular tissue of the animal. The immobilizing agent used was succinyl choline (Pistey and Wright, 1961). The "shooting" of the animals was done by J. F. Wright, veterinarian at the National Zoological Park, Washington, who had had considerable experience in the use of "Cap-Chur" equipment on wild and domestic animals. Dr. Wright also instructed Federal and State veterinarians in immobilizing techniques. Twenty-three animals were carefully examined and 151 red ticks collected, 21 of which were females. The preponderance of male ticks is attributable to the fact that the adult female engorges and drops from the host in less than two weeks, whereas the adult male remains on the host during its entire life span, which may be many months.

Developing an eradication program presented some unusual problems, since the red tick is a two-host tick and the infestation was on a variety of wild animals. Quite naturally, first consideration was given to the systematic dipping of the animals, similar to the cattle tick eradication program. Such an operation was impossible, however, because of the variety in size and shape of the animals (from a 2-foot high blackbuck gazelle to a 20-foot giraffe, with many intermediate sizes and shapes), and because of the difficulty of handling such wild animals.

A spray program likewise was considered impractical because of the impossibility of rounding up, confining, and treating each animal every week or two for approximately two years.

Since the larvae and nymphs of the red tick attach deep in the ear of the host, and since many adults attach in the folds of skin in the perianal area and in the penis sheath, individual treatments of those areas would have to supplement any dip or spray program.

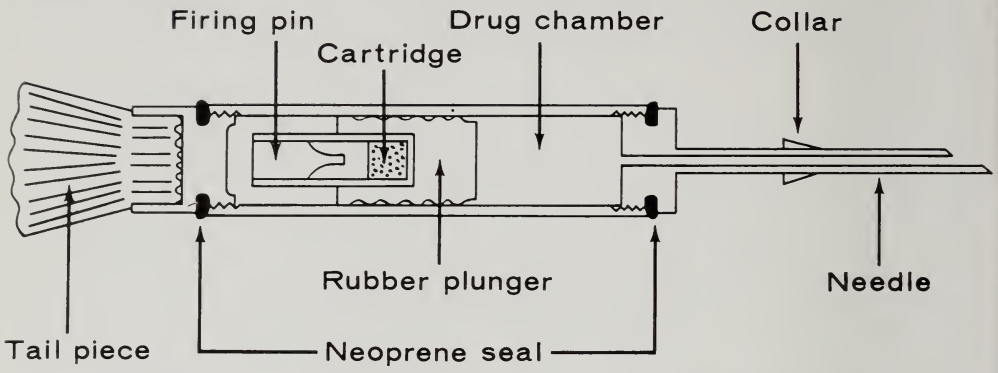
Other methods of approach to the eradication effort that were considered included pasture rotation; individual treatments of the animals with a pesticide, then moving them to an uninfested area; and finally, treatment of the entire compound with a pesticide which would be toxic to the ticks yet harmless to the animals. This last approach appeared to be the most practicable; therefore, a program was initiated in which the compound would receive at least four applications of a DDT suspension spray, each treatment to be applied at the rate of 2 pounds of the active ingredient per acre, and at 3-week intervals.

Applications of pesticides were started on November 1 and continued at approximate 3-week intervals until mid-February, during which time six applications had been made. The DDT suspension sprays were applied by a Buffalo turbine to open, clear land, and by means of power sprayers to the wooded areas. One of the applications was followed by a 6-inch rain which undoubtedly adversely affected its usefulness. Two treatments of granular dieldrin, each at the rate of 1.5 pounds active ingredient per acre, were applied for a distance of 20 feet around the periphery of the compound.

During the period February 27 to March 10, a number of animals were immobilized and carefully inspected for ticks to evaluate the progress of the eradication effort. In

PROJECTILE SYRINGE

Cross Section



Longitudinal section of projectile syringe used in immobilization of animals.

anticipating the results of the eradication effort, the finding of adult male ticks was expected, but it was hoped that the adult female ticks would have been killed. As was noted above (data on the life cycle of the red tick), unfed adult ticks may live for 14 months. No data are available on the longevity of adult male ticks on the host; but since they do not leave the host until they have completed their life span, the spraying of the premises would, obviously, have no effect on them. However, the female tick remains on the host less than two weeks, during which time she completes engorgement, then drops to the ground to oviposit and die. By keeping a toxic residue of DDT on the soil and vegetation, it was expected that the female ticks or the newly-hatched larvae would be killed. Seventy-four animals were inspected and 72 ticks, including only one female, were collected. The presence of the one female indicated that the treatments were not completely effective, and a reevaluation of the program was necessary.

In reviewing program operations, it was concluded that three factors may have contributed to the survival of one or more female ticks:

1. Inadequate gallonage of spray for effective distribution of the pesticide. Liquid pesticides, for tick control, should be applied as coarse sprays with enough gallonage to thoroughly wet the vegetation and soil. The Buffalo turbine, with its mist-like spray, was not adapted to this type of spray operation.

2. Accumulations of palm fronds, in the wooded areas, probably gave protection to some ticks from the pesticide applications.

3. Prolonged cool weather during the time when pesticide applications were made may have slowed down the activities of this tropical tick, and thereby lessened its chance of contacting a toxic dose of the pesticide.

After consideration of these probable adverse factors, it was believed that a continuation of the DDT spray program, with a few minor changes, would effect eradication of the red tick from the wild animal compound. Therefore all accumulations of debris, particularly palm fronds, were destroyed and four more applications of DDT were made, each at the rate of 2 pounds per acre and at 3-week intervals. All pesticide applications were made with a power

sprayer and with adequate gallonage to obtain complete coverage of ground and vegetation.

Since the completion of the spray program in July 1961, each animal has been given two careful inspections without the finding of a single tick. It can be assumed, therefore, that the red tick has been eradicated from "Africa U.S.A." and that this serious threat to the livestock industry in the United States has been eliminated. If the infestation had spread to our native wild and domestic animals, the eradication of this two-host tick would have been extremely difficult, if not impossible.

The amount of DDT applied per acre, as reported above, needs some modification. Errors in formulating the sprays sometimes exceeded the recommended dosages of 2 pounds of active ingredient per acre, per treatment, in some of the treated areas. Most of these higher dosages of DDT were applied during the second series of spray applications, when much higher gallonages were used to ensure complete coverage of the premises. It is believed that the dosages of DDT in excess of 2 pounds per acre were unnecessary to obtain the desired results, and that 10 treatments of the premises, each applied at the rate of 2 pounds per acre and at 3-week intervals, would have effected eradication of the red tick from the wild animal compound.

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Goals for Climatology*

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Climatology as an environmental science impinges on a great many other sciences. The points of contact with aerology, geology, geography, biology, medicine, agriculture, mathematical statistics, and engineering make progress in this field of wide interest.

There are goals and scientific ambitions in climatology which need attention and support. In this age of large-scale science (Weinberg, 1961) these need to be set forth with vigor to share in the scientific efforts which can assure better living for mankind.

Improved knowledge about climate can set the stage for more food, for improved water management, for more comfortable homes. It can assist in assuring better health for people. It can lead the way to the use of the cheap natural energy sources of sunshine and wind. In atmospheric science it may lead to a better understanding of the complex ways of the general circulation, and may even furnish further clues to the elusive objectives of long-term prediction of climatic trends.

There exist many gaps in our knowledge. If we attempt to chart a future course for climatological research, we are fully aware that the ingenuity and curiosity of individ-

* Condensation of a report outlining a 10-year program (1961-1970) for climatology, presented to the Interdepartmental Committee on Atmospheric Sciences, Federal Council of Science & Technology.

ual investigators will remain the guiding force. Yet there are obvious needs and challenges that should be considered in placing emphasis on various areas which have been neglected in the recent past. These are outlined in an order that, to the writer, appears dictated by the urgency of the problems.

Water Resources and Droughts

Climate is at the root of water problems. It governs the income in form of precipitation, and it rules the losses from soil and open water surfaces through evaporation. Man's crops depend upon adequate water supplies. Modern communities and industries cannot function without them. In the world at large, the areas of marginal rainfall are among the chronic trouble spots. The most populated countries (China and India) are dependent upon the unreliable summer monsoons for their rainfall.

In some parts of the United States—as in many regions of the world, where water is a problem—there is lack of knowledge about the basic elements of the water balance. These shortcomings have been decried for our own area by one official committee after another.

To follow their proposals the basic network of climatological observing stations in the country has to be completed at the earliest possible moment. At the same time, the data on rainfall, evaporation, and drought, that have accumulated over the decades, need analysis. The temporal and spatial variations have to be established. Studies of the effect of the climatic variables on run-off and ground water table, and the consequences of water shortages for crops, are essential. The probabilities and risks of water deficiencies and excesses in their geographical, orographical, and geological relations have to be calculated.

A broad analysis for a large segment of the northern hemisphere (and perhaps later for the whole hemisphere and the globe) of the flux of water vapor is indicated. We now have only a pilot study (Benton *et al.*, 1953) for a single year for the United States. Even the residence time of water vapor in the atmosphere is not yet firmly established. Evaporation and heat balance studies which have been undertaken by Budyko (1955) for a very loose global network of stations need expansion to the local scale with the use of a dense station network.

It is quite certain that man can, at least on a micro-scale, interfere with the hydrologic cycle by irrigation, reduction of evaporation, and change in the heat balance. Therefore a systematic program of experimentation in this direction is called for. For achievement of practical results in the field of agriculture, the basic physical problems of evaporation and condensation, and their interplay with radiation, temperature, and wind must be completely understood. Only then can the proper bridge to the biological phenomena be built, and the possibilities of modification rationally evaluated.

Biological Influences of the Atmospheric Environment

This is an area of most important implications, yet most incompletely explored.

It has already been stated that physical parameters are closely related to the problems of water supply and water needs from a botanical and agricultural point of view. Why are some plants relatively resistant to drought? What plant associations can best withstand aridity, and which of these promise to be productive for human consumption or use? The answers to these questions are of greatest importance to the future of the arid and semiarid lands (White, 1960).

Strangely enough, analogous studies are also needed for the areas of excessive rainfall. Here the problem is to select species of maximum productivity. Some of them, such as trees, are important because of the high price they command, while others have food values which have yet to be exploited. Although the United States' share of land with excessive rainfall is small, it might well serve as an experimental and demonstration area for the developing nations of the tropics (Pirie 1960). The importance of the role of climatological research in this

connection has been recognized by the Food and Agricultural Organization (FAO) for its freedom-from-hunger campaign (I. W., 1961).

For our own and higher latitudes, a concerted effort in the field of phenology is needed. The relation of weather to simultaneous or subsequent periodic biological phenomena in plants is of great ecological interest. Evaluations of this type for crop plants permit the delineation of areas that can be suitably cultivated; and departures from average conditions in any given year can be used for agricultural plans and practices.

Considerably greater effort in the future is also needed in the study of the effects of microenvironments on plant associations and plant disease and insect pest infestations.

The use of plant parameters (such as pollen associations or tree rings) as indices of contemporary climatic conditions is also of great importance for the study of long-range climatic fluctuations, a theme to which we shall return below.

Many challenging problems of the future relate to large-scale ecological systems. Of immediate concern are the relations of climate to forests. This applies both to macro- and meso-climatic questions. It includes the whole complex of forest growth, forest pests, and forest fires.

In the field of animal and human bioclimatology, the establishment of suitable climatic indices is one of the urgent tasks of the future. Past experience has shown that the usual meteorological parameters have only very limited usefulness in assessing the physiological and pathological reactions to the atmospheric environment (Lee, 1953). The short-term and long-term effects of different climatic settings have to be assessed. The effects of migration by healthy and diseased persons to a different climate have to be more intensively studied than heretofore. Are there generally beneficial or harmful climates? Are there places which can justifiably claim to be climatic resorts? Is their climate actually a therapeutic agent? Are there climates which, by objective standards, benefit older persons?

Another group of problems clusters around the seasonal and areal distribution of disease. There is good reason to believe that these patterns have climatic causes at their base. Little but the annual rhythm and the broad geographical distribution is known. The relations to the pathogens, the vectors, and the hosts should be traced.

Many unanswered questions relate to the influences of man on climates and the effects of these artificial changes on plants, animals, and humans. Considerable attention has already been devoted to the problem of air pollution, but the effects of city climate as a whole have been only sporadically studied. The climate of human habitations and their environs needs intensive research. Are these optimal for health? Are even or cyclically changing climates preferable? Is there an ideal climate? Are there pathological, psychological, and genetic reactions to climates both artificial and natural?

Ultimately, answers to these questions might have profound influences on heating, cooling, housing design, and urban and regional planning.

Synoptic and Dynamic Climatology

Among the climatological programs which have been postponed from year to year are analyses of climates according to prevalent synoptic weather types. This is a major effort which should be undertaken. It will require extensive typing of synoptic charts, analysis of surface weather conditions according to upper flow patterns, and the eventual synthesis of such data into a scheme of world climates. The purpose of such work is not only the replacement of inadequate climatic classifications of the past, but also a better physical theory of climates (Godske, 1959).

What we should like to have are better time and space series of dynamic features of atmospheric flow. This covers the major surface and upper wind currents, including jet streams, the circumpolar vortices, the circumpolar wave number, the position

and intensities of the subtropical dynamic high pressure systems, and the paths of depressions.

Hand in hand with this should go calculations of daily statistics of circulation parameters on a global scale. There should be compilations on the fields of heat sources and sinks. Conventional data should, if possible, be supplemented by observations from satellites. Reliable statistics for longer series of years of meridional and zonal flow of heat and of momentum are basic for building of a dynamic climatology (Gião, 1959). Areal distributions of climatic conditions and their variations might be derived from such data. Also, a better understanding of the climate of the free atmosphere through cross sections and topologies of the pressure surfaces can now be envisaged.

The ultimate aim is, as in any exact science, the derivation of mathematical models based upon physical realities. These then should enable one—at least in the ideal case—to predict the climate from the position of a point on the earth, its location with respect to heat sources and sinks, its orographic setting, and other *a priori* conditions. Such models can be extended (or might even be easier to develop) for various microclimatic settings within a macroclimate.

A truly causal system would lead to the explanation of extremes or major departures of the atmospheric flow patterns from the modal conditions.

Statistical Climatology

In the area of statistical climatology lie the most immediate potentials for practical pay-offs. The aim here is the development of functional relationships which represent or simulate universes of observations of climatological elements or their combinations. Although even strictly empirical relations can be made useful with the aid of conventional statistics, attempts to develop statistical models which fit the special conditions inherent in climatological data and series have to be continued. Aside from individual elements, probability functions of climatic risks for severe local storms, hurricanes, and blizzards are needed.

The levels of probability, by areas, for weather events damaging to life, crops, structures, and a wide range of enterprises have yet to be developed for insurance purposes, long-range planning, and managerial decisions.

Some of the more complex problems are now within reach of solution through the use of electronic computers. Among them are statistical models for natural multimodal scalar and vectorial distributions, also the U-shaped and J-shaped frequencies. Further sophistication can be envisaged by superimposition of daily and annual cycles.

The most complex difficulties will have to be faced in analysis of the areal distribution of rainfall. An extension to a two-dimensional statistical analysis (perhaps analogous to problems faced in turbulence studies) is a long-term objective.

Of considerable importance are statistics of "duration" in climatology. Very little has been done along this line, except perhaps for dry and wet periods. Yet many practical questions require probability information of that type. Even more complex are analyses and models of "build-up" and "decay," for example, of soil moisture and the various shapes of the curves of accumulation and loss. The present "bookkeeping" methods account for contemporaneous conditions, but have so far neglected the peculiar statistical aspects of these problems throughout a climatic time series.

The aim in all these studies is a body of statistical models with climatological relevance.

Climatic Trends

Trends are the greatest puzzle in climatology. Why and how have climates changed? Procedures and the type of answers we can hope to obtain depend greatly on the time interval with which we are concerned.

Closest to us are the trends and fluctuations during the interval of instrumental observations. We hope to find, through con-

tinued analysis of long-term records, clues to the causes for fluctuations of varying time-length. As yet no decisions can be reached as to whether the causes are terrestrial or extra-terrestrial, or a combination of these. In each case a multiplicity of causes has been suspected, but no firm answers are at hand. Once causes have been found—whether they are terrestrial teleconnections or backfeed mechanisms, or diastrophic or catastrophic events, or are embodied in celestial mechanics and solar phenomena—a hope for longer-range predictions can be held.

Recognition of true trends would be of considerable impact on planning, especially for the water supply problem.

Obviously, there is also a crying need to find what human interference has done to natural climatic conditions, be it through urbanization, cultivation, or modification of the atmospheric composition. We should at least learn how much we are tampering with our destiny.

The contemporary fluctuations or those of the recent past might enable us to "calibrate" indirect measures, such as those employed in dendrochronology and palynology, varve studies, and interpretation of animal associations in climatic terms. This requires an interdisciplinary effort which will have important bearing particularly on the problems of the post-Pleistocene climates. Some of it might even carry further back into paleoclimatology.

In this last field a truly heroic effort is involved. Interpretation of rocks and fossils in terms of climate is among the most complex scientific tasks. Many side-issues are involved, not the least among them being pole positions, relative position of continents, and extent of land and oceans. The most precise data are likely to come from isotope investigations of the type so successfully carried out by Emiliani (1957). Much further work in this direction is warranted.

Even if it might prove very difficult to unravel the climatic mysteries of the past, it is imperative that all possible assistance be provided to the climatological historian of the future. This requires meticulous documentation of current observations—and as far back as records will permit. Also, station stability for at least a restricted network is absolutely imperative. These stations should be essentially complete observatories, providing continuous records of all atmospheric variables. The establishment of additional stations in nature reservations should be promoted. There phenological records can be kept in parallel with the climatological data. Although the benefits of such a policy will be decades away, a beginning has to be made *now*. The groundwork for some tasks in science must be laid on a long-term basis, and the study of climatic trends is one of them.

Micro- and Mesoclimatology

Emphasis on special and relatively localized environments will increase the utility of climatology for practical purposes. Typical questions that arise are: What distinguishes a local climate from a general regional climate? What measurements and what length of record are needed to establish the differences?

Radiation and low-level turbulent exchange are among the most important parameters governing local climatic speciation. They have to be ascertained for various types of micro- and mesoclimatic settings. The tools of discriminant analysis have to be brought to bear on the differentiation problem. Ultimately, the aim is a series of physical models which will make it possible to predict the climatic reaction of any given site within a macroclimatic realm. This will have to encompass prevision on what effects human interference on various scales will have.

This is a matter of greatest practical importance in intensive agriculture. It also affects a great many problems of city climate. With conurbations of great extent impending in the next few decades, local wind-systems and ventilation problems need intensive investigation.

The microclimates in areas of climatic extremes are not well known. Some work

in this respect is now going on, but most microclimatic research of the past has been devoted to the temperate zone. Microclimates in deserts, tundras, icefields, coastal areas, and mountains above timberline pose many unanswered questions.

On the smallest scale, the environments of single plants, animal dens, nests, and cocoons require more refined observing equipment than is now available, and systematic series of observations need to be taken. The interactions of the usual weather events and this microscale have to be analyzed so that we may, among other things, more effectively control plant and animal diseases and insect pests.

We also need to know more about the occurrence, amount, and significance of dew. In certain areas this is an important factor in the energy budget and water balance, as well as in the promotion of plant disease.

Microclimates can be beneficially modified. Hence greater emphasis should be placed on quantification of the results, including problems of irrigation and suppression of evaporation, windbreaks, soil surface changes in texture, albedo, and cover. Frost protection, much as it has been explored, still leaves fruitful avenues of research open. Here again, emphasis should be on predictability of results from any given procedure of modification.

General Climatology

The decade of the sixties will bring new tasks beyond the special questions so far enumerated. The climatologist will have to cope with many "unconventional" types of data. They come from radar installations, instrumented rockets, and satellites. Not only will they lift the ceiling of climatological aerology, but also new procedures of data handling will be required. Some of the observations require translation from an image to a numerical quantity. Climatic systematization of sporadic data will be an obstacle yet to overcome.

An important aspect will be the development of quantities derived from primary observations. Among them will be atmospheric density at all levels, and a variety of combined factors. The latter are in the class of influence parameters, such as effective temperature, saturation deficit, cooling power, evapotranspiration, etc. Also, a meaningful climatology of atmospheric composition is needed. A special problem will be posed by the three-dimensional aspects of cloud layers which can now be observed from the surface, from flights, and from satellites. This will for the first time permit an approach to the layered reality of cloudiness.

A special effort will be the exploitation of accumulated observations through contingency methods for short-range and extended weather forecasting. Reference material of this type can form a new "platform" on which the forecaster can build.

Other elements, skirted in the past, need observations. They are frost penetration, freezing and thawing cycles, ice thickness, inland water temperatures, and low-level inversions.

A further exploration of the annual march of the conventional elements and of weather types also seems to be warranted. The purpose would be validation or refutation of the singularity concept, which claims recurrence of the same weather events within short segments of the annual cycle.

There is further need for deriving, from existing data sources, more meaningful analyses for aviators and mariners. As a specific example, past weather charts could be exploited to obtain historical series of wave-height charts. As another example, we can cite the needs for three-dimensional climatic mapping of air space, especially in terminal areas. Further aid can be given through climatological analyses for the exploitation of windpower and solar energy.

At the fringes of the research and development area are the preparation of a multilayer climatological atlas for the world, possibly in form of three-dimensional models. By the end of the 1960 decade, enough new—and presumably better—aerological material will be available to warrant such an effort.

Similarly, a series of historical world charts of monthly "departures from normal" for the principal elements at various levels, and including sea surface temperatures, for an interval of 25-30 years might be feasible by 1970.

In view of the increasing world literature in the field, a new comprehensive Handbook of Climatology is needed. Such a solid "floor" would stimulate scholarship, facilitate research, and improve teaching in the field. Automation of searching for references, especially data sources, would contribute much for the specialist.

A fair amount of "hardware" will have to be developed for use by the climatologist, including improved versions of curve readers for automatic evaluation of records, digitizers for radar and satellite films, and recall systems for various types of data from the archives. Of particular importance will be to find economical means for rearranging data, filed in station-by-station time series, in synoptic form.

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THE BROWNSTONE TOWER

No matter how interesting a person's professional work may be, he is usually not willing to devote all his waking hours to it. Speculating on this human characteristic, I wonder if this recurring desire for a change is not simply the reaction of an individual to compulsion. He does not enjoy feeling that he *must* keep the grindstone in motion continuously, even though the product pleases him and others. Periodically I like to pretend that I am not obligated to do any of the pleasant tasks that await me. I like to turn to something so absorbing and so useless that for a little while I am as free as if I were asleep, yet am living intensely. Concentration upon some physical or mental challenge will do it. For me it used to be tennis and anagrams; now it is ping pong and Scrabble. It could be golf and chess, mountain climbing and music, skiing and bridge, etc., or any activities that demand one's entire attention and the development of skill with or without competition.

Scrabble may now be regarded by most people as a fad that has passed like Monopoly, mah-jongg, and many other games that enjoyed a brief period of popularity. However, I noticed recently in the newspaper that Scrabble is now being played competitively by young Latin scholars—in Latin, of course. Perhaps Scrabble has a permanent place after all, as a recreational device with educational byproducts. I have played it in German, but I find that its interest in English is inexhaustible, and I go back to it repeatedly expecting and never failing to learn something new about the anatomy and physiology of English words.

For more competitive Scrabble one needs not only the standard equipment, but also a good opponent and a durable, modern

desk dictionary. Although Scrabble can be played by more than two people, it has interest for me only as a game for two who can thrust and parry as if in combat, exercising their best judgment as to when to defend and when to attack. In Scrabble one is struggling not only against his opponent but also against the vagaries of chance and the laws of probability. One makes a decision on every play, taking many factors into consideration and evaluating them in the light of experience. I do not like a sand-glass time limit placed upon the deliberative process. Some plays that are set up and awaited expectantly can be made instantly; others, particularly the disposal of all seven letters in one play, may require much thought and consultation of the dictionary. Plays at the end of a game may be critical and may require identification, by elimination, of the opponent's letters and a plan to dispose of all of one's own letters in the fewest possible plays.

For the development of the greatest interest in Scrabble, one should have a permanent opponent, preferably a patient spouse. The ground rules should be agreed upon at the beginning of a period of competition and should not be changed. If records are kept of scores, the development of skill can then be demonstrated numerically.

Mrs. Campbell and I played our first game of Scrabble on August 23, 1953. It was a beautiful afternoon on the terrace of the country home of a classmate of mine on Second Hill overlooking New Milford, Connecticut, the Housatonic River Valley, and beyond to the Catskills in New York. During the years 1954-61 we played 712 games using the same ground rules and dictionary, now well worn. The results might be used in a study of psychokinesis (I find it is best to draw my letters with my eyes closed), but I shall mention here only some records of which we are proud, and that will show that skill does increase through the years.

To play all of one's seven letters at once yields a bonus of 50 points and is likely to determine the winner of a game. Therefore much cerebration is applied to their disposal. When better brainstorms are had, they will come to my opponent, who made the word "zucchini"; got the highest score for a single play—140 for "carotene," a triple-triple play; incorporated two letters in her seven to make a nine-letter word; connected four letters of her seven-letter word with four on the board; and disposed of seven letters four times in one game. My highest score in a single game is 508; highest total score in the same game, 827.

The following table indicates our increase in skill through the years in terms of increase in number of seven-letter plays per 100 games, and in the mean total scores of these games. The relation between frequency of seven-letter plays and mean total scores is obvious.

Year	Number of games	Number of seven letter plays	Number of seven-letter plays per 100 games	Mean total score per game
1954	94	61	65	591
1955	83	67	81	616
1956	93	96	103	626
1957	95	110	116	628
1958	111	146	132	634
1959	81	98	121	630
1960	93	109	117	632
1961	62	97	156	648

The score in number of games won by each of us will not be divulged.

—*Frank L. Campbell*

MEETINGS

The **Czechoslovak Society of Arts and Sciences in America** will hold its first scientific congress at the Statler Hotel, Washington, on April 20-22. Featured will be a two-day symposium on the contributions of Czechoslovak science and arts to world culture. The program will include papers on science and medicine, technology, fine arts, literature and literary criticism, slavistics and linguistics, law and economics, history and political science, and philosophy and sociology; finally, a special session will be devoted to Czechs

and Slovaks abroad, particularly in the Americas.

The Third general meeting of the **International Mineralogical Association** will be held in Washington April 17-20. The porgram will feature symposia on the mineralogy of sulfides, under the chairmanship of Alfred J. Frueh of McGill University, Canada, and on layered intrusives, under the chairmanship of C. E. Tilley of Cambridge University, England. The scientific sessions will be held at the National Museum.

The sessions will be preceded by a northern field trip on April 14-16, led by Paul F. Kerr, to laboratories of the Lamont Observatory of Columbia University, Paterson (N.J.) zeolite localities, and the Franklin (N.J.) and Cornwall (Pa.) mining districts. Following the sessions, another field trip on April 21-23, led by Richard V. Dietrich, will visit various Virgina mineral localities; and on April 24-27 an excursion will be made to mineralogical museums in Philadelphia, New York, New Haven, and Boston.

Summary of Journal Operations for 1961 (Volume 51)

Statistical

Issues: 8 (January through May and October through December).
Pages text (excluding covers): 148 (20 per issue except 8 for January).
Copies per issue: 1500 (except 1575 for February).

Budgeted Expenses

(*obligated* in 1961)

Printing expenses:		
Composition	$2,345.57	
Printing and binding	2,047.13	
Corrections	55.91	$4,448.61
Other expenses:		
Engraving	90.28	
Addressing and mailing (excludes list maintenance)	150.56	
Mailing envelopes	43.00	
Postage deposits	125.00	
Staff expenses	4.72	413.56
Total budgeted expenses		$4,862.17

Reprints

(income *earned*, expenses *obligated* in 1961)

Reprint income received	$249.34	
Reprint income due	21.40	$270.74
Reprint costs		254.20
Net reprint income		$ 16.54

Income Credits

(*received* in 1961)

Subscriptions	$2,382.20
Sales of back issues	617.00
Total	$2,999.20

Summary

Journal expenses		$4,862.17
Income credits	$2,999.20	
Net income on reprints	16.54	3,015.74
Net cost of *Journal*, 1961		$1,846.43

Science in Washington

SCIENTISTS IN THE NEWS

Contributions to this column may be addressed to Harold T. Cook, Associate Editor, c/o U.S. Department of Agriculture, Agricultural Marketing Service, Room 2628 South Building, Washington 25, D.C.

COAST AND GEODETIC SURVEY

Lansing G. Simmons presented a paper on "Geodesy in the Missile Age" before the Surveying and Mapping Division, ASCE, at the Houston Convention, February 22.

Paul D. Thomas, mathematician with the Office of Research and Development, spoke on "The Use of Artificial Satellites for Geodetic and Navigational Purposes" before the February 15 luncheon meeting of the Society of Military Engineers. Columbus, Ohio.

GEOLOGICAL SURVEY

A Nelson Sayre has retired from the Geological Survey and has accepted an appointment as ground-water consultant with Behre Dobear & Company of New York. His address is 4212 Yuma Street, N.W., Washington 16.

NATIONAL BUREAU OF STANDARDS

Recent talks presented by Academy members of the Bureau have included the following:

F. L. Alt: "Pattern Recognition by Use of Moments"—International Business Machines General Production Laboratory, Education Department, Endicott, N. Y.; also, "Management of a Mathematical Research and Service Facility" and "Mathematical Theory of Management Problems" —University of Delaware, Newark, Del.

R. G. Bates: "Medium Effects on Acidity in Alcohol-water Solvents"—Institute of Inorganic, Analytical, and Physical Chemistry, University of Bern, Switzerland.

L. M. Branscomb: "The Structure of Atomic Negative Ions"—University of Pittsburgh, Department of Physics.

H. P. R. Frederikse: "Properties of Oxide Semiconductors (in Particular, Rutile)"—F. O. M. Laboratorium voor Massascheiding, Amsterdam, Netherlands.

A. G. McNish: "Basis of our Measuring System"—Corning Glass Works—High School Science Teachers' Seminar, Corning, N. Y., and "Education in Measurement Science"—Boston Section of the Standards Engineers Society, Waltham, Mass.

A. T. McPherson: "Meeting the Demand for Increased Accuracy in Calibration"—American Society for Quality Control, Quality Control Symposium, Dayton.

G. C. Paffenbarger: "Denture Base Resins: Pertinent Physical Properties and Dimensional Changes Occurring in Dentures on Wetting, on Drying, and on Heating"—American Denture Society, Chicago.

R. J. Rubin: "Energy Exchange and Chemical Exchange Reactions in Gases"—Department of Chemistry, University of Toronto, Canada.

R. Schaffer: "Higher Sugar Synthesis by the Aldol Reaction" — University of Birmingham, Chemistry Department, Edgbaston, Birmingham, England.

L. A. Wall: "Some Aspects of the Thermal Stability of Polymers"—American Chemical Society, Northeastern Section (Joint Meeting of the Elastomer and Plastomer Sessions), Boston.

At the Fourteenth Annual Honor Awards Program of the Department of Commerce, held in the Department Auditorium on February 14, the following Academy members were honored with the Exceptional Service Gold Medal Award: **Edward W. Cannon, Karl G. Kessler, H. William Koch, Earle K. Plyler, Leo A. Wall, and William J. Youden.**

Lewis M. Branscomb, chief of the

Atomic Physics Division, has received one of the 1961 Arthur S. Flemming Awards. Dr. Branscomb was cited for his outstanding contributions in the area of the atomic processes of stellar atmospheres, and for his leadership in a scientific program to obtain basic atomic data.

Ernest Ambler has been named chief of the Cryogenic Physics Section to succeed R. P. Hudson, now chief of the Heat Division. Dr. Ambler, an internationally recognized expert in the field of low temperature physics, will direct research into the properties of matter at very low temperatures.

John Howard Park, physicist, retired on February 23 after 31 years of Government service.

NATIONAL INSTITUTES OF HEALTH

Dorland J. Davis will direct the newly established Vaccine Development Program in the National Institute of Allergy and Infectious Diseases.

DeWitt Stettin, Jr., associate director in charge of research, National Institute of Arthritis and Metabolic Diseases, has been appointed vice-president of the American Association for the Advancement of Science.

Kenneth S. Cole, chief of the Biophysics Laboratory, National Institute of Neurological Diseases and Blindness, has been elected vice-president of the Biophysical Society for 1962-63.

Edward G. Hampp, senior research associate of the American Dental Association in the National Institute of Dental Research, was cited recently by the Washington University (St. Louis) Alumni Federation for outstanding service to the dental profession. The citation, made at the University's Founders Day banquet on February 24, was given "in recognition of his service of dentistry through teaching and through significant research in the field of microbiology." Dr. Hampp is a former Washington University faculty member, and the 1949 recipient of the Washington Academy of Sciences' award for outstanding research in the biological sciences.

USDA, BELTSVILLE

Lawrence Zeleny conducted informal public hearings to consider proposed changes in the official grain standards of the United States for grain sorghum, at Lubbock, Tex., on January 29, and at Kansas City, Mo., on January 31.

C. W. Whittaker, by invitation, presented a paper entitled, "What is Quality Lime?" at the Lime and Fertilizer Conference held at University Park, Pa., February 7-9. The meeting was sponsored by Pennsylvania State University and the Pennsylvania Plant Food Educational Society.

C. H. Hoffmann, assistant director of the Entomology Research Division, ARS, was principal speaker at the banquet of the First Nebraska Agricultural Chemicals Short Course on the evening of January 31. He spoke on "Research on New Approaches to Insect Control to Counteract Insecticide Residue Problems."

J. M. Lutz spoke at the New Jersey State Potato Association meeting in Trenton, N. J., January 24, on "Means of Reducing Potato Soft Rot in Transit." Dr. Lutz also attended the annual meeting of the Ohio Vegetable and Potato Growers Association in Cincinnati, January 30, and discussed "Potato Handling and Storage."

USDA, WASHINGTON

Harold H. Shepard spoke on February 26, on "The Past, Present and Future of Pesticides" at the Eleventh Annual Texas Agricultural Aviation Conference, A&M College of Texas, College Station.

W. T. Pentzer, director of the Market Quality Research Division, AMS, spoke before the Ohio Vegetable and Potato Growers Association in Cincinnati on January 29, on the subject "Handling Practices to Deliver High Quality Vegetables to Markets," and on February 5 before the Southern Agricultural Workers at Jacksonville, Fla., on the subject, "Meeting the Quality Requirements of Today's

Markets."

UNCLASSIFIED

The Governor of North Carolina has named **Willard H. Bennett** a member of the State's Scientific Advisory Committee, a group of about 40 scientists of various disciplines, organized last December to aid in the scientific and industrial development of North Carolina.

AFFILIATED SOCIETIES

Acoustical Society of America

The Section met February 19 at Catholic University to hear Malcolm Henderson's discourse on the investigation of molecular structure of gases by acoustical techniques. Early notices gave an erroneous biological flavor to the subject by citing acoustic absorption in "gasps".

On March 19, an extensive symposium on "Recent Developments in Architectural Acoustics" was held. A panel of speakers, including R. K. Cook of NBS and Harold Burris-Meyer, consultant, led the presentation and entertained discussion from the audience on design objectives, new material and construction, methods of measurement, and standards of acoustical performance. The meeting, held in the Industrial Building of NBS, was preceded by an informal dinner at the Cafe Burgundy.

American Society of Civil Engineers

The Section met on February 27 at Barker Hall for a luncheon meeting to hear Paul C. Aebersold discuss the industrial uses of radioisotopes. He pointed out that this is one of the foremost peaceful civilian applications of atomic energy. His presentation showed that these materials constitute one of the safest tools that one can envision in industrial use.

On March 27, the members of the Section met again to hear Robert L. Morris of the Downtown Progress Association enlarge on the "Action Plan"; they were shown slides which showed the proposed appearance of the area in 1980.

The members met for their annual dinner on March 13 in the Terrace Room of the Shoreham Hotel, where National President G. Brooks Earnest spoke on "Modern Trends in Civil Engineering Education." The Society announced seven recipients of life memberships, among whom Elliott B. Roberts, special adviser and assistant director of research and development in the Coast & Geodetic Survey, is a member of the Washington Academy of Sciences.

American Institute of Electrical Engineers

The Section members celebrated "Ladies Night" on March 13, in the Officers Club at the Naval Weapons Plant. The feature of the evening, after a buffet supper, was a fashion show complete with door prizes.

Society for Experimental Biology and Medicine

The Section met on March 29 at Georgetown Medical School. W. B. Savchuck and W. L. Lockhart of the Division of Nutrition, Food and Drug Administration, gave a paper on "The Influence of beta-Hydroxybutyrate on Cultured Mammalian Cells"; Roy E. Ritts of the Georgetown University School of Medicine reported on "Biological Warfare"; and Melvin Reich of the George Washington University School of Medicine spoke on "The Effect of 5-Fluorouracil on *Bacillus cereus*."

Geological Society of Washington

The members met in John Wesley Powell Auditorium twice in March. On Wednesday the 14th, Charles C. Bates of ARPA presented a report on "Two Years of Vela Uniform"; Eugene Boudette, USGS, gave a paper on "Volcanic Geology in Byrd Land"; and Richard S. Fiske of Johns Hopkins University gave a paper, jointly prepared with Tokihiko Matsuda of Tokyo University, on "Submarine Eruptions of Ash-flow Type in the Tokiwa Formation (Miocene), South Fossa Magna, Japan."

On March 28 the Society heard G. William Holmes, USGS, speak on "Glacial Geology of Ulfs Fjord, North Norway"; also, Dennis P. Cox, USGS, spoke on "Structure of the Serra de Jacobena," and G. W. Lee, also of the Survey, on "Petrologic Problems of the Serra de Jacobena."

Insecticide Society of Washington

The Society met for its 197th meeting in Symons Hall, University of Maryland, on February 21. It was addressed by Horatio C. Mason, USDA, on "New Approaches to Control of Drosophila as a Pest of Canning Tomatoes," and by C. H. Mahoney, National Canners Association, on "The Canning Industry Program for Control of Drosophila." Refreshments were served in Dr. Haviland's Laboratory during a social hour after the program.

American Society of Mechanical Engineers

The Section met on March 8 at PEPCO Auditorium to hear Irwin Vigness, NRL, on "Measurements and Analyses of Shock and Vibration Motion." Dr. Vigness discussed instrumentation, particularly of transducers, and the principles involved, as well as the reduction of measurements into useful forms.

On March 9, a joint meeting was held with the Society of Naval Architects and Marine Engineers, Chesapeake Section, in PEPCO Auditorium to hear Capt. C.F.A. Trewby, assistant director of marine engineering, Admiralty, England, speak on "Recent Operating Experience with British Naval Gas Turbines." He made an assessment of the various lessons learned through the introduction of gas turbines for propulsion in operational warships of the Royal Navy.

On March 22, the Section met again in PEPCO Auditorium to elect officers and to consider the annual Student Papers Competition.

American Meteorological Society

The local branch members met on March 21 at NAS to hear Capt. Wm. S. Lanterman, Jr., USN, commanding officer of Fleet Weather Central, speak on the "Environmental Influence on Antarctic Operations." Captain Lanterman discussed the problems of carrying out logistic support of the U. S. Antarctic Research Program during the period October to March, when aircraft, ships, construction, and over-ice traverse operations are dependent upon the Antarctic environment.

Society of American Military Engineers

The Members of the Washington Post met on March 19 in Barker Hall to hear Brig. Gen. Thos. H. Lipscomb, division engineer, U.S. Army Engineer Division, North Atlantic, speak on "Engineers in the Civil War." The talk was interestingly illustrated.

Medical Society of the District of Columbia

The Society held its 10th Midwinter Seminar on February 12, 19, and 26, on the general subject, "A New Approach to the Older Patient."

Philosophical Society of Washington

The 1523rd meeting of the Society was held in John Wesley Powell Auditorium on March 30. James A. Hummel of the University of Maryland addressed the members on the subject, "What Are Mathematicians Up To?" His discussion concerned an examination of the fact that each year hundreds of volumes are filled with new mathematics, much of it "pure mathematics" having no obvious applicability to physical problems. He discussed the reasons for such work, and whether or not it has new applications. He made a defense of rigor, and discussed how modern research in mathematics is reflected in high school and college curricula.

Institute of Radio Engineers

The local section had two general meetings in March. At the first, in the lecture hall of NAS, Leonard Jaffe, director of Communications Systems, Office of Applications, NASA, spoke on the "NASA Space Communications Program."

The second meeting was held March 19 at the Museum of Natural History, and was addressed by Georges Goudet, Paris, France, who spoke on "Western European Advances in Electronics." The lecture was preceded by a dinner to introduce the speaker, at O'Donnell's Restaurant.

CALENDAR OF EVENTS

April 10—Institute of Radio Engineers

Speaker: Leslie Ball, Boeing Company. Museum of Natural History auditorium, 8:00 p.m.

April 11 — Geological Society of Washington

(1) John B. Mertie, Jr., Coast & Geodetic Survey, "Platinum Metals of the Goodnews Bay District, Alaska." (2) Stanley R. Hart, Department of Terrestrial Magnetism, Carnegie Institution, "Discordant Mineral Ages and their Interpretations." (3) William C. Prinz, Coast & Geodetic Survey, "Structural History of the Ore Deposits at Philipsburg, Mont."

John Wesley Powell Auditorium, 8:00 p.m.

Members are reminded that the last meeting of the Spring series will be held on April 25.

April 15-18 — American Society of Mechanical Engineers

Members are reminded of the 34th Annual Oil and Gas Power Conference, on "Engine Design for Progress."

BOARD OF MANAGERS MEETING NOTES

The Board of Managers held its 544th meeting on February 6 at the National Academy of Sciences, with incoming President Van Evera presiding.

Announcements and Appointments. The President announced the following results of the recent elections and balloting on bylaws amendments: *President-elect*, Heinz Specht; *Secretary*, George W. Irving, Jr.; *Treasurer*, Malcolm C. Henderson; *Board Members at Large* (terms through 1964), R. B. Stevens and H. H. Shepard; *Board Member at Large* (unexpired term through 1963), Leo Schubert. The bylaws were amended by two-thirds majority to increase resident dues to $10 and nonresident dues to $7.50, effective January 1, 1962; and to permit affiliation of the Institute of Food Technologists with the Academy.

The President announced that an organizational meeting of the Executive Committee was held on February 1, and that A. E. Brown and R. B. Stevens had been appointed to represent the Board of Managers on the Executive Committee.

The President announced appointment of the following Standing Committee chairmen: *Meetings*, F. N. Frenkiel; *Membership*, M. L. Robbins; *Monographs*, Dean Cowie; *Grants-in-Aid*, A. T. McPherson; *Policy and Planning*, Wayne Hall; *Encouragement of Science Talent*, Abner Brenner; *Science Education*, J. K. Taylor. (Vacancies in Standing Committee chairmanships: *Achievement Awards; Ways and Means; Directory.)*

Meetings. No report. The President reminded the Board of the Academy meeting on February 15 to hear the address of the retiring President, P. H. Abelson, on "Long Term Fate of Biochemicals."

Membership. Following the Second Reading of their names by Dr. Robbins, 17 nominees were elected to membership in the Academy, as follows: P. B. Barton, Jr., H. C. Burnett, L. A. Depue, W. L. Holshouser, P. E. Johnson, J. A. Kies, T. W. Lashof, K. H. Norris, W. A. Pennington, H. J. Rose, Jr., F. M. Reinhart, Leonard Shapiro, H. E. Stauss, Priestley Toulmin III, A. L. Voris, W. K. Wilson, and E-an Zen.

Grants-in-Aid. Chairman McPherson recommended approval of the following grants: (1) To June LoGuirato of Fairfax High School, for chemicals to be used in studying oxidation salts of dimethyl glyoxime. $41.60; (2) To Michael Smull of McLean High School for reagents to be used in determining whether hypocholesterolemia is hereditary or acquired, $39.00. The Board approved the grants.

Encouragement of Science Talent. Chairman Brenner reported the Committee's selection of 23 outstanding young scientists to be honored early in April at a banquet at Georgetown University; requested suggestions for additional nominees and for titles of books to be presented as awards: and reported that papers from the December meeting of the Junior Academy of Sciences are being reviewed.

Proposals for Membership. Dr. Robbins presented the names of seven nominees for membership, for First Reading.

Secretary. No report. Former Secretary Specht called the Board's attention to the recent death of Louis B. Tuckerman.

Treasurer. Treasurer Henderson reported (1) a balance of about $15,500, including about $4,500 of Academy funds and about $11,000 in funds of the Junior Academy, and (2) the hiring of Mrs. Hall to serve as part-time assistant to the treasurer.

An estimated budget for 1962 was presented and acceptance moved by Dr. Specht. Dr. McPherson moved to amend the budget by adding an item of $2,000 to the Office of the Secretary to cover expenses of a part-time executive secretary. Dr. Brenner proposed a change in the item for the Committee on Encouragement of Science Talent to raise it from $225 to $250. The budget was approved as amended.

Approved totals are as follows: Budgeted, $17,865; estimated income, $17,630; estimated deficit, $235.

(CORRECTION: An itemization of the budget is given in the March Journal, page 72. Therein the total estimated expenses for 1962 should be changed from $15,865 to $17,865.)

Editor. No report. H. A. Rehder, Custodian, reported completion of an inventory of back issues of Academy journals, and suggested appointment of a committee to arrange for disposition of surplus copies. The President suggested conferring first with Mr. Singer of Dr. Abelson's office, on his activities in this regard, before new action is taken.

New Business. Dr. Campbell moved approval for the publication of a joint directory of the Academy and its affiliated societies, as recommended by the Special Committee on the Joint Directory and reported in the minutes of the January 2 meeting. (See February issue, page 43, and March issue, page 78). An extended discussion of the pros and cons led to withdrawal of this motion and substitution of one by Dr. Frenkiel, that the Academy publish annually an up-to-date directory of its members, using the IBM punch card system, as an example to its affiliated societies, and investigate actively means by which a joint directory could be published in the near future. The motion was carried.

Dates for Board Meetings. The Board approved the following schedule of dates for Board of Managers meetings during 1962-63: March 7 (Wednesday); April 5 (Thursday); May 4 (Friday); June 4 (Monday); October 2 (Tuesday); November 7 (Wednesday); December 6 (Thursday); January 4 (Friday).

SCIENCE AND DEVELOPMENT

The insect collection of the Smithsonian Institution is one of the largest and most complete in existence. More than 200,000 specimens have been added in the past year, many of which represent rare species from all parts of the world. The most outstanding accession of the year was the John C. Lutz collection of Hemiptera, which is especially rich in neotropical species. Another important ac-

cession was the N. Baranov collection of Palearctic flies, which consists of 4,611 specimens representing more than 500 genera. The national collection of insects is continually being consulted by students and specialists from throughout the world.

The Department of Agriculture has issued a revised handbook that contains up-to-date recommendations for insecticides to control crop and livestock pests. It is Agricultural Handbook No. 120, "Insecticide Recommendations of the Entomology Research Division for the Control of Insects Attacking Crops and Livestock for 1962." This handbook has been prepared annually since 1956 by USDA's Agricultural Research Service in cooperation with the Federal Extension Service. The revised edition, for the first time, includes recommendations for control of mosquitoes. Also, several new insecticides, new uses for older insecticides, and more efficient dosages of some previously recommended materials are suggested.

A single treatment that gives cotton wash-wear properties and also permanently dyes, starches, and adds other finishing agents has been developed by the Department of Agriculture. The treatment involves use of divinyl sulfone derivatives which have the unusual ability to react with cotton's cellulose molecules to produce a good wash-wear finish and at the same time attach other finishing materials permanently to the cellulose molecules. Experiments indicate they also may be capable of attaching to cotton chemicals that give resistance to fire, heat, rot, and mildew, and some repellency to water and oil. The new multipurpose treatment can be applied with conventional textile-finishing equipment.

According to Harry Wexler, director of research at the Weather Bureau, available data made possible only by meteorological satellites is already providing new insights into the energetics of the earth's atmosphere. The magnitude of variations in amount and character of solar energy are being established. If there is sufficient time lag between solar "cause" and the atmospheric "effect," the observation of solar energy from space vehicles would give meteorologists an important new key to weather forecasting.

The first satellite equipped to make solar and terrestial radiation measurements was Explorer VII, launched in 1959. The later Tiros II, III, and IV satellites carry much improved and more versatile radiation sensors in addition to television cameras.

Cloud observations from satellites are useful for immediate forecasting and also provide valuable data for meteorological research. They can be used to draw charts of world cloud coverage averaged over months or other periods, and to note long-time variations in cloud amount and distribution. Cloud cover is the most important component in the earth's reflectivity, and serves as a natural thermostat in keeping the over-all variation in temperature within narrow limits.

Although present satellites can observe only clouds and radiation, new weather satellites are being designed which should provide much additional data of use to meteorologists.

Delegates to the Washington Academy of Sciences, Representing the Local Affiliated Societies*

Philosophical Society of Washington	Lawson M. McKenzie
Anthropological Society of Washington	Regina Flannery Herzfeld
Biological Society of Washington	Herbert Friedmann
Chemical Society of Washington	Alfred E. Brown
Entomological Society of Washington	William E. Bickley
National Geographic Society	Alexander Wetmore
Geological Society of Washington	Margaret D. Foster
Medical Society of the District of Columbia	Frederick O. Coe
Columbia Historical Society	U. S. Grant, III
Botanical Society of Washington	Harold T. Cook
Society of American Foresters	Harry A. Fowells
Washington Society of Engineers	Howard S. Rappleye
American Institute of Electrical Engineers	William A. Geyger
American Society of Mechanical Engineers	William G. Allen
Helminthological Society of Washington	Doys A. Shorb
American Society for Microbiology	Mary Louise Robbins
Society of American Military Engineers	Delegate not appointed
Institute of Radio Engineers	Robert D. Huntoon
American Society of Civil Engineers	Joseph M. Caldwell
Society for Experimental Biology and Medicine	Kathryn Knowlton
American Society for Metals	John A. Bennett
International Association for Dental Research	Gerhard Brauer
Institute of the Aerospace Sciences	Francois N. Frenkiel
American Meteorological Society	Jack Thompson
Insecticide Society of Washington	Milton S. Schechter
Acoustical Society of America	Richard K. Cook
American Nuclear Society	George L. Weil
Institute of Food Technologists	Richard P. Farrow

*Delegates continue in office until new selections are made by the respective affiliated societies.

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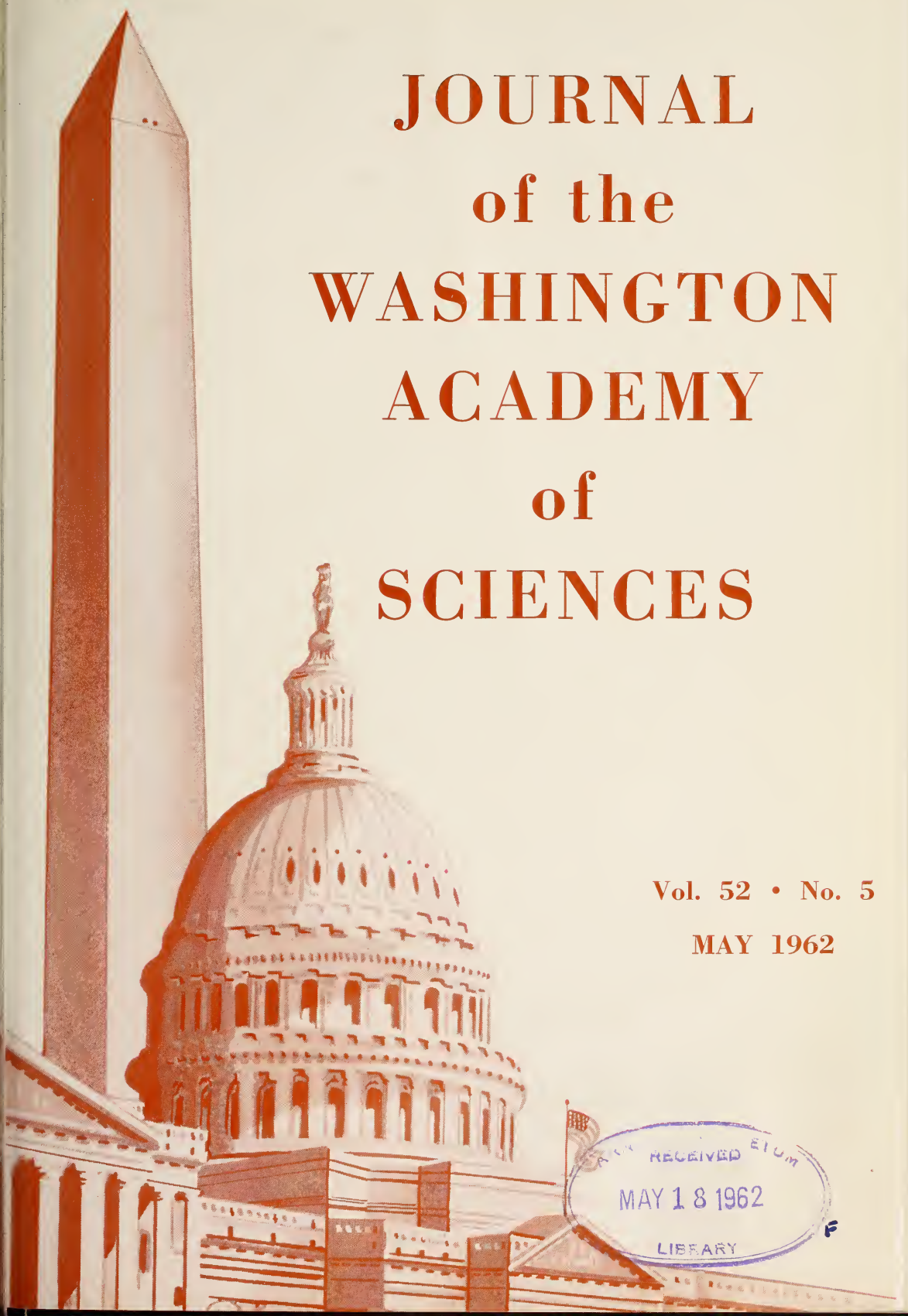

Vol. 52 • No. 5

MAY 1962

JOURNAL OF THE WASHINGTON ACADEMY OF SCIENCES

Editor: Samuel B. Detwiler, Jr., Department of Agriculture

This Journal, the official organ of the Washington Academy of Sciences, publishes historical articles, critical reviews, and scholarly scientific articles; notices of meetings and abstract proceedings of meetings of the Academy and its affiliated societies; and 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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Second class postage paid at Washington, D. C.

Ground Water in the Washington, D. C. Area, and a Brief History of the Public Water Supply*

Paul M. Johnston

U. S. Geological Survey

Ground Water

Although the greater part of the water used in the Washington metropolitan area is surface water distributed by public systems, a large volume of ground water also is used, both by public and individual systems. All public systems, except that of the District of Columbia, use some ground water. However, ground water finds its greatest use in the suburban and rural areas where public supplies are not available, as well as for industrial, commercial, and emergency use.

The use of ground water has many advantages. Besides the obvious advantage where it is present and surface water is not, the occurrence of ground water imparts qualities which make it superior to surface water in certain respects. In many places ground water can be produced near its point of use, thus eliminating the necessity of long pipelines. Filtration is generally not necessary, and its temperature remains nearly constant. It is commonly safe bacteriologically and its source is not affected by military operations. Compared with surface water, ground-water sources are relatively immune to contamination.

The location of successful wells in the Washington area is complicated by the diversity of the geology. On opposite sides of the "Fall Line," which crosses the area from northeast to southwest and separates the Piedmont from the Coastal Plain, very different geologic conditions prevail. (See map.)

* Publication authorized by the director, U. S. Geological Survey

Northwest of the Fall Line, the Piedmont is underlain by deeply weathered crystalline (metamorphic and igneous) rocks; to the southeast of the Fall Line these rocks are buried beneath the sedimentary rocks of the Coastal Plain (Johnston, 1962).

The sedimentary formations (interbedded sand, gravel, and clay) thicken from the Fall Line to as much as 1800 feet at the southeast corner of the map area. They lie upon a bedrock surface which dips to the southeast about 125 feet to the mile.

In the Piedmont, ground water moves under unconfined or water table conditions in the openings or fissures in the rocks, or in the weathered residual soil and subsoil above. Because of the compactness of the parent rock, little interstitial ground-water movement takes place below the weathered zone.

Of that part of the precipitation which infiltrates into the ground, a part may be returned to the atmosphere by evaporation or by transpiration by vegetation. The remainder, seeping downward, reaches the water table, which marks the surface of the saturated zone, and becomes ground water. It then moves laterally under gravity flow toward lower elevations, unless intercepted by wells, to places of discharge such as springs, seeps, or surface water bodies.

In the Coastal Plain, ground water moves both under unconfined (water-table) and confined (artesian) conditions. Shallow wells obtain water from the water table, and their characteristics are similar to those of wells in the residual soils of the

Piedmont. At greater depth in the Coastal Plain, wells may penetrate a bed of clay and tap the water in a sand or gravel bed beneath. The water, being under pressure, rises above its source in the well, and may even flow at the surface.

Although ground-water supplies sufficient for domestic use—5 to 10 gpm (gallons per minute)—can be obtained in most places in the Piedmont, well locations should be determined with reference to the local geology to improve the chances of success. Geologic studies are even more essential if supplies of 50 to 100 gpm or more are required. Wells producing as much as 200 gpm are known in the Piedmont, but such high-yield wells are in particularly favorable geologic locations.

Yields sufficient for domestic use generally can be obtained from shallow wells in the Coastal Plain also, except where a considerable thickness of clay occurs near the surface. However, deep artesian wells producing as much as 800 gpm can be located only through a knowledge of Coastal Plain subsurface geology.

Observations on water-table levels in the Piedmont for the last 30 years indicate no sustained downward trend. The present rate of ground-water withdrawal is not known, but it is safe to say that only a fraction of the potential is being utilized, except possibly in relatively small local areas.

It is estimated that about 15 mgd (million gallons per day) were being pumped from the Coastal Plain formations of the Washington area in 1960. This is balanced against an estimated average recharge of 27 mgd. The amount withdrawn is thus equal to about 55 percent of the available recharge—a reasonably favorable water balance. However, future large-scale developments should be carefully controlled so that safe limits of withdrawal are not exceeded.

Wells in Piedmont formations have yields ranging from 0.2 to 110 gpm from wells 21 to 825 feet deep, not including wells of the Pimmit Service Corporation in Fairfax County, which yield 45 to 212 gpm from wells 337 to 741 feet deep. The average depth of wells in the Piedmont, exclusive of those of the Pimmit Service Corporation, is 124 feet, the average yield 13 gpm. The average yield of Pimmit Service Corporation wells is 116 gpm, the average depth 550 feet.

Wells in the Wissahickon Formation yield slightly more than the average of all wells in Piedmont formations, and those in the Sykesville Formation yield slightly less. Wells in serpentine have the lowest average yield of wells in any Piedmont formation. Table 1 briefly describes the Piedmont formations and their water-bearing properties.

In the Coastal Plain, yields of wells in the Patapsco Formation and Arundel Clay range from 10 to 120 gpm and average 40 gpm. Wells in the Patuxent Formation have yields of 10 to 300 gpm and average 80 gpm. In the Potomac Group, yields range from 1 to 800 gpm and average 96 gpm. The Coastal Plain formations and their water-bearing properties are described briefly in Table 2.

The chemical quality of the water in the Piedmont and Coastal Plain formations is generally satisfactory for most uses. The water is soft to moderately hard—2 to 175 ppm (parts per million) of carbonate. High iron content and corrosiveness are problems in some places, and some shallow wells are polluted.

A Brief History of the Public Water Supply *

Long before the coming of the white man to the confluence of the "Potowmack" and the Anacostia, the Indians were supplied with water from the many springs and

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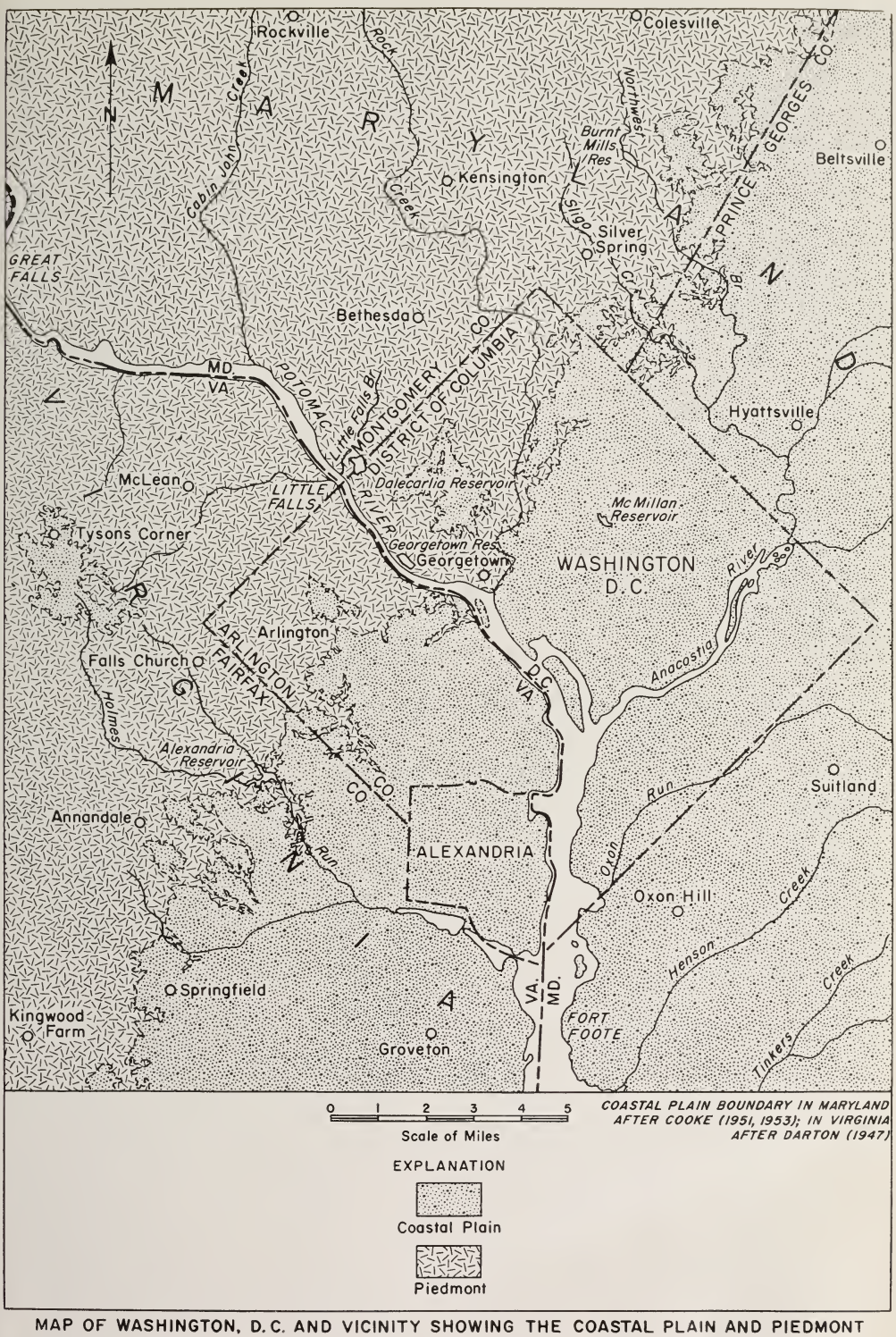

MAP OF WASHINGTON, D.C. AND VICINITY SHOWING THE COASTAL PLAIN AND PIEDMONT

brooks which watered the area. Captain John Smith described this region in 1629 as follows: "The country is not mountainous, nor yet low, but such pleasant plaine hils, and fertile valleys, one prettily crossing another, and watered so conveniently with fresh brookes and springs, no lesse commodious, then delightsome."

By the time the new capital city was established in 1800 some wells had been dug, and with the springs, furnished the sole source of supply until 1859. The area abounded in springs, some of which are still in existence. Place-names on present maps show locations of some of the large springs, many of which have been destroyed. Silver Spring is an example. The spring for which this community was named was destroyed in 1941 when Newell Street was built near the Silver Spring railroad station. Since then the spring and "Acorn" summer house have been "reconstructed" and city water is now piped into the spring!

Hume Spring in Alexandria is now the site of a large apartment building. Custis, or Arlington Spring, on the grounds of the Custis estate, now Arlington National Cemetery, was a favorite picnic spot before the Civil War.

In the District of Columbia, the name Carroll Springs was given to a community surrounding a group of springs on New Jersey Avenue, two or three blocks south of the Capitol (Brown, 1930, p. 5). Takoma Spring, though now unused, is still in existence at the corner of Elm and Poplar Avenues in Takoma Park.

Many anecdotes of fact and fiction about some of the springs in this region have come down through the years. The big spring at the Kingwood Farm southwest of Alexandria is said to have been a favorite "stopping place" of George Washington. A large spring (probably called Washington Spa Springs), formerly at the east side of Bladensburg Road just south of the entrance to Fort Lincoln Cemetery, figured in the battle of Bladensburg in 1814. Proctor (1930, p. 357) wrote: "Commodore Barney was taken prisoner, having ordered his officers to leave him where he lay bleeding at the spring * * *." Barney's wounds were treated by the British, and he was later released.

Silver Spring was named by Francis Preston Blair, the former owner of Blair House on Pennsylvania Avenue (now used as a guest house by the White House). In 1842 Blair happened on the spring while in pursuit of a runaway horse. The water bubbling up through the mica and sand glistened in the sunlight, and this effect suggested the name. Blair later purchased a large tract of land including the spring, and built a country home.

In the Seventy-fifth Anniversary History of Takoma Park (Olmstead and others, 1958, p. 16), it is related that when the Indian Chief Powhatan was wounded near the present site of Philadelphia he was taken to a "wonderful, healing spring" north of the Potomac—presumably Takoma Spring—referred to as Big Spring to distinguish it from lesser springs in the vicinity.

The Takoma spring was sold to the Takoma Park Springs Company, which in 1891 began to bottle and sell the water. According to Olmstead (1958, p. 17), this was tolerated until the company fenced in the spring to prevent access by the public, whereupon the irate citizenry took things in their own hands and tore the fence down. Investigation showed that " * * * the terms of the sale specifically intended to retain the spring in public use and that the claim of the owners was void * * *." The town then acquired possession of the spring and park. The Takoma spring was in use during the drought in 1932, when people came for water from many miles around.

Numerous other springs, whose names are no longer recorded on maps, have been destroyed, but former locations may be determined from records of the District Government and the Corps of Engineers, and from newspaper files and local historical writings.

Table 1.—Piedmont Formations and Their Water-Bearing Properties, Washington, D. C., and Vicinity.

	Lithology	*Water-Bearing Properties*
Age Unknown	*Granite* (undifferentiated) — Includes Bear Island Granodiorite of Cloos, 1953, and Kensington Granite Gneiss of Cloos, 1951 in Maryland, and undifferentiated granitic rocks in Virginia. Sheared and massive.	Thirty-eight wells yield an average of 9 gpm. Average depth 138 feet.
	Sykesville Formation of Jonas, 1928—Quartz-mica schist and gneiss, and quartzite; intrusive granitic rocks containing inclusions of schist and quartz. May include Laurel Gneiss in Virginia.	One hundred forty-two wells yield an average of 12 gpm. Average depth 124 feet.
	Laurel Gneiss of Chapman, 1942—Similar to Sykesville Formation of Jonas. Contains garnet and staurolite.	Fifteen wells yield an average of 10 gpm. Average depth 198 feet.
	Mafic rocks—Tonalite, gabbro, meladiorite, amphibolite, chlorite and biotite schist, soapstone, and undifferentiated mafic rocks.	Twenty-five wells yield an average of 13 gpm. Average depth 126 feet.
	Serpentine—Black, gray, and dark green serpentine.	Five wells yield an average of 6 gpm. Average depth 104 feet.
Lower Paleozoic(?)	*Wissahickon Formation*—Schist, phyllite, and quartzite.	Three hundred twenty-four wells yield an average of 14 gpm. Average depth 118 feet.

Note: Fourteen wells in formational contacts yield an average of 16 gpm. Average depth 138 feet. Seven wells of Pimmit Service Corp. (Fairfax County Water Authority) in formational contacts, not included above, yield an average of 116 gpm. Average depth 550 feet.

One of the largest springs in the city, "the celebrated Ridge [or City] Spring," was located on the north side of C Street between 4th and 6th Streets N.W. Water from this spring was piped to the yard of Center House, which was opened in 1804 at the corner of 9th and D Streets N.W. (Brown, 1930, p. 321). In 1808, water from this spring was conveyed by wooden (bored-log) pipeline to residences in the 600 block of Pennsylvania Avenue N.W. This is the first record of water supply for public use by pipeline in the city (Orndorff, 1962). The cost of pipe and installation was borne by the owners who used the service.

A large spring, known variously as Federal, Caffrey's, or Hotel Spring, at Ninth and F Streets N.W., was "concealed from view" when the Masonic Temple was built (Brian, 1914, p. 559). Water was piped from this spring in 1809 to Pennsylvania Avenue to serve the blocks between 9th and 14th Streets N.W. This was the first

pipeline to which the District Government contributed a part of the cost. One-third of the cost was borne by the District, two-thirds by the users. After this, no further extensions of pipelines were made until 1823, when water from a spring in the "public space" of 13th Street N.W., north of "Eye" Street, was piped southward along 13th and 14th Streets. During the course of several years these lines, which were partly of bored logs and partly of cast iron, were extended south to Ohio Avenue, east to 11th Street, and west to 15th Street N.W. (Orndorff, 1962).

Congressional or Smith Spring, now inundated, but marked by a circular brick structure in McMillan Reservoir, was purchased in 1833. It supplied water by pipeline to the Capitol building in 1834, and in 1837 the pipeline was extended to hydrants along Pennsylvania Avenue (Smith, J. C., 1962, written communication).

Delay in improving public facilities must have been as common in the nineteenth century as it is today. In 1819 Congress provided an appropriation to have water piped from a group of springs in what is now known as Franklin Park to the White House and executive buildings, which at that time were supplied from wells (Brian, 1914, p. 65). The project was not completed until 1834 because of "unwillingness of the government to pay what was regarded as a high price in 1819."

Cool Spring, a large spring near 15th and E Streets N.E., also was called Young's or Stoddert's Spring after former owners; later it became known as Federal Spring, a duplication of name with Caffrey's Spring (Brian, 1914). An ice plant was built at this site, and the water is still in use for cooling at the plant. This is one of two springs in use commercially in the Washington area. The other is southwest of Rockville, where the water is bottled and distributed for drinking.

No details are available concerning a spring in City Hall Park, now Judiciary Square, which supplied water by pipeline to the nearby area. There were many other springs of considerable importance in the old city, but it is doubtful if any of them were used to supply pipe systems.

The water lines from the springs were maintained and extended from year to year. By 1850 most of the area south of the springs to Pennsylvania Avenue, and between First and 15th Streets N.W., was served by pipeline. Most of the lines were connected to public hydrants or "pumps," but some supplied service lines into private premises.

According to Orndorff (1962), "an act of the City Council dated August 5, 1812, provided general authority 'for sinking of wells and erecting of pumps, conveying of water in pipes, and fixing of hydrants for the improvement of springs and other purposes.' Under this act, the Mayor * * * could cause one-half of the cost of such improvements to be assessed against the resident beneficiaries. In addition to the construction, improvement, and maintenance of springs, wells, and pipelines, the city constructed large brick cisterns or reservoirs in strategic street intersections to store water for fire fighting."

Wells were a great convenience, even if located on the corner of a block. However, the more affluent had wells dug in their own yards. Others used the public pumps.

Fortunately the chief source of soil contamination in centers of population was never a problem in Washington. The city fathers in their wisdom approved an ordinance May 13, 1805, prohibiting the use of privy pits.

The *Intelligencer* of December 1, 1849 stated that for more than a third of a century the city had made use of the "rich gifts of nature of under-ground springs which rise up wherever a well is dug." However, by mid-century the supply was no longer adequate for a population that had increased to 51,000. The demand was so great that it was impossible to prevent private citizens from tapping the pipe lines to public buildings (Brian, 1914, p. 305).

Table 2.—Coastal Plain Formations and Their Water-Bearing Properties, Washington, D. C., and Vicinity.

			Lithology	Water-Bearing Properties
Quaternary	Pleistocene and Recent		*Recent alluvium, Pamlico, Wicomico, and Sunderland Formations, Terrace gravel* — Clay, silt, sand, gravel, and boulders.	Yields small supplies to many shallow dug wells.
Tertiary	Pliocene (?)		*Brandywine and Bryn Mawr gravels*— Gravel, sand, and silt.	do.
	Miocene		*Chesapeake Group* — Diatomaceous earth, sand, silty, sandy clay, and clay.	do.
	Eocene		Pamunkey Group	
			Nanjemoy Formation—Massive pink clay overlain by fine gray micaceous glauconitic sand.	Yields small supplies to a few dug wells.
			Aquia Greensand—Coarse to fine glauconitic sand, locally lime cemented.	do.
	Paleocene		*Brightseat Formation*—Dark gray sandy clay (included in the mapped area of the Monmouth Formation).	Not important as a water-bearing formation.
Cretaceous	Upper		*Monmouth Formation*—Fine black, micaceous glauconitic sand.	do.
			Potomac Group (undifferentiated in Virginia)	Ninety-one wells in undifferentiated Potomac Group yield an average of 96 gpm.
			Patapsco Formation and Arundel Clay—Dark gray clay containing lignitized wood and saurian bones. Overlain by massive maroon clay and varicolored sand and clay. Sand lenses grade into clay lenses. In some places basal gravel, sand or arkose.	Eleven wells in the Patapsco and Arundel yield an average of 40 gpm.
	Lower		*Patuxent Formation*—Large round pebbles, fine sand, and thin lenses of white or iron stained clay.	Forty-five wells in the Patuxent yield an average of 80 gpm.

Several surveys had been made for a public water supply. Notes on L'Enfant's map of 1792 suggested that water from a branch of Tiber Creek be "conveyed to the high ground where Congress House stands," and from Reedy Branch to the President's House, also that Pine Creek (now Piney Branch) be "turned into James White Branch to supply the city." These suggestions were never carried out, except that Congressional or Smith Spring, which was the source of a branch of Tiber Creek, was piped to the Capitol building.

At various times consideration for a public supply had been given to the Potomac above Great Falls, Rock Creek, the Anacostia River, and the numerous wells and springs in the District (Somervell, *in* Proctor, 1930, p. 613).

In a letter written in 1798, General

Washington expressed a belief "that the water of the Potomac may, and will be brought from above the Great Falls into the Federal City, which would, in future, afford an ample supply of this object" (Orndorff, 1962).

In the years 1850-52, appropriations were made for a study of "the most available mode of supplying water" to the city, and by 1853 Capt. M. C. Meigs of the Corps of Engineers, U. S. Army, commenced construction of a project to bring water from the Potomac to the city. The project consisted of a dam above Great Falls, 9 miles of 9-foot conduit to Dalecarlia Reservoir (a 46-acre reservoir in Little Falls Branch) and 2 miles of 9-foot conduit from Dalecarlia to Georgetown Reservoir. From Georgetown the water was to be distributed through cast-iron mains to other parts of the city.

By 1859 construction had been partly completed, so that water from Little Falls Branch, impounded in Dalecarlia Reservoir, was turned into the system. Finally, on December 5, 1863, after delays caused by the War, water from above Great Falls began flowing into the mains (Orndorff, 1962).

When the system was first put into service, the water was at times polluted or made turbid by Little Falls Branch. Dalecarlia was then bypassed at times of pollution or turbidity by building a conduit around it, and water from Little Falls Branch was used only when in good condition or for emergencies. This was the situation until 1895, when a tunnel was built to carry Little Falls Branch around Dalecarlia Reservoir to the Potomac River.

McMillan Reservoir (38 acres for sedimentation and storage) was completed in 1902 and connected to Georgetown Reservoir. Even with the improvements at Dalecarlia the water, now all obtained from the Potomac, was frequently turbid and remained so periodically until a filtration plant was completed in 1905. The difference in quality of the water after filtration can be imagined by the remark of a young lady to the effect that "it was almost immodest to take a bath in the clear water" (Somervell, *in* Proctor, 1930).

The filtration plant left something to be desired—the water from the Potomac was still turbid at times and remained so until January 1911, when coagulant was added. After this the water was clear at all times (Somervell, *in* Proctor, 1930).

The next year the problem of pollution of the ground water made its appearance. According to the *Washington Evening Star* of February 6, 1906: "The recent action of Dr. W. E. Woodward, the health officer, in condemning the water from the springs in Franklin Square, between L, K, 13th and 14th Streets, declaring it to be deleterious to the public health, has caused comment in various quarters. For 75 years the springs have furnished water for use at the White House, the State, Treasury, War and Navy Department, and many houses in that portion of the city during which time there has been no complaint of the quality of water. Many hale, hearty old men and women, some of them octogenarians, have been lifelong users of the water, it is claimed, and have fared fully as well as those supplied by other springs * * *."

Ground-water supplies from wells also became suspect according to the *Washington Evening Star* of August 24, 1907: "Partisans of the public pumps, organized under the name of the District of Columbia Protective Association, held a meeting at Society Temple last night and condemned the action of the commissioners in abandoning a number of wells about the city. The health officials and the local Government in general got it good and hard. The association has already held four meetings to protest against the public pump removal * * *. Mr. R. S. Thorin got a good hand when he declared: 'The reason you poor mortals have no pure water is because you have no say in your own affairs. We have suffered from an autocracy, an oligarchy.' "

In spite of the protests the city fathers remained adamant, and the use of public shallow wells and springs was discontinued.

at least in the central part of the city. But the objections had become so violent that when pollution was suspected in the spring on 13th Street, water from the Potomac was turned into the lines at night, and the unsuspecting public apparently was none the wiser.

Although the public use of shallow wells and springs was forbidden, many that were privately-owned remained in use until a few years ago, and at the present time the District does not require permits for drilling private wells. However, cross-connections with the public system are strictly forbidden, and large commercial wells are metered so that a sewer charge can be made.

Long after the central part of the District was supplied with city water from the Potomac, the District Government continued to contract for the drilling of deep wells for schools in the outlying parts of the District. The Annual Report of the District for 1910 listed 11 shallow and 30 deep wells in use, presumably for public supply. The 1920 report shows that care and maintenance work was done on 2 springs and 23 wells.

In 1920 it was again found necessary to augment the public water supply. At this time additional sources considered were the Patuxent River, the Potomac River at Little Falls, and the Potomac above Great Falls. A new intake was installed about 100 feet above the old dam above Great Falls, and a new conduit was built parallel to the old one, to Dalecarlia. A new filtration plant was constructed just below Dalecarlia (Somervell, *in* Proctor, 1930).

As the suburbs expanded, water had to be provided for communities adjacent to the District. In March 1917 and April 1926, legislation was enacted to allow water to be supplied to the Washington Suburban Sanitary District in adjoining Maryland, and to Arlington County Sanitary District in Virginia. These areas encompassed 95 square miles in Maryland and 25 square miles in Virginia.

In 1928 Washington had a water supply "* * * so abundant that it will provide water for several more decades though the population increases at the present rate of 11,000 a year" (Proctor, 1930).

In the early 1900's, drilled wells began to supplant dug wells which had served the purpose for so many years. Most of these wells were artesian, drilled in the Coastal Plain for commercial establishments. Many of these wells are still in use within the District of Columbia and in nearby Maryland and Virginia.

Of course, many of the outlying suburban and rural sections within the metropolitan area are not supplied with city water. In those areas wells and springs are the sole source of supply.

Until 1959 the public water supply for the District of Columbia, Arlington, and Falls Church was taken from the Potomac River by means of the diversion dam above Great Falls. A new diversion dam and pumping station with installed pumping capacity of 450 mgd were constructed at Little Falls and put into operation in the summer of 1959. When the present filtering capacity of 204 mgd is increased to 333 mgd, the system will be capable of supplying the District and adjacent parts of Virginia until the early 1980's (Smith, J. C., 1962, written communication). The Army Engineers are now (1962) completing a comprehensive study of the Potomac River basin in order to select the best plan to supply needs in the more distant future.

Within the District, approximately 14 private wells in Coastal Plain formations supply water for a variety of commercial establishments such as a storage warehouse, a railroad terminal, a dairy, a hotel, a theater, retail establishments, and light industry. These wells together pump approximately 1.5 mgd. Two wells in the Piedmont west of Rock Creek supply a few gallons per minute for irrigation.

Public water supply in Maryland, in a 427-square-mile area adjoining the District

of Columbia, is furnished by the Washington Suburban Sanitary Commission. In 1961 an average of 49 mgd was supplied to a population of about 600,000. Water was obtained from two reservoirs on the Patuxent River, and from diversion works on the Potomac River placed in operation in 1960. A small reservoir and filtration plant on Northwest Branch are maintained at Burnt Mills, near Silver Spring, to provide for emergencies and peak loads. Three wells are operated by the Commission in Prince Georges County, and others are planned.

In all, the facilities of the Sanitary Commission have a total capacity of about 110 mgd, and an additional 90 mgd can be provided by expansion of the Potomac River plant. These facilities are considered adequate to supply the population expected in the area until the year 2000.

The city of Rockville, until October 1958, was supplied with water from 35 wells. Since that time the city has obtained its water from a plant on the Potomac River opposite Beall's Island. The city maintains 17 of its wells on a standby basis for emergency use.

Arlington County and Falls Church obtain public water supplies from the District of Columbia system. Falls Church, in turn, sells water to the Fairfax County Water Authority, and also supplies residents in a 22-square-mile area in adjacent Fairfax County. At least 10 privately owned water companies, most of which rely on wells or a combination of ground water and surface water, supply northern Virginia in the Washington area.

The Alexandria Water Company, the largest system in Northern Virginia, obtains most of its water from a dam on Occoquan Creek, about 20 miles southwest of Alexandria; it supplies the city of Alexandria and the adjacent part of Fairfax County, including Fort Belvoir.

In 1957 the Fairfax County Water Authority was established to purchase the private water companies and integrate them into a county system. By the end of 1961, four private companies had been acquired.

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The Genesis of Living Matter

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One of the most perplexing questions that has faced mankind throughout the ages is comprised in the three words "Whence and Whither." Many attempts, some based on scientific knowledge [1] and some not, have been made to provide an answer at least to the first part of the question. The difficulties confronting the scientist in attempting any sort of answer are formidable: the chemist may, however, make a modest beginning by attempting to discover the genesis of the chemical compounds that constitute living matter. How did the sugars, starches, fats, proteins, hormones, etc., come into being? Could they have been formed in an originally "dead" world before any living matter appeared? It turns out that it is now possible to make constructive hypotheses which permit us to understand how these substances could be formed in the absence of living matter.

It must be emphasized that under primitive planetary conditions, the process whereby the small stable molecules (carbon dioxide, water, etc.) could be converted into high molecular weight organic compounds, can hardly bear much resemblance to the incredibly [2] complex series of reactions in the green plant through which, in the presence of chlorophyll and various enzymes, these simple molecules are incorporated into its structure.

Matter recognizes only two driving forces; the first is the tendency for atoms to assume as low a potential energy as possible, and the second is the tendency for the motion of atoms to become as disorderly or random as possible. Left to itself matter will, under the influence of these forces, move inexorably toward a configuration consisting of small stable particles. What is it then that can undo the effect of these forces and bring into existence large complicated molecules, in the absence of any kind of molecule consisting of more than very few atoms? Under these primitive conditions, surely only the very simplest sort of mechanism could be expected to function.

There seems to be only one plausible solution, viz., to look for all possible means whereby the small stable molecules are broken down into the high energy particles that we call free radicals. Fortunately, throughout space, several ways exist to accomplish this: thus, the absorption of short-wavelength light by ammonia, water, methane, etc., decomposes them into free radicals; moving electrons such as occur in thunderstorms can bring about the same decomposition; and finally, heating followed by sudden cooling [3] also results in the production of free radicals.

The production of free radicals solves the most difficult part of our problem. While it is true that even after the formation of free radicals, the march toward equilibrium starts again, the path back is long and tortuous, chiefly because free radicals are so high in the energy scale. We may make an analogy by considering the evaporation of water from the sea and its precipitation on a high mountain, as rain or snow. Hardly ever does it return to the sea directly through a high waterfall. Normally it gets back to the ocean through winding streams, lakes, rivers, etc. The rain or snow on the mountain represents the high energy free radicals, the sea represents the small stable molecules, and the intermediate levels represent the substances that constitute living matter.

Thus we see that synthetic processes must be rather common throughout the universe; the countless millions of heavenly bodies are passing through a period of evolution, some of them being at millions

of degrees Centigrade, some of them near the absolute zero. Our own earth is passing through such a period of evolution, having originated probably together with other planets from a giant explosion in the sun. It seems reasonable to suppose that chemical synthesis is proceeding on an immense number of planets, resulting in the production of vast quantities of the substances that make up living matter.

Life, as we know it on this planet, is intimately connected with compounds of carbon. Even such oddities as the sulfur bacteria, that may contain upward of 90 percent sulfur, are not essentially different from other forms of living matter.[4] These bacteria obtain the energy necessary for growth by oxidizing hydrogen sulfide to elementary sulfur, which is stored in the body cells. However, the cells themselves are composed of carbon compounds, which differ in no way from those found in all other living cells; the sulfur plays no part in the essential structure of the cell, simply providing the necessary energy. We should, however, recognize the possibility that under different conditions of temperature, etc., the chemical behavior of sulfur and its compounds might be greatly modified, so that a planet may exist that is inhabited by beings whose organic chemistry is the chemistry of the sulfur compounds: the shores of this dismal planet would be washed not by H_2O but by H_2S!

Distribution of the Elements

A clue to the origin of the compounds occurring in living matter arises from the recognition of the fact that all the chemical elements of which they are composed are common throughout space.[5] The total matter of the observable universe is contained partly in the huge bodies which we call stars, partly in smaller and smaller aggregations such as planets, comets, meteors, and interstellar dust, until finally we come to the molecules and atoms. A tacit assumption that seems to be reasonable is that the various bodies in space have evolved from a huge, chemically homogeneous dust cloud. Evidence obtained from the spectra of stars and interstellar material, etc., tells not only what elements are present but also their relative abundances. Meteorites give us information about the non-volatile material of the original dust cloud, whereas comets contain volatile substances that produce the spectra of such particles as CH, CO, NH, OH, C_2, CN, etc. In general, stellar data are used for the evaluation of materials which condense with difficulty, and meteoric data are used for the more readily condensable substances.

Excluding the rare gases, it turns out that hydrogen is by far the most abundant element; it is followed by oxygen, nitrogen, and carbon listed in order of abundance, although the amounts do not differ greatly. A third group consisting of magnesium, silicon, sulfur, and iron comes next in abundance, but these are at least an order less common than the members of the previous group; all other elements are much less common.

Owing to the difficulty of making measurements of abundances, the actual numbers are known within a factor of perhaps ± 3. Fortunately, however, we are concerned with the atmospheres of planets, more particularly those of the solar system, and here our information is much more dependable and extensive.

As material condenses, fractionation will occur, resulting in the lighter elements predominating in the outer layers where living matter may be expected to originate. The major planets all contain hydrogen, ammonia, and methane in their atmospheres; the terrestrial planets are now highly oxidized and may contain in their atmospheres free oxygen, free nitrogen, carbon dioxide, and water—free hydrogen usually being absent.

The Characteristics of Carbon Compounds

Among all the chemical elements, carbon has no close competitor in the vast number and diversity of compounds it is

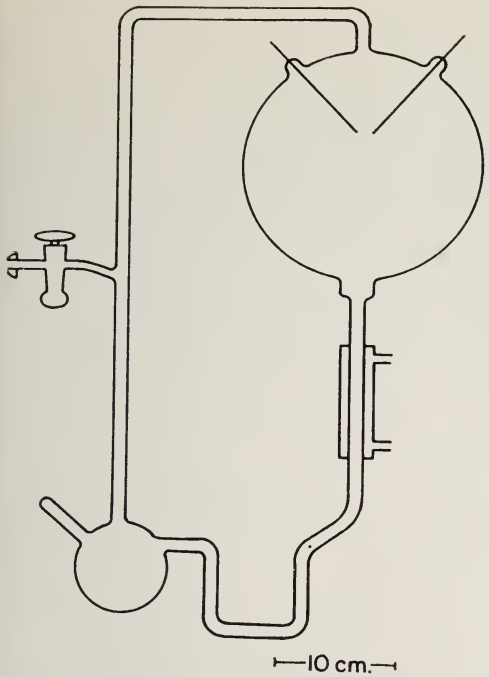


Fig. 1. Formation of amino acids, etc. in an electric discharge. The apparatus contains methane, ammonia, hydrogen, and water, which about half fill the small bulb. By boiling the water, the vapors are circulated through the large bulb, where they are subjected to an electrical discharge after which they are condensed and returned to the small bulb. See Reference 8.

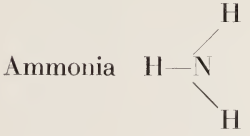
known to form, many of which are necessary in order to provide those qualities which we associate with living matter. It is not surprising, therefore, to find that living matter as we know it is composed of compounds of carbon, and that the chemistry of carbon compounds is still known by its old name, "organic chemistry." One of the extraordinary phenomena that occur in living matter is the uniqueness of each individual being. While this is self-evident in human beings, it extends also to lower forms of life (perhaps even to microscopic life) so that we must find some explanation to account for this astonishing diversity. The difference in properties between different substances which permit us to distinguish one from the other, resides in the last analysis, in the make-up of the molecules of which each is composed. Thus, ordinary oxygen, O_2, and ozone, O_3, bear no resemblance to each other, although each contains only oxygen atoms; the same is true of water, H_2O, and hydrogen peroxide, H_2O_2, although each contains nothing except hydrogen and oxygen. Normal octane, C_8H_{18}, which has its eight carbon atoms in a straight chain, is a liquid which smells like gasoline and has a boiling point of 126°C. The octane, hexamethylethane, C_8H_{18}, having the formula $(CH_3)_3C\text{-}C(CH_3)_3$, is a solid (M.P. 104°C.) and smells like camphor. It is important therefore, to consider whether carbon compounds exist in sufficient diversity to account for the material differences of the countless numbers of living creatures.

The capacity of carbon to form a huge number of compounds is due to several factors among which may be mentioned (a) its power of combining with itself to form long chains and (b) the curious phenomenon of isomerism. For example, oxygen and nitrogen have each only two hydrides:

Water H-O-H

Hydrogen peroxide H-O-O-H

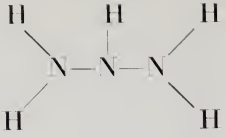
Ammonia



Hydrazine

If oxygen and nitrogen had the power of forming long chains, we might expect such compounds as

H—O—O—O—H and



but none such have ever been found.

In contrast, carbon not only forms CH_4 and C_2H_6, but a whole series of hydrocarbons containing up to several hundred carbon atoms. Thus, instead of having only two hydrides, carbon has several hundred in which there is a straight chain of carbon atoms, merely because of the property possessed by the carbon atom, of forming strong carbon-carbon bonds. Actually this is only the beginning of the story: owing to its ability to form isomers, the number of hydrides of carbon is increased beyond any possibility of counting them. Thus by following the valency rules, we may construct altogether 18 octanes having the formula C_8H_{18}. Each one is a separate and distinct chemical entity having its own characteristic properties which permit its separation and identification. As the number of carbon atoms increases, the number of isomers increases extremely rapidly. Thus, while octane has 18 isomers, decane, $C_{10}H_{22}$, has 75 isomers, and the numbers (rounded off to the nearest power of ten) of isomers of some higher hydrocarbons [6] are as follows:

Name	*Empirical formula*	*Number of isomers*
Eicosane	$C_{20}H_{42}$	10^5
Triacontane	$C_{30}H_{62}$	10^9
Tetracontane	$C_{40}H_{82}$	10^{14}
Pentacontane	$C_{50}H_{102}$	10^{22}
Decacontane	$C_{100}H_{202}$	10^{43}
Eicontane	$C_{200}H_{402}$	10^{87}

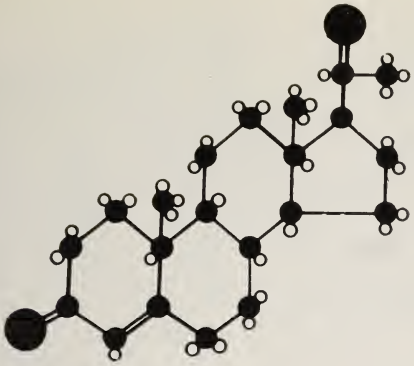
Each protein molecule in our bodies contains far more than 200 carbon atoms, and contains in addition, hydrogen, nitrogen, oxygen, and sulfur, so that the number of isomers possible increases to a fantastically huge number. Since the number [7] of electrons in the whole of the known universe (we have to count electrons because molecules and even atoms could not exist at the high temperature of the stars) is about 10^{80}, there is no possibility whatsoever of nature running out of enough molecules to make each living being characteristic in a material sense.

Generation of Free Radicals

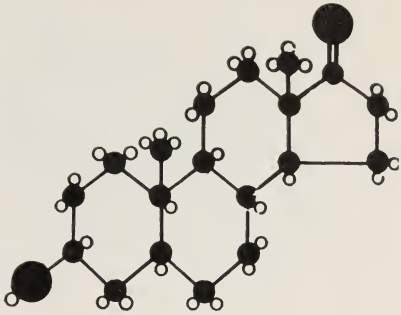
It has already been pointed out that the effect of short wavelength light, electrical discharge, or intense heating on methane, ammonia, water, carbon dioxide, etc. would be to generate various free radicals including the free atoms themselves. Under primitive earth conditions, therefore, we may expect the formation of such particles as CH_3, CH_2, CH, NH_2, NH, and OH, as well as free atoms. Reactions of the radicals with each other would be expected to produce a great variety of small stable molecules. Furthermore, reaction of the free radicals with the unsaturated molecules would cause polymerization and the formation of large molecules.

Free radicals can be generated by the action of heat alone, and can even be stabilized under certain very special conditions. While these conditions probably did not exist at any time on our own earth, it is possible that on other planets throughout the universe, the generation of free radicals by heat may have contributed to the formation of high molecular weight organic compounds.

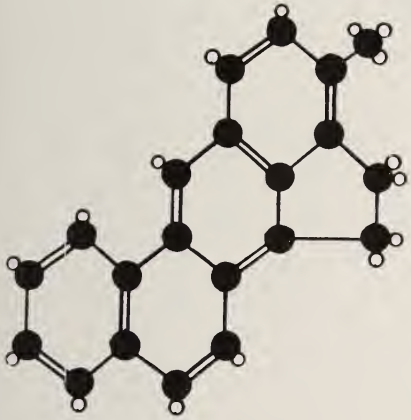
Conditions of extreme cold, combined with localized high temperatures, would obtain on any planet far away from a sun when struck by meteorites. A similar situation obtains on a planet such as Mercury, that rotates round the sun and on its own axis in the same period of time so that the same side of Mercury always faces the sun. The face of Mercury toward outer space would obtain heat only by conduction from the side facing the sun (assuming that Mercury has no interior heat of its own), and would finally

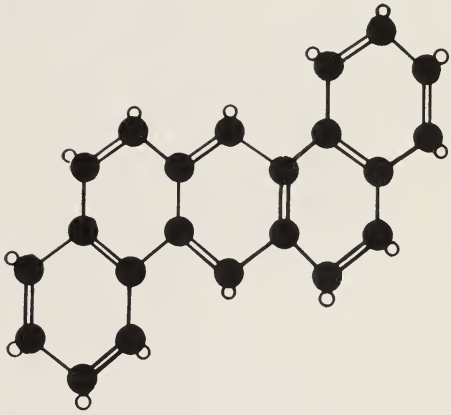


Progesterone
(A female sex hormone)



Androsterone
(A male sex hormone)





Cancer producing hydrocarbons

Methylcholonthrene

Dibenzanthracene

Fig. 2. Diagrams showing the structure of two of the sex hormones and two of the cancer-producing hydrocarbons. The small white circles represent hydrogen atoms, the smaller black circles represent carbon atoms, and the larger black circles represent atoms of oxygen.

obtain a very low temperature; Mercury is both the hottest and the coldest of the planets.

If a meteor should strike a surface near the absolute zero of temperature, and assuming the presence of compounds containing carbon, hydrogen, oxygen, etc., free radicals would be formed at the localized high temperature areas and would be frozen out and stabilized in the surrounding cold areas. If at some later period these cold areas become warm, the

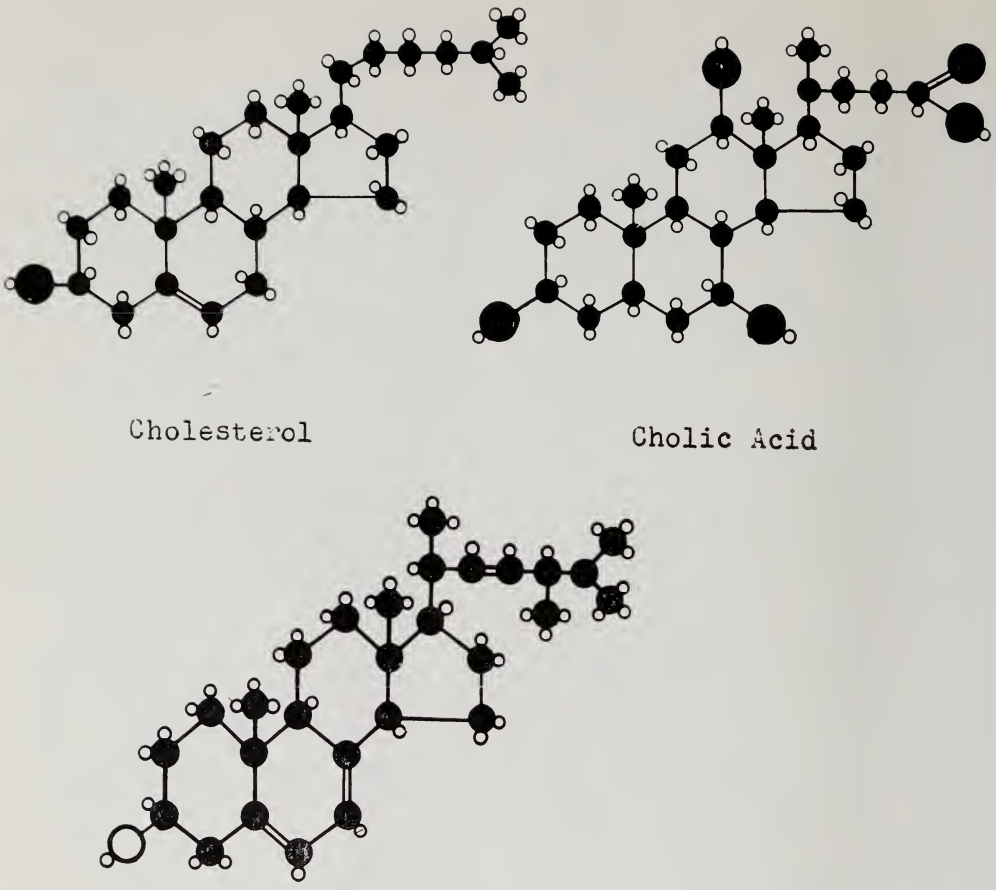


Fig. 3. Diagrams showing the structure of three compounds containing the sterol nucleus. The small white circles represent hydrogen atoms, the smaller black circles represent carbon atoms, and the larger black circles represent atoms of oxygen.

radicals would react to form small molecules followed by polymerization to form molecules of high molecular weight.

Experiments under Primitive Earth Conditions

Numerous experiments [8] (see Fig. 1) have been performed in the last few years in which a mixture of gases consisting of methane, ammonia, water, and hydrogen was subjected to the action of an electrical discharge; a great variety of amino acids were formed, some of which were specifically identified. Since the amino acids are the units out of which proteins are synthesized, these experiments give considerable support to the hypothesis that proteins themselves could have been formed prior to the appearance of living matter. In addition to the amino acids, there was evidence of the formation of some poly-hydroxy compounds which were not identified. Glycerine, which is an essential constituent of all fats, as well as the carbohydrates—the sugars and starches—are all polyhydroxy compounds. While no experiments have as yet been performed substantiating the hypothesis that

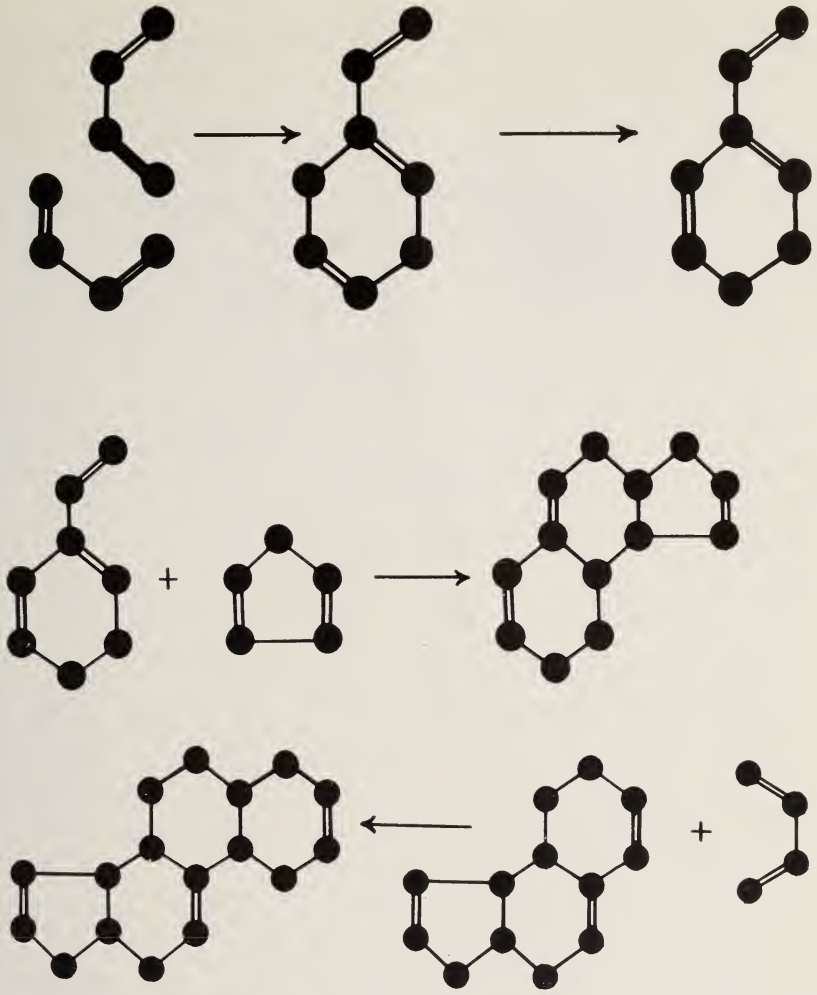


Fig. 4. The above sequence of reactions shows the condensation of 1,3-butadiene with vinyl acetylene. These reactions, together with hundreds of others, could occur in a heated tube. The second reaction is an isomerization which could occur on the walls of the tube. In the above diagram, only the carbon skeleton is shown, hydrogen atoms being omitted. The last structure is the sterol nucleus.

protein, fats, and carbohydrates actually were formed under non-living conditions, the difficult step has been accomplished, namely, of proving that the units that go to make up these complicated compounds can be produced under primitive planetary conditions; the condensation and polymerization of these units, especially in the presence of free radicals, would be expected to occur and would lead to a whole host of complicated organic compounds, including the known proteins, carbohydrates, and fats.

The Sterol Nucleus

There are several other classes of compounds, essential for living matter, the members of which do not appear to be formed under the conditions described in the foregoing section. As an example, we may mention the class of compounds containing the sterol nucleus (see Figs. 2 and

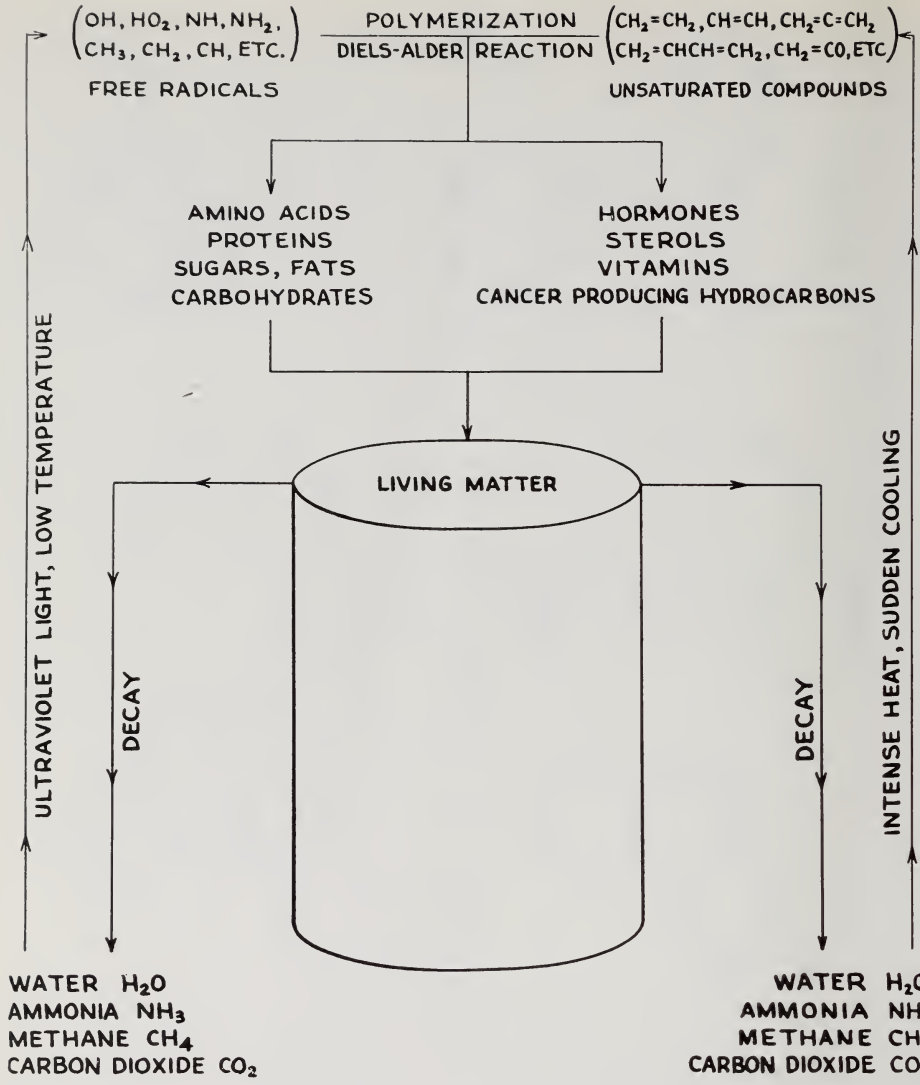
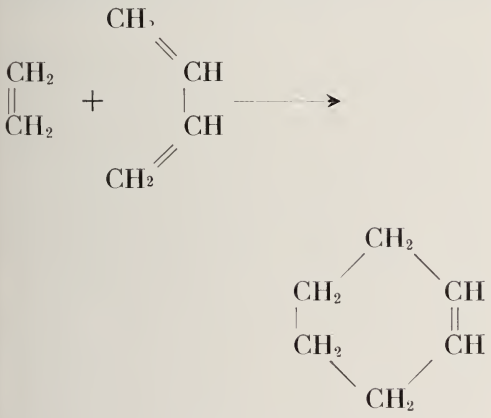


Fig. 5. Life cycle. Through the action of ultraviolet light, electric discharges, or intense heating, followed by sudden cooling, small stable molecules such as ammonia, methane, carbon dioxide, etc. are converted into free radicals and unsaturated molecules. Polymerization and the Diels-Alder reaction yield a huge variety of complicated organic compounds, among which are those present in living matter as we know it. The production of living matter is followed by decay and formation of the original small stable molecules.

3) which includes such substances as cholesterol, vitamin D, the sex hormones, and adrenal corticoids, as well as many of the drugs in common use, such as digitalis: in addition, some of the members of this class are highly pathogenic, most particularly the cancer-producing hydrocarbons. We will now consider the possible syntheses of these under primitive earth conditions.

In the proposed synthesis, I shall assume that an iron meteor, for example, penetrates the surface of a planet at some point where there are compounds containing carbon, hydrogen, oxygen, etc., and where the temperature is near the absolute

zero. In such a situation there would be formed essentially a very hot tube in which gases would be generated at high pressures. If the localized temperature were sufficiently high, perhaps at the inner end of the tube, all the molecules that are stable at ambient temperatures would be broken down to free radicals, or even to atoms; as these passed through the tube approaching the cooler open end, compounds such as acetylene, cyclopentadiene, ethylene, ketene, and butadiene, would be formed from the radicals.[9] It is under such conditions that the Diels-Alder [10] reaction might occur, the simplest example being the condensation of ethylene and butadiene to give cyclohexene:



All these substances are ordinary molecules, and it is not necessary therefore to have extreme cold at the outlet end of the tube, since they are stable at ambient temperatures.

The sequence of reactions in Fig. 4, which is only one out of many hundreds that would be occurring simultaneously, shows how the sterol nucleus could be formed under primitive conditions in the absence of living matter. It seems entirely possible that meteoric collisions [11] might give rise to conditions leading to the synthesis of the sterol nucleus and related structures; moreover, it even seems likely that on cooling to ambient temperatures, conditions may arise leading to the oxidation, reduction, hydration, and so forth of such nuclei with the formation of the physiologically active compounds that we know.

Conclusion

In Fig. 5 a diagrammatic sketch is given of what may be the life cycle. Through the agency of light, heat, or electricity, free radicals and small unsaturated molecules are formed from the stable molecules, water, ammonia, methane, and carbon dioxide. Polymerization and the Diels-Alder reaction would lead to the formation of thousands of complicated organic compounds, many of which are essential to living matter as we know it. Living matter appears to be but one stage in a cycle that begins and ends with small stable molecules. If the foregoing speculation is correct, Nature with her usual prodigality has adopted a method of synthesis which produces thousands and thousands of unused compounds along with the few which are physiologically active and essential to life.

It may be too that on other planets, the development from dead to living matter, even if it is based on carbon compounds, has not proceeded through the compounds —proteins, fats, carbohydrates, enzymes, hormones—that we know on this earth. We may perhaps speculate further that even on this earth, a whole host of primitive microscopic forms of life originally developed from the huge variety of complicated organic compounds available; but as Darwin postulated in his "Survival of the Fittest" theory, only those forms survived and developed that found physical conditions conducive to their well being, and these prove to have been those based on the physiologically active compounds with which we are familiar.

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Academy Honors Forty-four Students

On April 4 at a dinner at Georgetown University, the Washington Academy of Sciences honored 44 high school seniors of the Washington metropolitan area for their attainments in science. These students had been selected by the Academy's Committee for the Encouragement of Science Talent, consisting of Abner Brenner as chairman, Roy J. Barker, John K. Taylor, and Alfred Weissler. The Committee took into consideration their performance in the Westinghouse Science Talent Search, officership in the Washington Junior Academy of Sciences or participation in its annual convention, participation in the NSF summer science training program, etc.

Sponsored by Father Francis Heyden, who is director of the University's Observatory, the dinner was held in the Faculty Lounge of the New South Building, which commands a view of both sides of the Potomac River. Bernice Lamberton arranged flowers for the dining room, and had place cards for the head table painted in an art class.

A buffet dinner, featuring unlimited beef Stroganoff and rice, was served to all. Each member of the senior academy paid $1.50 for his dinner; the juniors were guests of the senior academy. The senior scientists present seated themselves among the juniors at the several tables. B. D. Van Evera, president of the Washington Academy of Sciences, presided. Chester H. Page, former editor of this *Journal* and now chief of the Division of Electricity, National Bureau of Standards, spoke on "Mathematics: A Useful Game." He explained how understanding of natural science may be advanced by forms of mathematics not intended by their creators to have utility. This may happen when similarity is found between mathematical rules and those that govern natural phenomena.

Following Dr. Page's talk, the awards were presented to the students by Dr. Van Evera, assisted by Dr. Brenner. Each student was called to the head table and was handed a certificate of merit and one or more books that he or she had selected from a list of about 50 titles. About a third of the students chose "The Handbook of Chemistry and Physics." The other books covered a wide range of scientific fields. This was the first time that scientific books had been added to the certificates of merit.

Science in Washington

SCIENTISTS IN THE NEWS

Contributions to this column may be addressed to Harold T. Cook, Associate Editor, c/o U.S. Department of Agriculture, Agricultural Marketing Service, Room 2628 South Building, Washington 25, D.C.

COAST AND GEODETIC SURVEY

E. B. Roberts retired from active duty with the Coast and Geodetic Survey on March 31, after nearly 41 years of duty in the United States, Alaska, and the Philippine Islands. Captain Roberts was responsible for the accomplishment of geodetic surveys through extensive unexplored regions in the Philippines and of hydrographic investigation in Alaska during World War II. As chief of the Division of Geophysics in recent years, Captain Roberts organized the seismic sea wave warning system that now protects the lives of coastal dwellers in the Hawaiian Islands. As United States representative and member of the National Committee for the IGY, he attended more than a dozen international scientific congresses in many parts of the world. During his final duty as assistant director for research and development, he organized a new Office of Research and Development within the Coast and Geodetic Survey. He has published more than 75 papers and articles and one professional book. His inventions include a deep-sea tide gage, and a radio current meter which has had wide use in America and abroad.

GEOLOGICAL SURVEY

Marjorie Hooker and **Dorothy Carroll** served on the local committee for arrangements for the Third General Meeting of the International Mineralogical Association, held in Washington April 17-20.

Dorothy Carroll acted as representative of the Geological Society of Washington to the Senior Division Science Fair of Montgomery County for the purpose of recommending award certificates of commendation to meritorious projects in the earth sciences.

S. Kenneth Love served as chairman of a symposium on "Chemistry of Water Supplies," held on March 28 by the Division of Water and Waste Chemistry, during the 141st National Meeting of the American Chemical Society in Washington, D. C.

Alfred M. Pommer transferred on April 1 to the Laboratory of Experimental Nutrition, Division of Human Nutrition Research, at the Agricultural Research Center, Beltsville, Md.

NATIONAL BUREAU OF STANDARDS

Recent talks presented by Academy members of the Bureau have included the following:

F. L. Alt: "The Mathematical Theory of Management Problems," IBM Systems Research Institute, New York, March 28, and "Machine Translation of Natural Languages—A Survey," IBM Watson Laboratory, Columbia University, March 29; "Management of a Mathematical Research and Service Facility and Digital Pattern Recognition by Use of Moments," Nova Scotia Technical College, Nova Scotia, Canada, March 15: "Digital Pattern Recognition," Stevens Institute of Technology, Mathematics Department and Computer Center, Hoboken, N. J.

R. G. Bates: "Medium Effects and pH Scales," Societe Chimique de France, Universite de Poitiers, and "Problems Electrochimiques de la Determination du pH," Societe de Chimie Physique, Paris.

L. M. Branscomb: "The Structure and Spectra of Atomic Negative Ions," New York University, Department of Physics, March 13.

The following talks were presented before the International Association of

Dental Research, meeting at St. Louis: **G. M. Brauer:** "Studies to Reduce the Solubility of Zinc Oxide-o-Ethoxybenzoic Acid Eugenol Cements." **H. J. Caul:** "X-ray Spectroscopic Analysis of Noble Metal Alloys." **G. Dickson:** "Automatic Recording Thermal Expansion Apparatus." **W. T. Sweeney:** "The Strength of Dental Amalgam."

C. Eisenhart: "On the Measurement of Precision and Accuracy," Philadelphia Section, American Society for Quality Control.

H. P. R. Frederikse: "Electronic Behavior of TiO_2 (Rutile)," Netherlands Physical Society, Utrecht.

D. R. Lide, Jr.: "Microwave Spectroscopic Studies of Some Butadiene Derivatives," Chemistry Department Colloquium, Pennsylvania State University, University Park, Pa.

R. S. Marvin: "The Molecular Theories of Viscoelastic Behavior of Rubberlike Polymers," Japan Chemistry Society, Kyoto.

A. G. McNish: "Absolute and Relative Measurements," Institute of Radio Engineers, New York, and "The Basis of Confidence in Measurement Accuracy," Rochester Society for Quality Control, Rochester, N. Y.

C. H. Page: "Exactly One Volt, Exactly One Ampere, Exactly One Ohm," Virginia Section of the Institute of Radio Engineers, Norfolk Naval Shipyard, Portsmouth, Va.

R. J. Rubin: "Statistical Dynamics of Lattices and Brownian Motion," Department of Chemistry, Massachusetts Institute of Technology, Cambridge, Mass., April 3; and "Machine Calculation of Phonon Decay in a Disordered Lattice," Graduate School of Science, Yeshiva University, New York.

W. J. Youden: "Systematic Errors in Physical Constants." "A Study of Ranking Scores." "Statistical Methods in Biological and Chemical Experimentation." and "The Sample, The Procedure, The Laboratory," Commonwealth Scientific and Industrial Research Organization of Australia; "Systematic Errors in Physical Constants" and "Teaching of Statistics in the University," University of New South Wales; "Sophisticated Chemistry," Statistical Society of New South Wales and Royal Australian Chemical Institute; "Has Quality Control Failed?", National Standards Laboratory, Sydney, Australia.

A. T. McPherson has been detailed to the Office of Technical Services of the Business and Defense Services Administration, Department of Commerce, to develop a new program of inter-American cooperation on standards. He will work with a recently-organized Pan American Standards Committee to set up a framework of standards governing quality, varieties, and testing methods for raw materials and manufactured goods that enter into inter-American commerce.

Leo Wall has been named chief of the Polymer Chemistry Section. The following have been named consultants in the Polymer Division for each of the five major types of polymeric materials: **L. A. Wood,** rubber; **H. F. Schiefer,** textiles; **R. H. Hobbs,** paper; **J. R. Kanagy,** leather; and **S. G. Weissberg,** plastics.

Edward Wichers, one of the world's outstanding authorities on analytical chemistry, retired from NBS at the end of March. Dr. Wichers had been an associate director for the last 4 of his 44 years at the Bureau. During his career at the Bureau, he centered his interest on platinum metals, rare earth elements, reagent chemicals, and pure substances.

Herbert F. Schiefer received an honorary doctor of science degree from North Carolina State College, Raleigh, on March 7. In 1951 he served for a year as director of research of the School of Textiles at the College.

Benjamin L. Page, an internationally recognized metrologist, has retired as chief of the Length Section, after 43 years at the Bureau. Mr. Page has made some of the most precise length measurements of

line standards in the world. He has been in charge of the laboratory that has custody of a platinum-iridium meter bar known as Prototype Meter No. 27, which was the national standard of length for 70 years, and was responsible for comparing it with the various secondary line standards of length and long gage blocks which are measured in terms of the wavelength of light.

Thomas G. Digges, authority on the heat treatment and properties of steels, has retired as assistant chief of the Metallurgy Division and chief of the Thermal Metallurgy Section. During his 41 years at NBS, Mr. Digges directed and performed research in physical metallurgy on problems related to the flow, fracture, and ductility of metals and alloys; the influence of temperature on their properties, and their transformations when heated and cooled. He also established procedures for evaluating the machinability of steels, and studied experimental high speed steels.

Arnold H. Scott, physicist, has been awarded the Silver Medal for Meritorious Service by the Department of Commerce. Dr. Scott was cited for his many years of dedicated service to the standards mission of the Bureau, in the field of precision measurements of the dielectric properties of matter.

Jerome Kruger has been awarded the Silver Medal for Meritorious Service by the Department of Commerce. Dr. Kruger was cited for exceptional achievement in surface metallurgy, especially for his investigations on the kinetics of film formation and passivity in corrosion reactions.

NAVAL RESEARCH LABORATORY

James H. Shulman, head of the Dielectrics Branch of the Solid State Division, has returned to NRL after a year of duty as deputy scientific director of the Office of Naval Research, London. During Dr. Shulman's tour in London, he visited a large number of the laboratories in western Europe, and was a regular contributor to the ONR London periodic publication on science in Europe.

Herbert Friedman, superintendent of the Atmosphere and Astrophysics Division, early this year was elected to fellowship in the American Astronautical Society.

Richard Tousey, head of the Rocket Spectroscopy Branch, has been elected a member of the International Academy of Astronautics and the International Astronautical Federation. Dr. Tousey is also a member of a national research committee on line spectra of the elements; in this capacity he recently presented an invited talk on "New Solar Lines in the Rocket Ultraviolet" at the National Bureau of Standards.

Allen L. Alexander, head of the Organic and Biochemistry Branch, served as general chairman of the 141st meeting of the American Chemical Society, held in Washington March 20-29.

Joseph N. Krafft, of the Mechanics Division, Naval Research Laboratory, has been selected to receive the 4th Burgess Prize Award of the Washington Chapter, American Society for Metals, "in recognition of his outstanding contributions to the understanding of the effects of high strain-rates and metallurgical factors on the plasticity and fracture of metals." The award will be presented to Dr. Krafft at the Chapter's "National Officers Night" on May 14.

USDA, BELTSVILLE

Myron S. Anderson, before his retirement a USDA staff member, was recently asked by various producers and marketers of peat to call the group together for an all-day discussion of problems confronting the industry. An organization, "Peat Producers of the United States," was formed in Pittsburgh on March 2, with C. T. Cummings of Charleston, S. C., as secretary-treasurer.

Mildred A. Doss, formerly senior research scientist, Beltsville Parasite Laboratory, Agricultural Research Service, and presently a staff member of the Department of Zoology, University of Maryland, last October received the Anniversary Award of the Helminthological Society of Washing-

ton. (See Proceedings of the Helminthological Society of Washington, v. 29 (1), January 1962, pp. 92-94.)

C. H. Hoffmann presented a paper entitled, "Overall Objectives of USDA Entomology Research Division Laboratories in the North-Central States," at a meeting of the North Central Branch, Entomological Society of America, held at Minneapolis on March 22.

USDA, WASHINGTON

Justus C. Ward gave a talk on the Federal Insecticide, Fungicide, and Rodenticide Act and vertebrate pest control at the First Vertebrate Pest Control Conference, held at Sacramento, Calif., on February 7.

UNCLASSIFIED

F. N. Frenkiel, a member of the staff of the David Taylor Model Basin, has been elected chairman of the Division of Fluid Dynamics, American Physical Society.

Alfred Weissler presented papers at three national scientific meetings in February and March: one, on enzyme kinetics recording apparatus, before the Biophysical Society; another, on fluorescent products of ultrasonic hydroxylation of aromatic acids, before the American Chemical Society; and a third, on the measurement of cavitation in an ultrasonic cleaner, before the Institute of Radio Engineers.

JOURNAL STAFF NEWS

The Journal staff has shown a recent predilection for overseas travel. Dr. Campbell left town in mid-April for a vacation trip to Nassau. Mr. Detwiler expected to leave in early May for a five-week trip to India, to negotiate grants for agricultural utilization research under U. S. Public Law 480, 83rd Congress. And Dr. Specht is planning to visit Japan in September for about six weeks, in connection with a medical research grants program of the National Institutes of Health. Dr. Specht expects to return to Japan in early 1963, for a two-year tour of duty.

DEATHS

Oscar S. Adams, mathematician for 34 years in the Coast and Geodetic Survey, died March 4, at the age of 88. He had been retired since 1944. Dr. Adams made numerous contributions to map projections and geodesy. Born in Mt. Vernon, Ohio, he graduated from Kenyon College in 1896, and received the M.S. and Ph.D. degrees from the same institution.

THE BROWNSTONE TOWER

What should be done for foreign students who want to take advanced degrees in science in the United States? It would be good for our international relations if we could welcome and support all applicants until each had received a certificate of training in his chosen subject and had gone home to put his training to academic or industrial use. Actually the number we can support is limited, and we must somehow select foreign applicants on the basis of their probable ability to meet the same requirements for advanced degrees that govern our native students. The process of selection is very difficult, for how can one compare the graduates of foreign educational systems with each other and with graduates of our own universities?

Recently a member of the National Research Council who is the chairman of a department in one of our state universities pointed out the problem as follows:

"Small departments such as ours get dozens of letters every year from [students in foreign countries] asking to be considered for assistantships or other appointments. We wouldn't mind taking perhaps *one* student a year if we knew he was a reasonably good risk. But it takes too much time to go over all these applications, which are so difficult to evaluate.

"As a result I fear that many departments that could do a little more than they do now towards helping *deserving* and *qualified* foreign students get an education here simply by-pass the whole thing

and. unless there is a local man to vouch for the applicant, tell him '*no dice*'.

"There is a public relations and important good-will problem here. I realize it is complex, but perhaps some Washington agency has already considered it."

It seems to me that a central screening agency, suggested by our correspondent, is needed to handle applications in a fair and diplomatic manner so that every applicant would be assured of careful consideration under rules that should be made known to him. Applications regarded as worthy of consideration by our universities might be sent to those named by the applicants or to those deemed appropriate by the screeners. Others might be regretfully returned to the applicants with request for additional information or with other appropriate and helpful comments. If a chosen institution should decide to accept an applicant, it should carefully explain to him the conditions of acceptance; if it decided to reject him, it should give an adequate explanation and encourage him to try again, if hope might be extended.

How could a central screening agency make reasonable comparisons of applicants from different countries? I think the screening group would have to assemble and evaluate information on the applications and performance of foreign students who have already been accepted in U. S. graduate schools. Slowly, the screeners would learn how to correlate applications and expected performance. Competency in English might prove to be an important factor that can be properly weighted by study of past performances with respect to English capability. One cannot help wondering how the writer of the following letter could take a Ph.D. at a large American university. The names, of course, are fictitious.

Dear Sir:

I am a graduate student working toward Ph.D. degree from Utopia. I have been asked to investigate the possibility of getting the grant in order to proceed the botanical research in Utopia from Professor Nemo.

Professor Nemo has been doing the research on the taxonomy of vascular plants in Utopia. At this time of the century the fauna and flora of Utopia should be known to us much better than what we know now. There have been urgent demands to establish Utopian biota as soon as possible.

At the present time Professor Nemo is short in research fund and in fact no fund at all. This is my reason why I am asking you a help.

I would greatly appreciate having an information concerning the r e s e a r c h grant for foreigner which you may have. If you do not handle any foreign matter, please inform me where I may contact or write to.

Sincerely yours,

Dr. Francis A. Young, executive secretary of the Committee on International Exchange of Persons, says that the problem posed above is real and important. It has been recognized, he says, by the Department of State and something may be done about it, perhaps first for students from Africa.

—*Frank L. Campbell*

AFFILIATED SOCIETIES

Acoustical Society of America

The Section met on April 16 at NBS to hear R. W. Hart of Johns Hopkins University on "Acoustic Instability in Solid Propellant Rockets" (or, "Giant Organ Pipes in the Sky"). At this meeting the nominating committee presented a slate of nominees for the 1962-1963 year. An informal dinner was held at the Cafe Burgundy preceding the meeting.

American Institute of Electrical Engineers

On April 4 the Technical Group on Nuclear Science sponsored a joint meeting with IRE on "Problems and Nuclear In-

strumentation Associated with Satellite Laboratories." The speaker was George Ludwig of the Instrumentation Section, Fields and Particles Branch, Goddard Space Laboratory. A dinner at Hammel's preceded the meeting, in honor of the speaker. The meeting was held in PEPCO Auditorium.

The Section members met on April 10 in PEPCO Auditorium to hear W. E. Jacobsen and R. L. Koch of the General Electric Company, Schenectady, speak on "Diesel-Electric Propulsion for Polaris Submarine Tender." A dinner honoring the speakers was held at O'Donnell's Restaurant preceding the meeting.

American Meteorological Society

The members met in the National Academy of Sciences to hear Harry Wexler, director of the Office of Meteorological Research, U. S. Weather Bureau, speak on "The World Weather Watch." Dr. Wexler explained how new observing techniques permit an overall view of the global weather pattern. A discussion was held on the future role of such worldwide systems. Refreshments were served after the meeting.

The joint AMS-AGU banquet was held on April 27 at the National Press Club. Roger R. Revelle, science advisor to the Secretary of the Interior, was the principal speaker, his subject being "The Earth as a Space Ship."

The Weather Bureau's National Meteorological Center, Meteorological Satellite Activities, and Office of Climatology at Suitland held "open house" on April 26 in conjunction with the AMS-AGU Spring Meeting.

American Society of Civil Engineers

On April 16 the members met in Mackenzie Hall, Fort Belvoir, Va., for a dinner meeting, with the Army Engineer Research and Development Laboratories as host. The program theme concerned research and development projects of the Corps of Engineers, with four presentations: "LASER—Breakthrough in Light Source," by Stanley M. Segal; "MAB—New U. S. Army Mobile Assault Bridge," by F. J. Tamanini; "Mass Spectrometer and its Uses," by Don Easter; and "Universal Engineer Tractor—Ten Men in a Bowl," by Lt. James E. Komer.

American Society of Mechanical Engineers

The Section met on April 12 for a symposium on supercavitating flows. The speakers were: Marshall P. Tulin, vice-president of Hydronautics, Inc., on "Supercavitating Flows in Cascades"; Elias Venning, Jr., LCDR, USN, design project coordinator for the Bureau of Ships, on "Supercavitating Propellers"; and Melvin J. Hartmann, head of the Pump Section, NASA Lewis Research Center, on "Supercavitating Inducers". A pre-meeting dinner was held at the Cy Ellis Restaurant. The meeting itself was held in PEPCO Auditorium.

The 34th Annual Conference and Exhibit of the Oil and Gas Power Division was held April 15-19 at the Shoreham Hotel. The theme was "Engine Design for Progress." A banquet was held on April 17 in the Terrace Banquet Room, the principal address being "Soviet Imperialism Versus Free World Unity—A Time for Great Decision," by Oliver C. Schroeder, director of law at the Medicine Center, Western Reserve University, Cleveland. A river cruise aboard the DIPLOMAT was held on April 16, followed by a dinner at the Flagship Restaurant.

The Section met on April 26 in PEPCO Auditorium to hear George H. Nolte speak on "Pratt & Whitney J-75 Applied to a 500-ton Hydrofoil." Mr. Nolte is military requirements engineer of Pratt & Whitney Aircraft Division, United Aircraft Corporation. Mr. Nolte discussed the development of marine gas turbine engines, utilizing existing Pratt & Whitney lightweight, high performance, aircraft gas generators and free turbines embodying aircraft design principles. The talk also included a discussion of the development of a 30,000 horsepower engine for the Bureau of Ships as part of the Hydrofoil Advanced Re-

search Project. The Pratt & Whitney J-75 jet engine will comprise the gas generator section of this engine. A pre-meeting dinner was held at the Cy Ellis Restaurant.

Geological Society of Washington

The members met in John Wesley Powell Auditorium on April 25. The program consisted of the following speakers: W. Wimmenauer, Geologisches Landesamt, Freiburg, Germany, on "Alkalic Rocks and Carbonatites of the Kaiserstuhl"; Stuart O. Agrell, Cambridge University, England, on "Metamorphic Studies at Volcanic Pipes"; and James Gilluly, USGS on "The Roberts Thrust in Central Nevada."

Insecticide Society of Washington

The members met on March 21 at the University of Maryland to hear William H. Anderson, USDA, on "Biological Control of Weeds by Insects," and L. L. Danielson, also of USDA, on "Recent Advances in Weed Control Theory and Practice."

Institute of Radio Engineers

The local section held a general meeting on April 10. Leslie W. Ball of the Boeing Company spoke on the "Impact of Reliability on the Engineering Profession." The meeting was held in the Auditorium of the Museum of Natural History. A pre-meeting dinner was held at O'Donnell's Restaurant, in honor of the speaker.

On April 2, Kenneth D. Smith of the Bell Telephone Laboratories spoke on "Solar Cell Development and Applications." This meeting was held in the auditorium of the Museum of Natural History; a dinner at the Neptune Room preceded the meeting.

On April 4, George Ludwig, head of the Instrumentation Section, Fields and Particles Branch, Goddard Space Laboratory, spoke on "Problems and Nuclear Instrumentation Associated with Satellite Laboratories." This meeting was held in PEPCO Auditorium; a dinner at Hammel's preceded the meeting.

On April 12, Yaohan Chu of Melpar spoke on "Radar-Guided Automobiles." This meeting was held in the Materials Testing Laboratory, NBS. Cocktails and dinner at Yegher's Cosmopolitan Restaurant preceded the meeting.

On April 17, Conway A. Bolt, Jr., of the Westinghouse Air Arm Division, gave a talk on "Survey and Analysis of Mapping Antenna Characteristics" at the Materials Testing Laboratory, NBS. Cocktails and dinner at Yenching Palace preceded the meeting.

Philosophical Society of Washington

The 1524th meeting of the Society was held in John Wesley Powell Auditorium on April 13. Everett Fuller of NBS spoke on "The Polarizability of the Atomic Nucleus." In his talk he pointed out that, on the basis of classical definitions, relationships can be given between polarizability and the photon absorption and scattering cross sections for a charged system. He then used these expressions to define a static polarizability for the nucleus, and compared, for a series of nuclei, the static polarizability given by a simple nuclear model with that obtained from measurements of the photo-nuclear absorption cross section. He introduced the concept of a tensor polarizability, and discussed the experimental evidence for an optical anisotropy in nuclear matter.

CALENDAR OF EVENTS

May 8—American Institute of Electrical Engineers

Topic, "Magnetohydrodynamics." Speaker to be announced. PEPCO Auditorium, 8:00 p.m.

May 10—American Society of Mechanical Engineers, Fuels Division

N. W. Eft, "Coal Slurry—Its Transportation and Combustion." PEPCO Auditorium, 8:00 p.m.

May 16—Insecticide Society of Washington

200th meeting of the Society. Program to be announced. Symons Hall, University of Maryland, 8:00 p.m.

June 12-16—Helminthological Society of Washington

Joint meeting with the American Society of Parasitology. Program to be announced later. Mayflower Hotel.

JOINT BOARD ON SCIENCE EDUCATION

The National Science Foundation has announced that it has granted $18,600 to the Washington Academy of Sciences for the conduct of science education activities in the Washington area during 1962-63. This is the fourth year in which an NSF grant has been made to the Academy. As with previous grants, administration of this grant will be delegated to the Joint Board on Science Education.

The grant is subdivided into three major activities. The largest, amounting to $10,550, is concerned with sponsorship of ten conferences for educators and scientists on various aspects of science education. Similar conferences held during the past three years, attended by an aggregate of 2500 persons, have had a significant effect in encouraging and nurturing high quality in science teaching at local schools.

The second part of the grant provides $5,550 for conduct of a visiting scientists and engineers program. The objectives of this program are to maintain the current register of scientists and engineers willing to assist in educational activities; to prepare and distribute a brochure listing lecture-demonstrations and other services of visiting scientists and engineers; and to maintain facilities so that school requests for such services may be appropriately channeled and activated.

The smallest part of the grant, dollarwise, provides $2,500 to support publication of *The Reporter*, which is sent to all science and mathematics teachers in the Washington metropolitan area. This newsletter, now completing its fourth year of publication with a circulation of 2600, has become a vital line of communication between educators and scientists of the area.

The grant to the Academy is one of 55 made by NSF to 38 state academies of science and comparable institutions, totaling $609,945. The academy program has been in existence since 1959, and the Washington Academy of Sciences has been a recipient each year since that time. Grants for 1959-60 and 1960-61 amounted to $35,250 and $34,990 respectively; the past year's grant was for $26,775. The smaller grant for the coming year results from the Academy's decision not to sponsor experimental courses, a feature of the earlier programs.

The program will continue under the supervision of John K. Taylor, who serves as director of science education projects for the Joint Board and the Academy. He will be assisted by an advisory committee, of which Francis J. Heyden, S.J., director of the Georgetown College Observatory, is chairman.

SCIENCE AND DEVELOPMENT

The Food and Drug Administration is measuring the strontium-90 content of an average 19-year-old boy in the Washington, D. C. area by a series of "market-basket" samplings. Samplings are being made quarterly. It is probable that results of these tests will not show up until the May 1962 sampling. Results from samplings in May, August, and November 1961 show that the strontium-90 intake during that period was only 6 percent of the average daily intake considered acceptable for a lifetime, and that about half of the strontium-90 content will be discarded with the garbage when foods are prepared for the table. In this survey, the foods are purchased from large chain stores in the D. C. area. Foods selected are those recommended in the Department of Agriculture "moderate income plan" as nutritionally adequate for this age group. A 19-year-old boy eats more than people in any other age group, consuming on the average about 55 pounds of food and drink per week.

Delegates to the Washington Academy of Sciences, Representing the Local Affiliated Societies*

Philosophical Society of Washington	Lawson M. McKenzie
Anthropological Society of Washington	Regina Flannery Herzfeld
Biological Society of Washington	Herbert Friedmann
Chemical Society of Washington	Alfred E. Brown
Entomological Society of Washington	William E. Bickley
National Geographic Society	Alexander Wetmore
Geological Society of Washington	Margaret D. Foster
Medical Society of the District of Columbia	Frederick O. Coe
Columbia Historical Society	U. S. Grant, III
Botanical Society of Washington	Harold T. Cook
Society of American Foresters	Harry A. Fowells
Washington Society of Engineers	Howard S. Rappleye
American Institute of Electrical Engineers	William A. Geyger
American Society of Mechanical Engineers	William G. Allen
Helminthological Society of Washington	Doys A. Shorb
American Society for Microbiology	Mary Louise Robbins
Society of American Military Engineers	Delegate not appointed
Institute of Radio Engineers	Robert D. Huntoon
American Society of Civil Engineers	Joseph M. Caldwell
Society for Experimental Biology and Medicine	Kathryn Knowlton
American Society for Metals	John A. Bennett
International Association for Dental Research	Gerhard Brauer
Institute of the Aerospace Sciences	Francois N. Frenkiel
American Meteorological Society	Jack Thompson
Insecticide Society of Washington	Milton S. Schechter
Acoustical Society of America	Richard K. Cook
American Nuclear Society	George L. Weil
Institute of Food Technologists	Richard P. Farrow

*Delegates continue in office until new selections are made by the respective affiliated societies.

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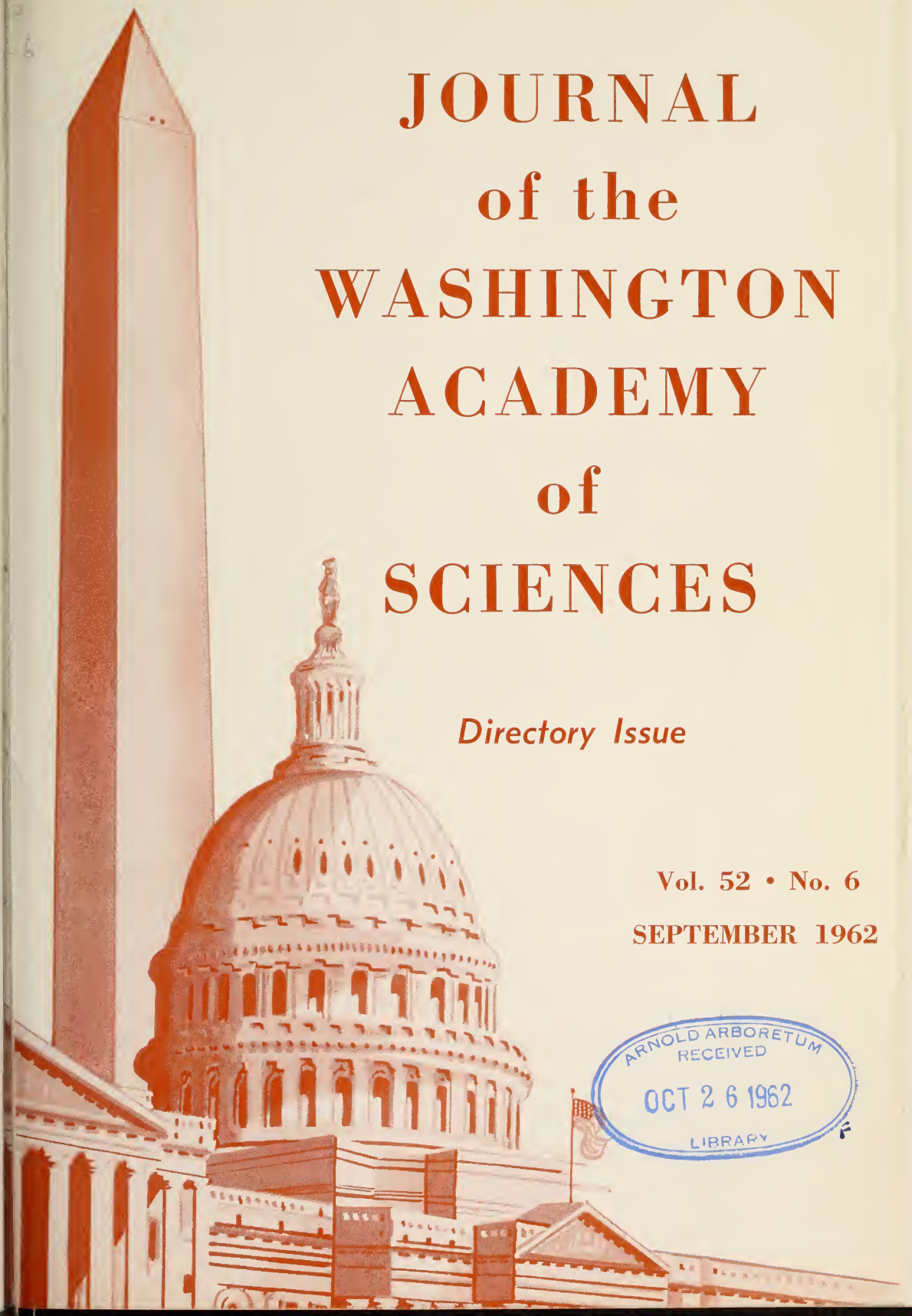

Directory Issue

Vol. 52 • No. 6

SEPTEMBER 1962

JOURNAL OF THE WASHINGTON ACADEMY OF SCIENCES

Editor: Samuel B. Detwiler, Jr., Department of Agriculture

This Journal, the official organ of the Washington Academy of Sciences, publishes historical articles, critical reviews, and scholarly scientific articles; notices of meetings and abstract proceedings of meetings of the Academy and its affiliated societies; and 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.

Subscription rate: $7.50 per year (U.S.), $1.00 per copy. Foreign postage extra.

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".

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Advertising rates may be obtained from the Editor, care of Academy Office.

Second class postage paid at Washington, D. C.

Washington Academy of Sciences

Directory, 1962

Foreword

The last previous editions of the Academy's directory, in various degrees of elaborateness, appeared in 1947-8, 1953, 1956, and 1959. In the 1956 directory, for the first time, members were listed not only alphabetically but also by place of employment; the latter classification was accomplished by use of a semi-mnemonic code and mechanical punch cards.

In discussions over the past three years, it has been the sense of the Academy's Board of Managers that directories rapidly become out-of-date, and one that is more than a year old serves no very useful purpose; that if a directory is published annually, its cost must be within the Academy's means; and that the Academy should look forward to regular publication of a joint directory that would include the membership of affiliated societies as well as of the Academy itself.

The present, 37th, directory is the result of these discussions. It is, we hope, the first of an annual series that can be brought up to date each year at minimum cost to the Academy, and with minimum expenditure of effort by an already-overburdened volunteer staff. The classification of members by place of employment has been retained, at least as concerns resident, active members; and a new classification, by membership in affiliated societies, has been introduced for resident, active members of the Academy. Addresses of members have been eliminated, since keeping them up to date would add inordinately to the cost of the directory in future years; however, it is felt that between the classified listing and the Washington telephone book, little difficulty should be involved in getting in touch with local members. Finally, the directory has been issued as a regular number of the *Journal*, rather than as a separate publication.

As a first step toward a joint directory of the Academy and its affiliated societies, the punch cards for the present directory have been designed to be consonant with those used by the Chemical Society of Washington in the preparation of its annual directory. It is entirely feasible to consider that, in subsequent years, the punch cards of the two groups could be integrated at little or no additional expense, for the publication of a joint directory of the two groups. The later inclusion of other affiliated societies in such an operation likewise should offer few difficulties.

In the present directory, because of time limitations, codes have not been assigned to nonresident members, nor to emeritus members whether resident or nonresident. Consideration will be given to their inclusion in subsequent issues of the directory.

Assignment of codes for place of employment and membership in affiliated societies is based upon results of a postcard questionnaire sent to active, resident members. Where members did not answer the questionnaire, the coding was made on the basis of other available information. Corrections should be called to the attention of the Academy office, at 1530 P St., N.W.

Besides the listing of members, this issue of the directory contains supplementary information on the Academy's organization and objectives, etc. It does not contain the Bylaws, which appeared in the January 1962 issue of the *Journal*.

Explanation of Listings

The alphabetical listing purports to include all members on the Academy rolls as of July 1, 1962, whether resident or nonresident, and whether active (dues-paying), emeritus (retired), or honorary. The first set of code symbols after the name is a cross-reference to place of employment, as shown in the first classified list. The second set of code symbols is a cross-reference to membership in affiliated societies (identified below), as shown in the second classified list. The third set of code symbols refers to status of membership in the Academy, as follows:

R = Resident (living within 25 miles of the White House)
N = Nonresident
A = Active (dues-paying)
E = Emeritus (retired, non-dues-paying)
H = Honorary

Those emeriti who choose to continue to pay dues have been listed as active members.

Affiliated Societies and Year of Affiliation

Code

B Philosophical Society of Washington (1898)
C Anthropological Society of Washington (1898)
D Biological Society of Washington (1898)
E Chemical Society of Washington (1898)
F Entomological Society of Washington (1898)
G National Geographic Society (1898)
H Geological Society of Washington (1898)
I Medical Society of the District of Columbia (1898)
J Columbia Historical Society (1899)
K Botanical Society of Washington (1902)
L Society of American Foresters, Washington Section (1904)
M Washington Society of Engineers (1907)
N American Institute of Electrical Engineers, Washington Section (1912)
O American Society of Mechanical Engineers, Washington Section (1923)
P Helminthological Society of Washington (1923)
Q American Society for Microbiology, Washington Branch (1923)
R Society of American Military Engineers, Washington Post (1927)
S Institute of Radio Engineers, Washington Section (1933)
T American Society of Civil Engineers, National Capital Section (1942)
U Society for Experimental Biology and Medicine, D. C. Section (1952)
V American Society for Metals, Washington Chapter (1953)
W International Association for Dental Research, Washington Section (1953)
X Institute of the Aerospace Sciences, Washington Section (1953)
Y American Meteorological Society, D. C. Branch (1954)
Z Insecticide Society of Washington (1959)
2 Acoustical Society of America, Washington Chapter (1959)
3 American Nuclear Society, Washington Section (1960)
4 Institute of Food Technologists, Washington Section (1961)

Organization, Objectives, and Activities

The Washington Academy of Sciences had its origin in the Philosophical Society of Washington. The latter, organized in 1871, was for a few years the only scientific society of Washington. As other more specialized local scientific societies were formed, need was felt for federation of all such societies under an academy of sciences. Therefore 14 local scientific leaders moved to establish the Washington Academy of Sciences, which was incorporated on February 18, 1898. In that year the first eight societies listed above became affiliated with the Academy. The Philosophical Society heads the list because of its key position in the establishment of the Academy; the other seven are listed in alphabetical order, and the remaining 20 in chronological order of affiliation. Some of these 28 societies are local, without other affiliation; most are local sections or branches of national societies; one, the National Geographic Society, became a popular national society,

whose present affiliation with the Academy is only of historical significance.

The primary purpose of the Academy is the promotion of science in various ways through cooperation among natural scientists and engineers of the Washington metropolitan area. Except during the summer, the Academy holds monthly meetings, stressing subjects of general scientific interest. It publishes a monthly journal, which is intended to facilitate and report the organized scientific activity of the Washington area. It may sponsor conferences or symposia and publish their proceedings, or it may publish suitable scientific monographs. In many ways, the Academy encourages excellence in scientific research and education, e.g., by sponsoring the Washington Junior Academy of Sciences; by sponsoring through the Joint Board on Science Education, experiments in and services to secondary scientific education in the public and private schools of the area; by making annual awards to promising high school students and to a few outstanding young professional scientists for their achievements in research or teaching; and by making small grants-in-aid for support of research. The Academy also may aid public understanding of important scientific developments through sponsored conferences and teacher training. It may make recommendations on public policy involving scientific matters.

The Academy acts as the federal head of its affiliated societies, each of which is represented on the Board of Managers by a delegate appointed by his society. Annual elections are by mail ballot.

The membership is composed principally of resident active members who by reason of scientific attainment are deemed eligible. Nominations for membership, endorsed by at least two members of the Academy, and changes in the status of members, are acted upon by the Board of Managers upon recommendation of the Committee on Membership.

As of December 31, 1961, the membership of the Academy was:

Resident Members: active, 830, emeritus, 68. Nonresident Members: active, 159, emeritus, 68, honorary 4. Total, 1129.

Organization for 1962

Officers

President	Benjamin D. Van Evera	George Washington University (FE 8-0250, X681; home CL 6-3298)
President-Elect	Heinz Specht	National Institutes of Health (496-5730; home WH 2-4159)
Secretary	George W. Irving, Jr.	Department of Agriculture (DU 8-5134; home OL 2-8564)
Treasurer	Malcolm C. Henderson	Catholic University (LA 9-6000 X313; home CO 5-1252)

Managers

Term through		
1962	William G. Brombacher	National Bureau of Standards (EM 2-4040 X7619; home OL 2-5031)
1962	Aurel G. Foster	Department of Agriculture, Beltsville (GR 4-4800 X387; home WA 7-4613)
1963	Alphonse F. Forziati	Diamond Ordnance Fuze Laboratories (EM 2-8000; home JU 8-9617)
1963	Leo Schubert	American University (WO 6-6800 X267; home OL 4-7565)
1964	Russell B. Stevens	George Washington University (FE 8-0250 X459; home EL 6-2232)
1964	Harold H. Shepard	Department of Agriculture (DU 8-3561; home OT 4-7050)

Standing Committee Chairmen

Executive Committee	Benjamin D. Van Evera	George Washington University (FE 8-0250 X681; home CL 6-3298)

(The Executive Committee consists of the president, president-elect, secretary, treasurer, and Alfred E. Brown and Russell B. Stevens for the Board of Managers.)

Meetings	Francois N. Frenkiel	David Taylor Model Basin (EM 5-2600 X292; home WO 6-2344)
Membership	Mary Louise Robbins	George Washington University (FE 3-9000 X510; home OL 2-5410)
Monographs	Dean B. Cowie	Dept. Terrestrial Magnetism, Carnegie Institution (WO 6-0863; home OL 2-7530)
Awards for Scientific Achievement	John S. Toll	University of Maryland (WA 7-3800; home OL 4-0404)
Grants-in-Aid for Research	Archibald T. McPherson	National Bureau of Standards (EM 2-4040 X7218; home WH 2-4065)
Policy and Planning	Wayne C. Hall	Naval Research Laboratory (JO 3-6600 X1864; home LO 7-3728)
Encouragement of Science Talent	Abner Brenner	National Bureau of Standards (EM 2-4040 X7266; home OL 4-4191)
Science Education	John K. Taylor	National Bureau of Standards (EM 2-4040 X7855; home WA 7-4659)

Delegates of Affiliated Societies

See inside rear cover.

The Journal

Editor	Samuel B. Detwiler, Jr.	Department of Agriculture (DU 8-6548; home JA 7-8775)
Associate Editors	Frank L. Campbell	National Academy of Sciences
	Harold T. Cook	Department of Agriculture
	Richard P. Farrow	National Canners Association
	Russell B. Stevens	George Washington University
	John K. Taylor	National Bureau of Standards
	Lawrence A. Wood	National Bureau of Standards

Past Presidents

1898	John R. Eastman	1926	George K. Burgess	1944	Clement L. Garner
1899-1910	Charles D. Walcott	1927	Alexander Wetmore	1945	John E. Graf
1911	Frank W. Clarke	1928	Robert B. Sosman	1946	Hugh L. Dryden
1912	Frederick V. Coville	1929	Ales Hrdlicka	1947	Waldo L. Schmitt
1913	Otto H. Tittmann	1930	William Bowie	1948	Frederick D. Rossini
1914	David White	1931	Nathan Cobb	1949	F. H. H. Roberts, Jr.
1915	Robert S. Woodward	1932	Leason H. Adams	1950	Francis B. Silsbee
1916	Leland O. Howard	1933	Robert F. Griggs	1951	Nathan R. Smith
1917	William H. Holmes	1934	Louis B. Tuckerman	1952	Walter Ramberg
1918	Lyman J. Briggs	1935	George W. McCoy	1953	Frank M. Setzler
1919	Frederick L. Ransome	1936	Oscar E. Meinzer	1954	Francis M. Defandorf
1920	Carl L. Alsberg	1937	Charles Thom	1955	Margaret Pittman
1921	Alfred H. Brooks	1938	Paul E. Howe	1956	Ralph E. Gibson
1922	William J. Humphreys	1939	Charles E. Chambliss	1957	William M. Rubey
1923	Thomas W. Vaughan	1940	Eugene C. Crittenden	1958	Archibald T. McPherson
1924	Arthur L. Day	1941	Austin H. Clark	1959	Frank L. Campbell
1925	Vernon Kellogg	1942	Harvey L. Curtis	1960	Lawrence A. Wood
		1943	Leland W. Parr	1961	Philip H. Abelson

Alphabetical List of Members

ABBOT, CHARLES G		RE
ABELSON, PHILIP H	3IGEL BEHQ3	RA
ACHTER, MEYER R	1DNRL V	RA
ADAMS, ELLIOT Q		NE
ADAMS, LEASON H		NE
AKERS, ROBERT P	1HNIH G	RA
ALDRICH, JOHN W	1IFWS D	RA
ALEXANDER, ALLEN L	1DNRL E	RA
ALEXANDER, LYLE T	1ARFR E	RA
ALEXANDER, SAMUEL N	1CNBS BNS	RA
ALLARD, H A		RE
ALLEN, HARRY C JR	1CNBS BE	RA
ALLEN, WILLIAM G	1CMAA O	RA
ALLISON, FRANKLIN E	1ARFR EGQ	RA
ALT, FRANZ L	1CNBS B	RA
ALTER, HARVEY	5HARE E	RA
AMES, LAWRENCE M	3INAS K	RA
AMIRIKIAN, ARSHAM	1DNBY RT	RA
ANASTOS, GEORGE	2HUMD P	RA
ANDERSON, EVELYN		NA
ANDERSON, MYRON S	7RETD E	RA
ANDERSON, WENDELL L	1DNRL E	RA
ANDERSON, WILLIAM H	1ARFR FZ	RA
ANDREWS, HOWARD L	1HPHS	RA
ANDREWS, JOHN S	1ARFR P	RA
ANDREWS, T G	2HUMD	RA
APPEL, WILLIAM D	3AATC E	RA
APPLEMAN, CHARLES O		RE
APSTEIN, MAURICE	1DAOF S	RA
ARMSTRONG, CHARLES		RE
ARMSTRONG, GEORGE T	1CNBS BEG	RA
ASLAKSON, CARL I	4CONS RT	RA
ASTIN, ALLEN V	1CNBS B	RA
ATTIX, FRANK H	1DNRL	RA
AXILROD, BENJAMIN M	1CNBS B	RA
BABERS, FRANK H		NA
BAILEY, WILLIAM J	2HUMD E	RA
BAKER, ARTHUR A	1IGES H	RA
BAMFORD, RONALD	2HUMD K	RA
BARBEAU, MARIUS		NA
BARBROW, LOUIS E	1CNBS BN	RA
BARKER, ROY J	1ARFR FZ	RA
BARNES, R PERCY	2HHOU E	RA
BARNHART, CLYDE S	1DAER F	RA
BARON, LOUIS S	1DAWR Q	RA
BARRETT, MORRIS K	1HNIH U	RA
BARRETT, MORRIS K MRS	1HNIH U	RA
BARSS, H P		NE
BASS, ARNOLD M	1CNBS	RA
BATEMAN, ALAN M		NE
BATES, P H		NE
BATES, ROGER G	1CNBS E	RA
BAUER, HUGO	1HNIH E	RA
BEACH, LOUIS A	1DNRL BG3	RA
BEAN, HOWARD S	4CONS O	RA
BEARCE, HENRY W		NE
BECKER, EDWIN D	1HNIH E	RA
BECKETT, CHARLES W	1CNBS E	RA
BEHREND, EDWIN H		RE
BEIJ, K HILDING		NE
BEKKEDAHL, NORMAN	1CNBS BEG	RA
BELKIN, MORRIS	1HNIH U	RA
BELOTE, EARL S		NA
BELSHEIM, ROBERT	1DNRL BGO	RA
BENDER, MAURICE	1HPHS E	RA
BENEDICT, WILLIAM S	2HJHU	RA
BENJAMIN, CHESTER R	1ARFR DK	RA
BENNETT, JOHN A	1CNBS V	RA
BENNETT, MARTIN T	4CONS	RA
BENNETT, WILLARD H		NA
BERKNER, L V		NA
BERL, WALTER G	3IAPL BE	RA
BERLINER, ROBERT W	1HNIH	RA
BERNHARD, SIDNEY A	1HNIH	RA
BERNTON, HARRY S	4PHYS I	RA
BIBERSTEIN, FRANK A JR	2HCUA	RA
BICKLEY, WILLIAM E	2HUMD FZ	RA
BIRCKNER, VICTOR		RE
BIRD, H R		NA
BIRKS, L S	1DNRL	RA
BISHOPP, F C		NE
BLACK, RICHARD B		NA
BLAIR, WILLIAM R		NE
BLAKE, DORIS H		RE
BLANC, MILTON L	1CWEB Y	RA
BLOOM, MORTIMER C	1DNRL BEV	RA
BLUM, WILLIAM		RE
BLUNT, ROBERT F	1CNBS	RA
BOGLE, ROBERT W		NA
BOHNERT, JOHN I	1DNRL	RA
BOLTON, ELLIS T	3ICIW	RA
BOND, HOWARD W	1HNIH E	RA
BONDELID, ROLLON O	1DNRL	RA
BORTHWICK, HARRY A	1ARFR DK	RA
BOSWELL, VICTOR R	1ARFR	RA
BOUTWELL, JOHN M		NA
BOWER, VINCENT E	1CNBS	RA
BOWLES, ROMALD E	5BOEN X	RA
BOWMAN, JOHN R		NA
BOWMAN, PAUL W	2HGWU DK	RA
BOWMAN, THOMAS E	1XSMI D	RA
BOYD, FRANCIS R	3IGEL H	RA
BOZEMAN, F MARILYN	1DAWR	RA
BRAATEN, NORMAN F	1CCGS BMR	RA
BRANHAM, SARA E		RE
BRANSCOMB, LEWIS M	1CNBS	RA
BRANSON, HERMAN	2HHOU	RA
BRAUER, GERHARD M	1CNBS EW	RA
BRECKENRIDGE, F C	1CNBS B	RA
BRECKENRIDGE, ROBERT G		NA
BREIT, GREGORY		NA
BRENNER, ABNER	1CNBS E	RA
BREWER, A KEITH	1DNNO E	RA
BREWER, CARL R	1HNIH Q	RA
BRICKWEDDE, F G		NA
BRIERLEY, PHILIP	1ARFR GK	RA
BRIGGS, LYMAN J		RE
BRODIE, BERNARD B	1HNIH EU	RA
BROMBACHER, W G	7RETD B	RA
BROOKS, HERBERT B		RE
BROWN, ALFRED E	5HARE E	RA
BROWN, B F	1DNRL V	RA
BROWN, EDGAR		NE
BROWN, J R C	2HUMD	RA

BROWN, RUSSELL G	2HUMD	K	RA	COOLIDGE, HAROLD J	3INAS	G	RA
BROWN, THOMAS M	2HGWU		RA	COOLIDGE, WILLIAM D			NA
BUCKLEY, FLOYD W	1CNBS	E	RA	COONS, GEORGE H			RE
BUHRER, EDNA M	1ARFR	P	RA	COOPER, G ARTHUR	1XSMI	H	RA
BUNN, RALPH W	8CLUN		RA	COOPER, STEWART R	2HHOU	E	RA
BURAS, EDMUND M JR	5HARE	E	RA	COOTER, IRVIN L	1CNBS	BN	RA
BURGERS, J M	2HUMD	BX	RA	CORNFIELD, JEROME	1HNIH		RA
BURINGTON, RICHARD S	1DNBW	BG	RA	CORRELL, DONOVAN S			NA
BURK, DEAN	1HNIH	EU	RA	CORY, ERNEST N			RE
BURKE, BERNARD F	3ICIW		RA	COTTAM, CLARENCE			NA
BURKE, FREDERIC G	4PHYS	I	RA	COULSON, E JACK	1ARUR	EU	RA
BURKEY, LLOYD A	7RETD	Q	RA	COWAN, RICHARD S	1XSMI		RA
BURNETT, H C	1CNBS	V	RA	COWIE, DEAN B	3ICIW		RA
BURSTEIN, ELIAS			NA	COX, HIDEN T	3IAIB		RA
BUTLER, JAMES W	1DNRL		RA	CRAFTON, PAUL A	2HGWU	NOX	RA
BYERLY, PERRY			NA	CRAGOE, CARL S			RE
BYRNE, ROBERT J	2HUMD	Q	RA	CRAVEN, JOHN P	1DNBW	O	RA
				CREITZ, E CARROLL	1CNBS	E	RA
				CRESSMAN, GEORGE P	1XNMC		RA
CABALLERO, EDUARDO			NA	CULLINAN, FRANK P	1ARFR	K	RA
CALDWELL, FRANK R	1CNBS	B	RA	CURRAN, HAROLD R	1ARUR	Q	RA
CALDWELL, JOSEPH M	1DAEB	T	RA	CURRIER, LOUIS W	7RETD	H	RA
CALLEN, EARL R	1DNOL	B	RA	CURTIS, ROGER W			NA
CAMPAIGNE, HOWARD H			NA	CURTISS, LEON F			NE
CAMPBELL, FRANK L	3INAS	BDEFZ	RA	CUTTITTA, FRANK	1IGES	EGH	RA
CANNON, EDWARD W	1CNBS		RA				
CARDER, DEAN S	1CCGS	BH	RA				
CAREY, FRANCIS E	5ASPR		RA	DAFT, FLOYD S	1HNIH	EU	RA
CARHART, HOMER W	1DNRL	E	RA	DALZELL, R CARSON	1XAEC		RA
CARMICHAEL, LEONARD	1XSMI		RA	DANE, CARLF H	1IGES	H	RA
CARRINGTON, TUCKER	1CNBS	E	RA	DARWENT, BASIL DE B	2HCUA	E	RA
CARROLL, DOROTHY	1IGES	H	RA	DAUER, CARL C	1HPHS		RA
CARROLL, THOMAS J			NA	DAVIDSON, ROSS W			NE
CARROLL, WILLIAM R	1HNIH	E	RA	DAVIS, DORLAND J	1HNIH	Q	RA
CARRON, MAXWELL K	1IGES	EH	RA	DAVIS, MARION M	1CNBS	EG	RA
CARTER, HUGH	1HX		RA	DAVIS, PHILIP J	1CNBS		RA
CASH, EDITH K			RE	DAVIS, R F	2HUMD		RA
CASSEL, JAMES M	1CNBS	E	RA	DAVIS, WATSON	3ISCS		RA
CAUL, HAROLD J	1CNBS	EVW	RA	DAVISSON, JAMES W	1DNRL	B	RA
CHALKLEY, HAROLD W			RE	DAWSON, PAUL R			NA
CHAPIN, EDWARD A			NE	DAWSON, REED			NA
CHAPIN, EDWARD J	1DNRL	V	RA	DAWSON, ROY C	8CLUN		RA
CHAPLIN, HARVEY JR	1DNDT	X	RA	DE FERIET, J KAMPE			NA
CHAPLINE, W R			RE	DE LAUNAY, JULES			NA
CHASE, AGNES			RE	DE PUE, LELAND A	1DNRL	V	RA
CHRISTENSON, LEROY D	1ARFR	F	RA	DEAN, H TRENDLEY			NE
CLAFFEY, PAUL J	2HCUA	T	RA	DEBORD, GEORGE G			NE
CLAIRE, CHARLES N	1CCGS	BM	RA	DEFANDORF, FRANCIS M	1CNBS	BGN	RA
CLARK, FRANCIS E			NA	DEIGNAN, HERBERT G	1XSMI		RA
CLARK, GEORGE E JR	5REAN		RA	DEIGNAN, STELLA L	1XSMI		RA
CLARK, KENNETH G	1ARFR	E	RA	DEITZ, VICTOR R	1CNBS		RA
CLAUSEN, CURTIS P			NE	DERMEN, HAIG	1ARFR	K	RA
CLEAVER, OSCAR P	1DAER	NR	RA	DETWILER, SAMUEL B	7RETD	LK	RA
CLEMENT, J REID JR	1DNRL		RA	DETWILER, SAMUEL B JR	1ARUR	E	RA
COATNEY, G ROBERT	1HPHS		RA	DIAMOND, JACOB MRS	2SMOC		RA
COBLENTZ, W W			RE	DICKSON, GEORGE	1CNBS	W	RA
COCHRAN, DORIS M	1XSMI	G	RA	DIEHL, WALTER S	7RETD	X	RA
COE, FRED O	4PHYS	I	RA	DIEHL, WILLIAM W	7RETD	DK	RA
COE, MAYNE R			NE	DIGGES, THOMAS G	8CLUN		RA
COHN, ROBERT	1DNX	B	RA	DOCTOR, NORMAN	1DAOF		RA
COLE, HOWARD I			NA	DOETSCH, RAYMOND N	2HUMD	Q	RA
COLE, KENNETH S	1HNIH		RA	DOLECEK, RICHARD L	1DNRL		RA
COLEMAN, JOHN S	3INAS	2	RA	DORN, HAROLD F	1HNIH		RA
COLLINS, HENRY B	1XSMI	C	RA	DOSS, MILDRED A	2HUMD	P	RA
COMPTON, W DALE			NA	DOUGLAS, CHARLES A	1CNBS		RA
CONGER, PAUL S	1XSMI		RA	DOUGLAS, THOMAS B	1CNBS	E	RA
COOK, HAROLD T	1AMMR	BK4	RA	DOWNING, LEWIS K	2HHOU	T	RA
COOK, RICHARD K	1CNBS	B2	RA	DRAEGER, R HAROLD			NA
COOK, ROBERT C	3AAGA		RA	DRECHSLER, CHARLES	7RETD	K	RA
COOKE, C WYTHE			RE	DRESSLER, ROBERT F			NA

DRUMMETER, LOUIS F JR	1DNRL		RA	FOX, ROBERT B	1DNRL	E	RA
DRYDEN, HUGH L	1XNAS	BOX	RA	FRAME, ELIZABETH G	1HNIH	EU	RA
DU SHANE, GRAHAM P	3AAAS		RA	FRANK, BERNARD			NA
DUERKSEN, JACOB A	1CCGS	B	RA	FRANCK, JAMES			NH
DUNCAN, HELEN M	1IGES	H	RA	FRANK, KARL	1HNIH		RA
DUNCAN, ROBERT C			RE	FRANKLIN, PHILIP J	1D-S	ENS	RA
DUNNING, K L	1DNRL	B	RA	FRANKLIN, TEMPIE R	2SARC		RA
DUTILLY, A	2HCUA	K	RA	FRAPS, RICHARD M	1ARFR		RA
				FREDERIKSE, H P R			NA
				FREEMAN, MONROE E	1XSMI	EU	RA
EARLE, WILTON R	1HNIH	U	RA	FRENKIEL, FRANCOIS N	1DNDT	BXY	RA
ECKERT, W J			NA	FRIEDMAN, ABRAHAM S			NA
ECKHARDT, E A			NE	FRIESS, S L	1DNMR	E	RA
EDDY, BERNICE E	1HNIH	GQU	RA	FRUSH, HARRIET L	1CNBS	E	RA
EDDY, NATHAN B	1HNIH	U	RA	FULLER, HENRY S	1DAWR	DFQ	RA
EDMUNDS, LAFE R	1XNSF	F	RA	FULLMER, IRVIN H	1CNBS	BO	RA
EDSON, JAMES B	1XNAS		RA	FULTON, ROBERT A	1ARFR	EZ	RA
EGLI, PAUL H	1DNRL	E	RA	FURUKAWA, GEORGE T	1CNBS	BEG	RA
EHRMAN, JOACHIM B	1DNRL		RA				
EISENHART, CHURCHILL	1CNBS	B	RA				
EISENSTEIN, JULIAN C	1CNBS		RA	GABRIELSON, IRA N	3IWMI		RA
ELBOURN, ROBERT D	1CNBS	BNS	RA	GAFAFER, WILLIAM M	1HPHS		RA
ELLINGER, GEORGE A	1CNBS	GV	RA	GALTSOFF, PAUL S			NE
ELLIOTT, CHARLOTTE			NE	GAMOW, GEORGE			NA
ELLIOTT, F E			NA	GARDNER, IRVINE C	7RETD	B	RA
ELLIS, NED R	1ARFR	EGU	RA	GARNER, CLEMENT L			RE
EMERSON, W B			RE	GARSTENS, HELEN L	2HUMD		RA
EMERY, ALDEN H	3AACS	GE	RA	GARVIN, DAVID	8CLUN		RA
EMMART, EMILY W	1HNIH	U	RA	GATES, G E			NA
EMSWELLER, S L	1ARFR	K	RA	GAZIN, C L	1XSMI	DH	RA
ENDICOTT, KENNETH M	1HNIH	U	RA	GEIL, GLENN W	1CNBS	GV	RA
ENNIS, WILLIAM B JR	1ARFR		RA	GELLER, ROMAN F	7RETD	BG	RA
ERICKSEN, J L			NA	GELTMAN, SYDNEY	1CNBS		RA
ESTERMANN, IMMANUEL			NA	GEYGER, WILLIAM A	1DNOL	N	RA
ETZEL, HOWARD W	1XNSF		RA	GHAFFARI, ABOLGHASSEM	1CNBS	B	RA
EVANS, ALICE C			RE	GIBSON, KASSON S			RE
EVANS, W DUANE	1LBLS		RA	GIBSON, RALPH E	3IAPL		RA
EWERS, JOHN C	1XSMI	C	RA	GILLMAN, JOSEPH L JR	4CONS		RA
				GINNINGS, DEFOE C	1CNBS	E	RA
				GINTHER, ROBERT J	1DNRL		RA
FABER, JOHN E JR	2HUMD	Q	RA	GISH, OLIVER H			NE
FAHEY, JOSEPH J	1IGES	EHG	RA	GLASGOW, AUGUSTUS R JR	1CNBS	EG	RA
FARR, MARION M	1ARFR	P	RA	GLASS, JEWELL J	1IGES		RA
FARROW, RICHARD P	3ANCA	E4	RA	GLASSER, ROBERT G	1DNRL		RA
FAUST, GEORGE T	1IGES	H	RA	GODFREY, THEODORE B	1DAOF		RA
FAUST, WILLIAM R	1DNOR		RA	GOLDBERG, MICHAEL	1DNBW	B	RA
FERGUSON, HENRY G			RE	GOLUMBIC, CALVIN	1AMMR	EU4	RA
FERGUSON, LLOYD N			NA	GONET, FRANK	1XUST	E	RA
FERGUSON, ROBERT E	1CNBS	E	RA	GORDON, CHARLES L	1CNBS	BEG	RA
FERRELL, RICHARD A	2HUMD		RA	GORDON, RUTH E			NA
FIELD, WILLIAM D	1XSMI		RA	GOULD, I A			NA
FIELDNER, ARNO C	4CONS	EM	RA	GRAF, JOHN E	1XSMI		RA
FINLEY, HAROLD E	2HHOU	D	RA	GRAHAM, EDWARD H	1AX		RA
FIOCK, ERNEST F			NA	GRANT, ULYSSES S III	7RETD	J	RA
FISK, BERT	1DNRL		RA	GRASSL, CARL O			NA
FIVAZ, ALFRED E	1CBDS	L	RA	GRATON, L C			NA
FLETCHER, HEWITT G JR	1HNIH	E	RA	GRAVATT, G FLIPPO			NA
FLORIN, ROLAND E	1CNBS	GE	RA	GREEN, MELVILLE S	1CNBS	B	RA
FONER, SAMUEL N	3IAPL	B	RA	GREENOUGH, M L	1CNBS		RA
FOOTE, PAUL D	3INAS	B	RA	GREENSPAN, MARTIN	1CNBS	2	RA
FOOTE, RICHARD H	1ARFR		RA	GRIFFING, VIRGINIA	2HCUA	E	RA
FORD, T FOSTER	1DNRL	E	RA	GRISAMORE, NELSON T	2HGWU		RA
FORZIATI, ALPHONSE F	1DAOF	EW	RA	GROSVENOR, GILBERT	3INGS	G	RA
FORZIATI, FLORENCE H	1ARHE	E	RA	GUARINO, P A	1DAOF	S	RA
FOSTER, AUREL O	1ARFR	P	RA	GURNEY, ASHLEY B	1ARFR	DFG	RA
FOSTER, MARGARET D	1IGES	EH	RA				
FOURNIER, ROBERT O	1IGES		RA				
FOURT, LYMAN	5HARE	E	RA	HACSKAYLO, EDWARD	1AFOR	K	RA
FOWELLS, HARRY A	1AFOR	L	RA	HAGEN, JOHN P	1XNAS		RA
FOX, MATTIE R S	1HNIH	E	RA	HAGUE, JOHN L	1CNBS	EG	RA

HAHN, FRED E	1DAWR	RA
HAINES, KENNETH A	1ARAO FZ	RA
HAKALA, REINO W	2HHOU E	RA
HALL, E RAYMOND		NA
HALL, R CLIFFORD		RE
HALL, STANLEY A	1ARFR EZ	RA
HALL, WAYNE C	1DNRL N	RA
HALLER, HERBERT L	1ARFR EF	RA
HALSTEAD, BRUCE W		NA
HAMBLETON, EDSON J	1ARFR DE	RA
HAMBLETON, JAMES I	7RETD F	RA
HAMER, WALTER J	1CNBS GEN	RA
HAMPP, EDWARD G	1CNBS QW	RA
HAND, CADET H JR		NA
HANSEN, IRA B	2HGWU DG	RA
HANSEN, MORRIS H	1CBUC	RA
HARDENBURG, ROBERT E	1AMMR	RA
HARDER, E C		NA
HARRIS, FOREST K	1CNBS	RA
HARRIS, MILTON	5HARE E	RA
HARRISON, W N	8CLUN	RA
HART, ROBERT W	3IAPL	RA
HARVALIK, Z V	1DAER E	RA
HARWOOD, PAUL D		NA
HASELTINE, NATE	5WAPO	RA
HASKINS, CARYL P	3ICIW F	RA
HASS, GEORG H	8CLUN	RA
HAUPTMAN, HERBERT	1DNRL	RA
HAUT, IRVIN C	2HUMD	RA
HAWTHORNE, EDWARD W	2HHOU	RA
HAYMAKER, WEBB		NA
HAZLETON, LLOYD W	5HALA EU	RA
HEINZE, PETER H	1AMMR KG4	RA
HELLER, ISIDOR		NA
HENDERSON, E P	1XSMI H	RA
HENDERSON, MALCOLM C	2HCUA B2	RA
HENLEY, ROBERT R		RE
HENNEBERRY, THOMAS J	1ARFR F	RA
HENRY, THOMAS R	7RETD B	RA
HERMAN, CARLTON M	1IFWS	RA
HERMAN, ROBERT C		NA
HERSCHMAN, HARRY K	8CLUN	RA
HERSEY, MAYO D		NA
HERZ, NORMAN		NA
HERZFELD, CHARLES M	1D-S B	RA
HERZFELD, KARL F	2HCUA	RA
HERZFELD, REGINA F	2HCUA C	RA
HESS, WALTER C	2HGEU EUW	RA
HEYDEN, FRANCIS J	2HGEU BG	RA
HICKLEY, THOMAS J	8CLUN	RA
HICKOX, GEORGE H	1DAER GQRT	RA
HICKS, V		NA
HIDNERT, PETER		RE
HIGGINS, ELMER		RE
HILL, FREEMAN K	3IAPL BX	RA
HILTON, JAMES L	1ARFR	RA
HINMAN, WILBUR S	1DAOF	RA
HOBBS, ROBERT B	1CNBS BEG	RA
HOERING, THOMAS C	3ICIW EH	RA
HOFFMANN, C H	1ARFR FLZ	RA
HOFFMAN, JAMES I		NA
HOFFMAN, JOHN D	1CNBS E	RA
HOFFMAN, RICHARD L		NA
HOGE, HAROLD J		NA
HOLLIES, NORMAN R S	5HARE E	RA
HOLLINGSHEAD, R S		RE
HOLMGREN, HARRY D	2HUMD B	RA
HOLSHOUSER, WILLIAM L	1XCAB V	RA
HOOKER, MARJORIE	1IGES H	RA
HOOVER, JOHN I	1DNRL B	RA
HOPP, HENRY		NA
HORTON, BILLY M	1DAOF	RA
HOSTETTER, J C		NE
HOTTLE, GEORGE A	1HPHS GQU	RA
HOUGH, FLOYD W	7RETD GRT	RA
HOWARD, FRANK L	1CNBS E	RA
HOWARD, GEORGE W	1DAER RT	RA
HOWE, PAUL E	4CONS E	RA
HUBBARD, DONALD	1CNBS GE	RA
HUMPHREYS, CURTIS J		NA
HUNDLEY, JAMES M	1HPHS	RA
HUNTER, GEORGE W III		NE
HUNTER, RICHARD S	5HUAS G4	RA
HUNTOON, ROBERT D	1CNBS BS	RA
HUTCHINS, LEE M		NA
HUTTON, GEORGE L	1DNBY F	RA
IMAI, ISAO		NA
INSLEY, HERBERT	4CONS BH	RA
IRVING, GEORGE W JR	1ARUR E	RA
IRWIN, GEORGE R	1DNRL B	RA
ISBELL, HORACE S	1CNBS E	RA
JACKSON, HARTLEY H T		RE
JACKSON, JULIUS L	1CNBS B	RA
JACOB, KENNETH D	7RETD	RA
JACOBS, WALTER W	1XNSA	RA
JACOBS, WOODROW C	1XNOD Y	RA
JAMES, L H		NA
JAMES, MAURICE T		NA
JASTROW, ROBERT	1XNAS	RA
JAY, GEORGE E JR	5MIAS G	RA
JEN, C K	3IAPL B	RA
JENKINS, ANNA E		NE
JENNESS, DIAMOND		NH
JESSUP, R S	7RETD B	RA
JOHANNESEN, ROLF B	1CNBS E	RA
JOHNSON, BERTRAND L		RE
JOHNSON, DANIEL P	1CNBS B	RA
JOHNSTON, FRANCIS E	2HGWU B	RA
JOHNSON, KEITH C	2SDCP	RA
JOHNSON, PAUL E	3INAS	RA
JOHNSON, PHYLLIS T		NA
JONES, HENRY A		NA
JONES, JACK C	2HUMD	RA
JOYCE, J W	1XNSF B	RA
JUDD, DEANE B	1CNBS B	RA
JUDD, NEIL M		RE
JUDSON, LEWIS V	1CNBS	RA
JUHN, MARY	2HUMD	RA
KAGARISE, RONALD E	1D-X	RA
KAHN, ARNOLD H	1CNBS	RA
KALCKAR, HERMAN W		NA
KALMUS, HENRY P	1DAOF S	RA
KANAGY, JOSEPH R	1CNBS E	RA
KANE, EDWARD A	1ARFR E	RA
KARLE, ISABELLA	1DNRL G	RA
KARLE, JEROME	1DNRL BE	RA
KARR, PHILIP R		NA
KARRER, ANNIE M		NE
KARRER, SEBASTIAN		NA
KEEGAN, HARRY J	1CNBS EG	RA
KEGELES, GERSON		NA
KELLUM, LEWIS B		NA
KEMPTON, JAMES H		NA
KENK, ROMAN	1XLIC G	RA

KENNARD, RALPH B	7RETD	B	RA	LINDQUIST, ARTHUR W			NE
KENNEDY, E R	2HCUA	Q	RA	LING, LEE			NA
KERESZTESY, JOHN C	1HNIH	EU	RA	LIPPINCOTT, ELLIS R JR	2HUMD	E	RA
KESSLER, KARL G	1CNBS	B	RA	LITOVITZ, THEODORE A	2HCUA	B2	RA
KEULEGAN, GARBIS H	1CNBS		RA	LITTLE, ELBERT L JR	1AFOR	KL	RA
KIES, JOSEPH A	1DNRL	BGV	RA	LOCKHART, LUTHER B JR	1DNRL	E	RA
KIESS, CARL C	2HGEU		RA	LOGAN, HUGH L	1CNBS	V	RA
KILLIAN, THOMAS J	1DNOR		RA	LORING, BLAKE M	4CONS	V	RA
KILLIP, ELLSWORTH P			NE	LOTHROP, S K			NA
KING, PETER	1DNRL	E	RA	LOVE, S KENNETH	1IGES	EH	RA
KINNEY, J P			NE	LUDFORD, G S S			NA
KLEIN, RALPH	1CNBS	E	RA	LUTZ, JACOB M	1AMMR	K4	RA
KLINE, GORDON M	1CNBS	E	RA	LYMAN, JOHN	1XNSF	EY	RA
KLUTE, CHARLES H	1DAOF	BE	RA	LYNN, W GARDNER	2HCUA	B	RA
KNAPP, DAVID G	1CCGS		RA				
KNIPLING, EDWARD F	1ARFR		RA				
KNIPLING, PHOEBE H	2SARC		RA	MAC CARDLE, ROSS C	1HNIH	BU	RA
KNOBLOCK, EDWARD C	1DAWR	E	RA	MADORSKY, SAMUEL L	7RETD	E	RA
KNOPF, ELEANORA B			NE	MAHAN, ARCHIE I	3IAPL	B	RA
KNOWLTON, KATHRYN	7RETD	EU	RA	MANDEL, H GEORGE	2HGWU	E	RA
KOHLER, HANS W	1DAOF	S	RA	MANDEL, JOHN	1CNBS	E	RA
KOLB, ALAN C	1DNRL		RA	MANN, DAVID E	1CNBS	E	RA
KOPPANYI, THEODORE	2HGEU		RA	MARCUS, MARVIN			NA
KOSTKOWSKI, HENRY J	1CNBS	B	RA	MARSHALL, LOUISE H	1HNIH		RA
KOTTER, F RALPH	1CNBS	N	RA	MARSHALL, WADE H	1HNIH	B	RA
KRASNY, J F	5HARE		RA	MARTIN, GEORGE W			NE
KRAUS, C A			NA	MARTIN, JOHN H	1ARFR	KG	RA
KRAUSS, ROBERT W	2HUMD	K	RA	MARTIN, MONROE H	2HUMD		RA
KREITLOW, KERMIT W	1ARFR		RA	MARTON, L	1CNBS	B	RA
KRUGER, JEROME	1CNBS	E	RA	MARVIN, ROBERT S	1CNBS	E	RA
KULLBACK, SOLOMON	2HGWU		RA	MARYOTT, ARTHUR A	1CNBS	E	RA
KULLERUD, GUNNAR	3IGEL		RA	MARZKE, OSCAR T			NA
KURTZ, FLOYD E	1ARUR	E	RA	MASON, EDWARD A	2HUMD	BE	RA
KURZWEG, HERMAN H	1XNAS	BX	RA	MASON, MARTIN A	2HGWU	MOT	RA
KUSHNER, LAWRENCE M	1CNBS	V	RA	MASSEY, JOE T	3IAPL		RA
				MATHERS, ALEX P	1TATT	E	RA
				MATLACK, MARION B	1ARFR	E	RA
LAKI, KOLOMAN	1HNIH	DEG	RA	MATOSSI, FRANK			NA
LAKIN, HUBERT W			NA	MAUSS, BESSE D	8CLUN		RA
LAMB, FRANK W			NA	MAXWELL, LOUIS R	1DNOL	B	RA
LAMBERT, EDMUND B	1ARFR	GK	RA	MAY, DONALD C JR	1DNBW	B	RA
LAMBERT, WALTER D			NE	MAY, IRVING	1IGES	EH	RA
LANDIS, PAUL E	1DAOF	S	RA	MAYER, CORNELL H	1DNRL	S	RA
LANDSBERG, H E	1CWEB	Y	RA	MAYOR, JOHN R	2HUMD		RA
LANG, WALTER B			RE	MAZUR, JACOB	1CNBS	B	RA
LANGFORD, GEORGE S	2HUMD	FZ	RA	MC BRIDE, GORDON W	5UNCA	E4	RA
LAPHAM, EVAN G			NA	MC CABE, LOUIS C	5RERS	GR	RA
LAPP, C J	3INAS		RA	MC CLAIN, EDWARD F JR	1DNRL	BS	RA
LAPP, RALPH E	5QUSI	B	RA	MC CLELLAN, WILBUR D	1ARFR	K	RA
LARRIMER, W H	3INAS	GLZ	RA	MC CLURE, FLOYD A	1XSMI		RA
LASHOF, THEODORE W	1CNBS	BG	RA	MC CLURE, FRANK J	1HNIH	EW	RA
LASTER, HOWARD J	2HUMD	B	RA	MC CLURE, FRANK T	3IAPL	BE	RA
LATTA, RANDALL			NA	MC CULLOUGH, N B	1HNIH	GIQ	RA
LE CLERG, ERWIN L	1ARFR	K	RA	MC DONALD, EMMA J	1CNBS	E	RA
LEDER, LEWIS B			NA	MC ELHINNEY, JOHN	1DNRL	B	RA
LEE, R H	1DNMR		RA	MC GUIRE, THOMAS R			NA
LEIGHTY, CLYDE E			RE	MC ILWRAITH, T F			NA
LEIKIND, MORRIS C	1HNIH		RA	MC INTOSH, ALLEN	1ARFR	P	RA
LEINER, ALAN L			NA	MC KEE, SAMUEL A	7RETD		RA
LEONARD, EMERY C			RE	MC KENZIE, LAWSON M			NA
LEONARD, MORTIMER D	7RETD	F	RA	MC KINNEY, HAROLD H			RE
LEVY, SAMUEL			NA	MC KNIGHT, EDWIN T	1IGES		RA
LEY, HERBERT L JR	2HGWU		RA	MC MILLEN, J HOWARD	1XNSF		RA
LI, HUI-LIN			NA	MC MULLEN, DONALD B			NA
LIDDEL, URNER			NA	MC MURDIE, HOWARD F	1CNBS		RA
LIDE, DAVID R JR	1CNBS		RA	MC MURTREY, JAMES E JR	1ARFR		RA
LIEBERMAN, MORRIS			NA	MC NESBY, JAMES R	1CNBS		RA
LIEBSON, SIDNEY H			NA	MC NISH, ALVIN G	1CNBS	B	RA
LIKINS, ROBERT C	1HNIH	W	RA	MC PHEE, HUGH C			RE
LILLY, JOHN C			NA	MC PHERSON, ARCHIBALD	1COTS	BE	RA

MC WHORTER, FRANK P			NA
MEADE, BUFOR K	8CLUN		RA
MEARS, ATHERTON H			RE
MEARS, FLORENCE	2HGWU		RA
MEBS, RUSSELL W	1CNBS	MV	RA
MEGGERS, W F	1CNBS	B	RA
MEINESS, F A			NH
MENDLOWITZ, HAROLD	1CNBS		RA
MENKART, JOHN H	5HARE	E	RA
MERRIAM, CARROLL F			NA
MERZ, ALBERT R			RE
MEYERHOFF, HOWARD A	1XSMC	H	RA
MEYERSON, MELVIN R	1CNBS	V	RA
MEYROWITZ, ROBERT	1IGES	E	RA
MICKELSEN, OLAF	1HNIH	EU	RA
MIDDLETON, H E			NE
MIDER, G BURROUGHS	1HNIH	G	RA
MILLER, CARL F	1XSMI	CG	RA
MILLER, CLEM O	1HNIH	E	RA
MILLER, JOHN C	1IGES	H	RA
MILLER, PAUL R	1ARFR	K	RA
MILLER, ROMAN R	1DNRL	E	RA
MINARD, DAVID	1DNMR		RA
MINARD, JAMES P	1IGES		RA
MISER, HUGH D			RE
MITCHELL, JOHN W	1ARFR		RA
MITCHELL, J MURRAY JR	1CWEB	GY	RA
MITTLEMAN, DON	1CNBS		RA
MIZELL, LOUIS R	5HARE	E	RA
MOHLER, FRED L	7RETD	B	RA
MOLLARI, MARIO	2HGEU		RA
MONTROLL, ELLIOTT W			NA
MOORE, GEORGE A	1CNBS	V	RA
MORGAN, RAYMOND	2HUMD		RA
MORRIS, JOSEPH B	2HHOU	E	RA
MORRIS, KELSO B	2HHOU	E	RA
MORRISON, BENJAMIN Y	7RETD		RA
MORRISON, HAROLD			RE
MORRISON, JOSEPH P	1XSMI	D	RA
MOSTOJI, F K	1DINP		RA
MUEHLHAUSE, CARL O	1CNBS		RA
MUELLER, E F			RE
MUESEBECK, CARL F W			RE
MURPHY, LEONARD M	1CCGS		RA
MYERS, ALFRED T			NA
MYERS, RALPH D	2HUMD	B	RA
NACE, RAYMOND L	1IGES	H	RA
NAESER, CHARLES R	2HGWU	EH	RA
NAMIAS, JEROME	1CWEB	Y	RA
NELSON, R H	3AESA	FZ	RA
NEUENDORFFER, J A	8CLUN		RA
NEUMANN, FRANK			NA
NEWMAN, MORRIS	1CNBS		RA
NEWMAN, SANFORD B	1CNBS		RA
NEWTON, CLARENCE J	1CNBS		RA
NICKERSON, DOROTHY	1AMCD		RA
NIKIFOROFF, C C			RE
NOLLA, JOSE A B			NA
NORRIS, KARL H	1AMMR	4	RA
NOYES, HOWARD E	8CLUN		RA
O BRIEN, JOHN A JR	2HCUA	K	RA
O BRYAN, H M	5BECO	BNS	RA
O KEEFE, JOHN A	1XNAS	B	RA
O NEILL, HUGH T			NE
OBERHOLSER, HARRY C			NE
OBOURN, ELLSWORTH S	1HX	B	RA
OEHSER, PAUL H	1XSMI	BD	RA
OKABE, HIDEO	1CNBS	E	RA
OLSON, BYRON J			NA
OLSON, HENRY W	2HDCT		RA
OPPENHEIM, IRWIN			NA
OREM, THEODORE H	1CNBS	V	RA
OSAWA, MISS ETSUKO	1DAWR	U	RA
OSBORNE, M F M	1DNRL		RA
OSGOOD, WILLIAM R	2HCUA	OT	RA
OSMUN, J W	1CWEB	Y	RA
OSTERHOUT, W J V			NE
OVERTON, WILLIAM C JR			NA
OWENS, HOWARD B	2SPGC	DF	RA
OWENS, JAMES P	1IGES	H	RA
PAFFENBARGER, GEORGE C	1CNBS	W	RA
PAGE, BENJAMIN L	7RETD	B	RA
PAGE, CHESTER H	1CNBS	S	RA
PAGE, R M	1DNRL	S	RA
PARK, HELEN D	1HNIH		RA
PARK, JOHN H			NA
PARKER, KENNETH W	1AFOR	L	RA
PARKER, MARION W	1ARFR	K	RA
PARR, L W			NE
PARSONS, DOUGLAS E	1CNBS	BT	RA
PATTERSON, MARGARET E	8CLUN		RA
PEARL, MARTIN H	2HUMD		RA
PEISER, H STEFFEN	1CNBS	BE	RA
PELCZAR, MICHAEL J	2HUMD	Q	RA
PELLAM, JOHN R			NA
PELLINI, WILLIAM S	1DNRL	V	RA
PENNINGTON, W A	2HUMD	EV	RA
PENTZER, WILBUR T	1AMMR		RA
PERROS, THEODORE P	2HGWU	BE	RA
PETRITZ, RICHARD L			NA
PHAIR, GEORGE	1IGES	H	RA
PHILLIPS, MRS M L	4CONS	S	RA
PIGMAN, WARD			NA
PIKL, J			NA
PIORE, E R			NA
PITTMAN, MARGARET	1CNBS	QU	RA
PLYLER, EARLE K	1CNBS	BE	RA
POLACHEK, HARRY	1DNDT	B	RA
POLING, AUSTIN C	1CCGS	S	RA
POLLOCK, BRUCE M	1ARFR	K	RA
POMMER, ALFRED M	1ARHE	EGH	RA
POOS, FRED W	3AESA	FGZ	RA
POPE, MERRITT N			NE
POPENOE, WILSON			NE
PORTER, B A	7RETD	FGZ	RA
POSNER, AARON S	1HNIH	W	RA
PRATT, HARRY D			NA
PRESLEY, JOHN T	1ARFR		RA
PRICE, E W			NE
PRO, MAYNARD J	1TX	E	RA
PROSEN, EDWARD J	1CNBS	E	RA
PUTNINS, PAUL H	1CWEB	GY	RA
RABINOW, JACOB	5RBEN		RA
RADO, GEORGE T	1DNRL	B	RA
RALL, DAVID R	1HNIH	U	RA
RAMBERG, WALTER			NA
RANDS, ROBERT D			NE
RAPPLEYE, HOWARD S	7RETD	BGMRT	RA
RAUSCH, ROBERT			NA
RAVITSKY, CHARLES	1DAOF		RA
READ, W T	4CONS	E	RA
READING, O S			NE

REAM, DONALD F	1DNBS		RA
REED, WILLIAM D	1DAEC	FGR	RA
REEVE, WILKINS	2HUMD	E	RA
REHDER, HARALD A	1XSMI	DG	RA
REICHELDERFER, FRANCIS	1CWEB		RA
REICHEN, LAURA E	1IGES	E	RA
REID, MARY E			RE
REINHART, FRANK W	4CONS	EG	RA
REINHART, FRED M	1CNBS	V	RA
REITEMEIER, R F	1XAEC		RA
RENKIN, EUGENE	2HGWU		RA
REYNOLDS, HOWARD	1ARHE	4Q	RA
REYNOLDS, ORR E	1D-X	W	RA
RHODES, IDA	8CLUN		RA
RICE, DONALD A	1CCGS		RA
RICE, FRANCIS O	2HGEU	E	RA
RICE, STUART A	5SURE		RA
RICKER, PERCY L			RE
RIDDLE, OSCAR			NE
RIOCH, DAVID M	1DAWR		RA
RITT, PAUL E	5MELP	S	RA
RIVELLO, ROBERT M	2HUMD	OX	RA
RIVLIN, RONALD S			NA
ROBBINS, MARY L	2HGWU	QU	RA
ROBERTS, ELLIOTT B	7RETD	B	RA
ROBERTS, FRANK H H	1XSMI	C	RA
ROBERTS, RICHARD B	3ICIW		RA
ROBERTSON, A F	1CNBS	G	RA
ROBERTSON, MYRNA J	7RETD	P	RA
ROBERTSON, RANDAL M	1XNSF	BGL	RA
ROBINSON, HENRY E	1CNBS		RA
ROCK, GEORGE D	2HCUA		RA
RODNEY, WILLIAM S	1XNSF	B	RA
RODRIGUEZ, RAUL	1DAX	R	RA
ROEDDER, EDWIN	1IGES	BH	RA
ROESER, WILLIAM F	1CNBS		RA
ROGERS, L A			NE
ROLLER, PAUL S	4CONS	BE	RA
ROMNEY, CARL F	1DFX	H	RA
ROSE, JOHN C	2HGEU	U	RA
ROSENBLATT, DAVID	1CNBS	B	RA
ROSS, CLARENCE S	1IGES		RA
ROSS, CULBERTSON W	1DAEB		RA
ROSS, SHERMAN	3AAPS		RA
ROSSINI, FREDERICK D			NA
ROTH, FRANK L	1CNBS	G	RA
ROTKIN, ISRAEL	1DAOF	BNS	RA
ROWE, WALLACE P	1HNIH	Q	RA
RUBEY, WILLIAM W			NA
RUBIN, MEYER	1IGES	H	RA
RUBIN, ROBERT J	1CNBS	B	RA
RUBIN, VERA C	2HGEU	B	RA
RUDD, VELVA E	1XSMI		RA
RUMBAUGH, LYNN H	5REAN	B	RA
RUSSELL, LOUISE M	1ARFR	DF	RA
RYALL, A LLOYD	1AMMR		RA
RYERSON, KNOWLES A			NA
SAENZ, ALBERT W	1DNRL		RA
SAGER, ELIZABETH	1CNBS	E	RA
SAGER, THERON P			NA
SAGER, WILLIAM F	2HGWU	E	RA
SAILER, REECE I			NA
SALKOVITZ, EDWARD I	1DNOR	B	RA
SANDERSON, JOHN A	1DNRL	B	RA
SANDOZ, GEORGE	8CLUN		RA
SANFORD, RAYMOND L			RE
SARLES, MERRITT P	2HCUA	PZ	RA
SAUNDERS, JAMES B SR	1CNBS		RA
SAVILLE, THORNDIKE JR	1DAEB	T	RA
SAYRE, A NELSON	4CONS	H	RA
SCHAEFFER, CLAUDE E			NA
SCHAFFER, ROBERT	1CNBS	E	RA
SCHALLER, WALDEMAR T			RE
SCHAMP, HOMER W JR	2HUMD	B	RA
SCHECTER, MILTON S	1ARFR	EZ	RA
SCHEER, MILTON D	1CNBS	BE	RA
SCHIEFER, HERBERT F	1CNBS		RA
SCHINDLER, ALBERT I	1DNRL		RA
SCHMITT, WALDO L	1XSMI		RA
SCHOENBORN, HENRY W	2HUMD		RA
SCHOENEMAN, ROBERT L	1TIRS		RA
SCHOENING, HARRY W	7RETD		RA
SCHOOLEY, A H	1DNRL	S	RA
SCHOONOVER, IRL C	1CNBS	EW	RA
SCHRECKER, ANTHONY W	1HNIH	E	RA
SCHREINER, OSWALD			RE
SCHREMP, EDWARD J	1DNRL		RA
SCHUBAUER, GALEN B	1CNBS	BGX	RA
SCHUBERT, BERNICE G			NA
SCHUBERT, LEO	2HAMU	BE	RA
SCHULMAN, JAMES H	1DNRL	B	RA
SCHULTZ, EUGENE S	7RETD		RA
SCHWARTZ, ANTHONY M	5HARE	E	RA
SCHWARTZ, BENJAMIN			RE
SCOFIELD, CARL S	7RETD	K	RA
SCOTT, ARNOLD H	1CNBS	BN	RA
SCOTT, DAVID B	1HNIH	W	RA
SCOVILLE, HERBERT JR	1XCIA		RA
SCRIBNER, BOURDON F	1CNBS	E	RA
SEEGER, RAYMOND J			NA
SERVICE, JERRY H			NE
SETZLER, FRANK M			NA
SHALOWITZ, AARON L	1CCGS	R	RA
SHANAHAN, A J	1ARAO	Q	RA
SHANNON, JAMES A	1HNIH	U	RA
SHAPIRO, LEONARD	1IGES	E	RA
SHAPIRO, MAURICE M	1DNRL	B	RA
SHAPLEY, A H			NA
SHAPOVALOV, MICHAEL			NE
SHAW, JOSEPH C			NA
SHEAR, MURRAY J	1HNIH	GU	RA
SHELTON, EMMA	1HNIH		RA
SHEN, SHAN-FU			NA
SHEPARD, HAROLD H	1AASC	FZ	RA
SHERESHEFSKY, J LEON	2HHOU	E	RA
SHERMAN, KENNETH L			NA
SHIMER, H W			NE
SHIMKIN, D B			NA
SHINN, LEO A	1DNOR	EU	RA
SHORB, DOYS A	1ARFR	P	RA
SHORB, MARY S	2HUMD	QU	RA
SHULER, KURT E	3IIDA	BE	RA
SIEGLER, EDOUARD H			RE
SILBERSCHMIDT, KARL M			NA
SILSBEE, FRANCIS B	7RETD	BN	RA
SILVERMAN, SHIRLEIGH	1DNOR	B	RA
SIMHA, ROBERT			NA
SIMMONS, LANSING G	1CCGS	T	RA
SIMMS, B T	1SAID		RA
SIMPSON, ROBERT H	1CWEB	Y	RA
SINGER, SIEGFRIED F	2HUMD		RA
SINGLETERRY, C R	1DNRL	E	RA
SIPLE, PAUL A	1DAX	G	RA
SITTERLY, BANCROFT W	2HAMU		RA
SITTERLY, CHARLOTTE M	1CNBS	BG	RA
SLADEK, JAROMIL V	1HFDA	E	RA
SLAWSKY, MILTON M	1DFOS	GM	RA
SLAWSKY, ZAKA I	1DNOL	B	RA

SLOCUM, GLENN G	1HFDA	Q	RA	STUART, NEIL W	1ARFR	K	RA
SMALL, JAMES D	8CLUN		RA	SULLIVAN, EUGENE C			NA
SMART, J SAMUEL			NA	SULLIVAN, MICHAEL X			RE
SMITH, CHARLES M			RE	SUTCLIFFE, WALTER D			NE
SMITH, EDGAR R			NE	SWEENEY, WILLIAM T	1CNBS	E	RA
SMITH, FALCONER	1HNIH	BU	RA	SWICK, CLARENCE H			RE
SMITH, FLOYD F	1ARFR	FZ	RA	SWINDELLS, JAMES F	1CNBS	B	RA
SMITH, FRANCIS A			NE	SWINGLE, CHARLES F			NE
SMITH, HENRY L JR			NA				
SMITH, JACK C	1CNBS		RA				
SMITH, NATHAN R			NE	TALBERT, PRESTON T	2HHOU	E	RA
SMITH, PAUL A	5RACO	GHTX	RA	TALBOTT, F LEO	2HCUA		RA
SMITH, PAUL L	1DNRL	BS	RA	TALIAFERRO, W H			NA
SMITH, SIDNEY T	1DNRL	S	RA	TASAKI, ICHIJI	1HNIH	B	RA
SMITH, WILLIE W	1HNIH	U	RA	TATE, DOUGLAS R	1CNBS	BG	RA
SNAVELY, BENJAMIN	1DNOL	2	RA	TAUSSKY, OLGA			NA
SNAY, HANS G	1DNOL	2	RA	TAYLOR, ALBERT L	1ARFR	P	RA
SNOKE, HUBERT R	1CNBS	E	RA	TAYLOR, GEORGE C JR	1SX		RA
SOKDELLI, A			NH	TAYLOR, JAMES H			RE
SOLLNER, KARL	1HNIH	E	RA	TAYLOR, JOHN K	1CNBS	BE	RA
SOMMER, HELMUT	1DAOF	S	RA	TAYLOR, LAURISTON S	1CNBS		RA
SOOKNE, ARNOLD M	5HARE	E	RA	TAYLOR, MODDIE D	2HHOU	E	RA
SOUDER, WILMER	4CONS	EW	RA	TAYLOR, RAYMOND L	3AAAS		RA
SPARHAWK, WILLIAM N			NE	TCHEN, CHAN-MOU	1CNBS		RA
SPECHT, HEINZ	1HNIH	BU	RA	TEELE, RAY P	1CNBS	B	RA
SPENCER, J T	1XNSF		RA	TELFORD, IRA R	2HGWU	U	RA
SPENCER, LEWIS V			NA	TEPPER, MORRIS	1XNAS	Y	RA
SPENCER, R R			NE	THALER, WILLIAM J	2HGEU	2	RA
SPICER, H CECIL	1IGES	H	RA	THAYER, THOMAS P	1IGES	H	RA
SPIES, JOSEPH R	1ARUR	E	RA	THOM, H C S	1CWEB	Y	RA
SPOONER, CHARLES S JR	5AUCO		RA	THOMAS, JAMES L	1CNBS		RA
SPRAGUE, GEORGE F	1ARFR		RA	THOMAS, PAUL D	8CLUN	V	RA
ST GEORGE, RAYMOND A	1AFOR	DFLZ	RA	THOMPSON, JACK C	1CWEB	Y	RA
STADTMAN, E R	1HNIH	E	RA	THOMPSON, PHILIP D			NA
STAIR, RALPH	1CNBS	S	RA	THURMAN, ERNESTINE B	1HPHS	F	RA
STAKMAN, E C			NA	TILDEN, EVELYN B			NA
STAUSS, HENRY E	1XNAS	V	RA	TILLYER, E D			NA
STEARN, JOSEPH L	1CCGS		RA	TIPSON, R STUART	1CNBS	E	RA
STEERE, RUSSELL L	1ARFR	K	RA	TITTSLER, RALPH P	1ARUR	Q4	RA
STEFANSSON, VILHJALMUR			NE	TITUS, HARRY W			NA
STEGUN, IRENE A	1CNBS		RA	TODD, FRANK E	1ARFR	DFZ	RA
STEINER, ROBERT F	1DNMR	EB	RA	TODD, MARGARET R	1IGES	H	RA
STEINHARDT, JACINTO	1DNX	EB	RA	TOLL, JOHN S	2HUMD	B	RA
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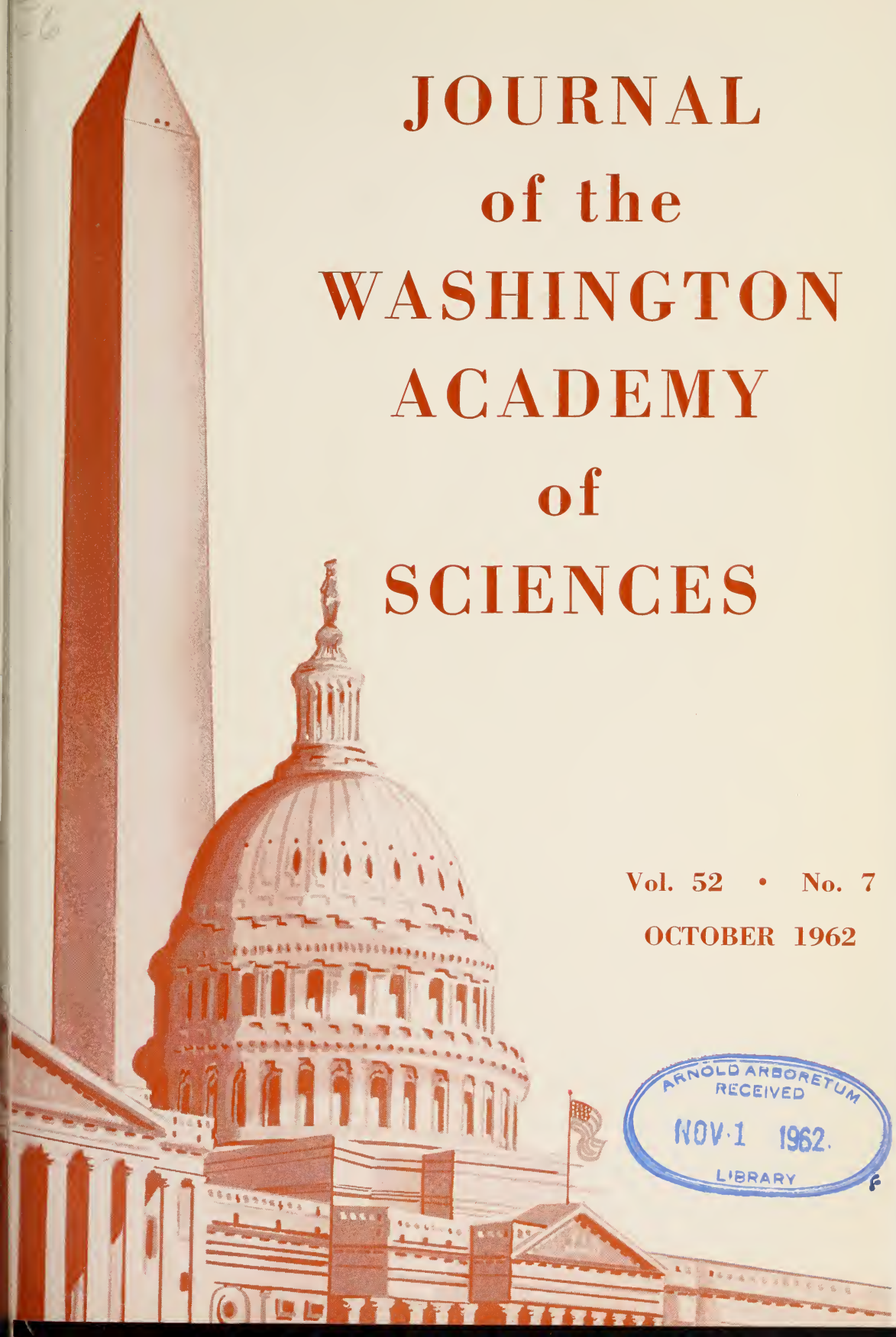

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Editor: Samuel B. Detwiler, Jr., Department of Agriculture

This Journal, the official organ of the Washington Academy of Sciences, publishes historical articles, critical reviews, and scholarly scientific articles; notices of meetings and abstract proceedings of meetings of the Academy and its affiliated societies; and 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 New Genetics and Its Implications*

T. M. Sonneborn

Indiana University

Within the past decade, the problems of genetics have been attacked by new techniques and with a new approach warranting recognition of a "new genetics." Of its implications for biology (and as will appear, also for Man), there are two opposed views. On the one hand, some hold that the essence of biology is complexity, that the new genetics is not biology at all, but chemistry and physics, and that it can never progress to understanding of "real" biology such as ecology or evolution. On the other hand, some of those who are inspired by the accomplishments of the new genetics maintain that it will progressively reduce all biology to biochemistry and biophysics, and that it is already a waste of time to work in the old biological ways. What does an attempted objective look at the old and the new genetics reveal about this conflict of views?

The significance of the old or classical genetics lies in its type of methodology as much as in its results. By mere observation of the characteristics of organisms and their relative frequencies in successive generations, it was possible to make valid inferences about the existence, organization, and behavior of unseen and otherwise unsuspected entities, sets of genes. These achievements of purely biological methodology were the essential prerequisites for the new genetics; they set the problems to be attacked.

With this background, the new genetics went on to tremendous accomplishments. They resulted from two essentially new approaches—simplification of materials and problems, and intensive concentration on a maximally limited area. The new genetics stripped away the complexities that impeded the further progress of classical genetics. It worked on cells instead of complex higher organisms; it worked on the underlying biochemical, instead of the more complex morphological, traits. And the new genetics posed only the simplest—that is, the most fundamental—questions: What is the gene? How is it organized? What is its chemical composition? How does it reproduce itself? What, at the genic level, is a mutation? What are the steps leading from the gene to its first product functional in the metabolic machinery of the cell? And it sought answers in the simplest organisms, mainly viruses and bacteria. In seeking them, it concentrated the attention of whole schools of researchers not just on the same organism, but on the same gene, and even—when a whole gene was recognized to pose problems too vast—on a delimited part of a gene. The rewards of this simplification and concentration have been fantastic. All of these problems, commonly believed 20 years ago to be beyond foreseeable solution, have been solved, or work toward their solution is far advanced; and much of this has been accomplished within the past decade, some within the past year.

No wonder, then, that many practition-

* At ceremonies on April 26, 1962, marking the opening of the new McCort-Ward Biology Building at Catholic University of America, the principal speaker was Tracy M. Sonneborn, Distinguished Service professor of zoology at Indiana University. Dr. Sonneborn, a member of the National Academy of Sciences and 1961 president of the American Institute of Biological Sciences, is internationally known for his research on the genetics of certain protozoa. The present paper is his own résumé of the address, which will be published in full in the AIBS Bulletin.—Ed.

ers of the new genetics and of the closely allied molecular biology believe that every problem of biology will yield to work guided by the same point of view—proceeding step by step to the next more complex set of problems after the underlying, simpler ones have been solved. They are, in fact, already beginning to train their guns on the next set of problems, the problems of cellular differentiation. Is the old sort of biology passé? No! Just as classical genetics — old-fashioned biology— yielded the prerequisite theoretical constructs and methodologies and posed the problems for the new genetics, so it is doing the same at the next level of complexity. This interplay of purely biological and molecular methodologies appears to be required at every step in the attack on progressively higher and more complex biological problems. It therefore seems necessary, for the long-range future advancement of biology, to nurture *both* approaches to biological problems.

What, if any, are the implications of the new genetics for the future of Man? Dramatic predictions have been publicly attributed to eminent researchers whose opinions are not to be taken lightly. They are said to hold that the findings of the new genetics are about to provide Man with great new powers to make the hereditary constitution of the human race according to his plans and wishes. They have urged that Man lose no time in meeting this new challenge before it comes upon him unprepared. On the other hand, there are doubtless some who believe that our present knowledge or presently foreseeable knowledge could not make such human genetic engineering possible. To what conclusions does an analysis of the evidence lead?

The control of human heredity can come, so far as we at present know, in only one of three ways: By selective breeding; by directed mutation; or by directed replacement of genes of one individual by genes extracted from another individual. All three methods have been to some extent successfully applied to bacteria. The first method is not new, and its limitations are well-known. In any case, the present division of opinion concerns only the two new methods. Is their early extension to Man likely to be feasible?

Examination of the facts shows that directed mutation is still far away. Only the first step has been taken: the use of chemical mutagens which act specifically on the genic material. Such mutagens do not act randomly. Nevertheless, each can mutate any gene, and can mutate each gene in many ways. Further, although these mutagens are more powerful than radiations, still only a small percentage of exposed cells show detectable mutations. With bacteria, the rarer desired mutants can be selected, the many undesired ones thrown away. Both the relatively high risk of getting no mutation or the wrong one, and the need to throw away the failures, make this an impracticable approach to human genetic engineering. It is imaginable that more specific and more efficient mutagenic chemicals could be constructed, but the first steps toward this have not been taken, and their application to Man, even if they were available, would present formidable purely scientific difficulties.

Similar limitations beset the isolation, transfer, and substitution of genes. In bacteria this is a very rare event and still quite undirectable. Two approaches to directed genic substitutions are possible, but neither has yet been accomplished, even with bacteria. Limited success for certain relatively unimportant genes is possible in the near future. However, the greatest presently forseeable successes with microorganisms do not include any satisfactory solution of the problem of low yield, and therefore of great wastage, due to radically selective procedures. Hence there appears to be no present indication that such approaches to human genetic engineering are likely to succeed in the foreseeable future.

Even if methods were now available

along these or related lines for complete directed control of the hereditary constitution in bacteria, the chance for their early extension to Man would be slim. The necessary knowledge of the genetics of human cell cultures is almost totally lacking. Special features of the genetics of higher organisms, that do not complicate the picture in bacteria, may be expected to impede the acquirement of the needed knowledge and to limit the applicability of methods of control which might be adequate for bacteria. Among these features, two are outstanding. One is the fact that the nuclei of human cells have two genes of each kind, while those of bacteria have only one. This renders much more difficult all work on mutations and on gene replacements in human cell cultures. The second fact is that most genes which are active in cells while they are in the human body, appear to lose their activity when the cells are taken out of the body and grown like protozoa. This has virtually prevented human cell genetics from getting off the ground. Until we learn how to make active the genes we want to study in cell cultures (and almost nothing is yet known about this), great progress in the new genetics of human cell cultures can hardly be expected. But, if and when that is accomplished, progress may be rapid. Meanwhile, it must be said that present knowledge of the genetics of microbes and Man appears to be a long way from predictable human genetic engineering. Many gaps in knowledge and methods would first have to be filled. How, when or if they will be filled is at present unforeseeable. All in all, the prospects of successfully using the new genetics to tamper with the genetic constitution of Man seem remote.

Pest Control and Wildlife Relationships*

W. H. Larrimer

National Academy of Sciences—National Research Council

Introduction

When national or international problems involving the applications of scientific research require examination by specialists and recommendations for their solution, the National Academy of Sciences—National Research Council (NAS-NRC) is often called upon to establish a suitable committee to take such action. Sometimes an *ad hoc*, or temporary, committee is first called upon to advise NAS-NRC on personnel, program, and support of a standing committee to be appointed later. Such was the case in 1959 after the great cranberry scare, when many people began to wonder about the alleged untoward effects of pesticides** on organisms, including man, that might inadvertently be exposed to them. The Food Protection

* This brief account of an important activity of the National Academy of Sciences—National Research Council is published in the JOURNAL because it is centered in Washington; because it is an example of the quiet, competent, public service characteristic of NAS-NRC; because the work of the Committee on Pest Control and Wildlife Relationships deserves more publicity than it has yet received, especially at this time when chemical pest control is under severe attack; and finally because the author—executive secretary of the committee whose conclusions are reprinted here—is a member of the Washington Academy of Sciences. (Complete reports appear in NAS-NRC publications 920A and 920B.)—Ed.

** "Pesticide" has come into use in recent years as a general term for chemicals used for

Committee of the Food and Nutrition Board, an important unit of the Division of Biology and Agriculture, NAS-NRC, already had a Subcommittee on Pesticides concerned with safeguarding human food from contamination by pesticides; but there was no committee looking into the side-effects of pesticides on fish, birds, and other wildlife that are so important to sportsmen and nature lovers. The manufacturers and users of pesticides on the one hand, and wildlife conservationists on the other, were eager to reduce to a minimum the damage to wildlife resulting from the application of pesticides.

Committees and Meetings

To gauge the problem, an *ad hoc* committee (see addendum), approved by the president of the National Academy of Sciences (then Detlev W. Bronk) was appointed by the former chairman of the Division, H. Burr Steinbach. Three of the members were officially concerned with pest control, three with the conservation of wildlife, and one with the protection of Man. The neutral chairman was Herbert E. Longenecker, now president of Tulane University. Thus it was hoped that diverse interests could be brought together and fused for the common good.

This committee met on July 7 and 8, 1959. It concluded that the need to define the nature and extent of possible hazards to wildlife, and to outline a continuing program of investigation and evaluation, could not be met adequately by a single conference of experts. This could best be accomplished, in the committee's view, by the formation of a standing NAS-NRC Committee on Pest Control and Wildlife Relationships, charged with responsibility (1) to identify and draw together the available scientific information and (2) to point out gaps in present knowledge and areas of needed research related to the ecological and economic implications and consequences of pest control operations.

In order to evaluate the possible moral and financial support, the *ad hoc* committee proposed that a conference be called of invited representatives of organizations that should be interested in such a continuing program.

Such a conference was held on January 15, 1960. Opening this meeting, S. Douglas Cornell, executive officer of the National Academy of Sciences—National Research Council, explained that the NAS-NRC is a private, non-profit corporation dedicated to the furtherance of science for the general welfare and required by its Congressional charter to act as an official adviser on scientific matters to the Federal Government. Thus is provided an independent, unbiased organization through which knowledge, experience, and thinking of the top scientific talent of the country may be brought to bear on problems of great public concern.

After presentation of background information by members of the *ad hoc* committee, there was general discussion. It was the sense of the meeting that (1) a standing Committee on Pest Control and Wildlife Relationships should be established in the Academy-Research Council and (2) financial support should be sought from diverse groups concerned, in order to assure broad interest in the problem and freedom of action on the part of the committee.

In response to this recommendation and after considering over 50 nominations, made by those who attended the meeting and others, a Committee on Pest Control and Wildlife Relationships (see addendum) was appointed by the president of NAS-NRC on May 12, 1960. At the first meeting of this Committee the following objectives were defined:

(1) To provide technical advice and guidance to Government agencies, industries, and other public and private organizations and individuals on problems involved in the maximum control of pests with a minimum of damage to other forms of plant and animal life.

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the protection of Man and his goods, domestic animals, crops, and forests against attack by insects, plant pathogens, nematodes, weeds, rodents, etc.

(2) To provide critical evaluation of information concerning the direct and indirect effects of various pest control operations on plants and animals, particularly fish and wildlife.

(3) To stimulate and encourage research and investigations to obtain factual information, as a basis for sound guiding principles and policy determinations.

(4) To foster cooperation among various agencies, organizations, industries, and individuals concerned with pest control operations and with their effects on plant and animal life.

(5) To provide a forum for the discussion of problems of pest control and wildlife relationships.

It was also decided that three subcommittees (see addendum) would be needed (1) to define, delimit, and evaluate areas that pose wildlife loss problems, (2) to develop guiding principles for control operations, and (3) to review past, present, and needed research.

Reports

Reports were prepared by the respective subcommittees, approved by the committee, and published by NAS-NRC in January, 1962. The conclusions are reprinted below.

Evaluation of Pesticide—Wildlife Problems

Destructive pests make difficult the production of food, fiber, and timber needed for man's survival, while still other organisms threaten his health or comfort.

Through years of research, the use of chemical pesticides has evolved as one of the several pest-control practices essential to the adequate production of farm crops, forests, and livestock, and in the control of pests detrimental to man's health, comfort, and general welfare. On the other hand, there have been instances where pesticides under certain conditions of use have brought about a reduction in numbers of desirable forms of life.

There is broad public interest in wildlife, representing individuals from all walks of life. Wildlife ownership is vested in the State, despite the fact that a high percentage of the birds and mammals are now produced on privately-owned land, largely agricultural in character. Although the Indians and early settlers relied upon wildlife to meet a substantial portion of their essential food requirements, today's emphasis, excluding commercial fisheries, is placed largely upon recreational and esthetic values. Because of increases in population, individual wealth, and leisure time, the number of people interested in the conservation of wildlife is increasing steadily.

While biologists generally regard the use of pesticides as an emergency measure, it seems obvious that their use will continue until such time as suitable substitutes can be developed. Efforts to hold pests in check through biological, cultural, and ecological measures have been and are being made, but such efforts alone are not enough. Increases in the population, modern trends in automation, and rising labor costs which demand increased efficiency preclude continuing the practice of sharing crops with pests.

Pesticide use imposes certain hazards on wildlife that are not shared by man and his domestic animals, which are afforded considerable protection by the observance of specified intervals between pesticide application, the occupation of treated areas, and the consumption of treated produce. Wildlife receives no such protection.

Sweeping generalizations must be avoided in drawing conclusions regarding the danger from use of pesticidal chemicals. Pesticides are used in many ways, for many purposes, and in many situations. Thus, as would be expected, many valuable uses for pesticides are practically devoid of any pronounced hazard to wildlife, while certain other practices pose very real hazards that at times have caused serious damage.

Four general conclusions stand out: (1) Because they were developed as toxicants for certain species of animals, insecticides and rodenticides tend to pose greater hazard to wildlife than do other classes of pesticides; (2) although wildlife may at times be adversely affected by

the normal use of pesticides, it is the misuse of those pesticides highly toxic to specific plants or animals that poses the greatest hazards to wildlife; (3) greater damage to wildlife may occur in eradication and other programs requiring pesticide dosage application rates considerably higher than those used in the routine agricultural, forest, and public health pest-control programs; and (4) heavy losses in aquatic life, especially fish, often can be traced to lack of proper safeguards to prevent unintended spread of the chemical over water areas.

In order to hold wildlife losses to a minimum, scientists representing all of the disciplines involved should unite forces in an all-out effort to identify and evaluate specific hazards and to develop corrective measures for objectionable practices.

Policy and Procedures for Pest Control

Careful organization and conduct of pest-control programs will do much to insure effective results with minimum damage to wildlife. The tested procedures described in this report are recommended to all those responsible for pest-control programs. In summary, these procedures are:

(1) ***Identify the problem.*** Organize and make systematic surveys promptly to detect and specifically identify the damaging pests. Review the literature.

(2) ***Make biological evaluation.*** Determine the status of each pest and its trend. Appraise probable damage.

(3) ***Choose control method.*** Determine for each pest situation the possible courses of action and evaluate their relative merits for controlling the pest with the least adverse effects on wildlife and other values. Choose the most suitable from the following methods: (a) Exclusion or confinement by quarantine, (b) eradication, or (c) supression. If supression is the course indicated, select from the following methods: (a) Biological, (b) cultural (manipulation of host or environment), (c) chemical, and (d) integrated. Decide whether pilot operations are necessary to test feasibility of large-scale work.

(4) ***Weigh costs of protection against values to be protected.*** Weigh costs of control, including hazard to fish and wildlife, against the economic and social values threatened. Take into account alternative courses of action and the relative urgency of competing projects.

(5) ***Recommend course of action.*** Make technical recommendations based on nature of the threat, available control measures, expected tangible benefits, and feasibility of control objectives.

(6) ***Decide on action.*** Review the technical recommendations with all affected groups participating. Decide (a) whether to undertake control, (b) how it will be done, (c) by whom it will be done, (d) whether legal authority and funds are adequate, and (e) what precautions are necessary.

(7) ***Allocate costs.*** Assign proportion of control costs on the basis of benefits to be derived.

(8) ***Plan the project.*** Define objectives clearly, determine the scope of the project, and plan carefully and realistically. Integrate into the plan positive measures for protecting wildlife values. Draft contracts to insure administrative control at all times.

(9) ***Carry out the project.*** Insure adequate supervision of the control program, keep procedures flexible enough to adjust to changing conditions. Measure effectiveness of control and impact on wildlife as work progresses. Consistent with public interests, respect private property rights.

(10) ***Appraise results.*** Review and assess project accomplishments to devise means for increasing effectiveness and lessening harmful side-effects.

(11) ***Keep people informed.*** Let the public know at all stages what is being done and why it is being done.

(12) ***Conduct research.*** Establish an active program of research to develop new methods and increase effectiveness of control, yet minimizing harmful effects to wildlife.

Research Needs

This report has not been completed. It will review the research that has been done on pest control, and on the effects of pesticides on wildlife. It will include a discussion of current research programs and research that needs to be done.

Many of the honest differences of opinion in the field of pest control and wildlife relationships are due to lack of dependable information on the various phases of the problem. This emphasizes all the more the need for a sound research program, manned by competent researchers in the various disciplines and under experienced and skilled leadership.

ADDENDUM

Membership of Committees

Ad Hoc Committee on Pest Control and Wildlife Relationships

Herbert E. Longenecker, vice-president, University of Illinois, Urbana, Ill.

George C. Decker, head, Economic Entomology Section, State Natural History Survey, Urbana, Ill.

Ira N. Gabrielson, president, Wildlife Management Institute, Washington 5, D.C.

Wayland J. Hayes, Jr., chief, Toxicology Section, Communicable Disease Center, Technical Deveolpment Laboratories, Department of Health, Education, and Welfare, Savannah, Ga.

L. S. Hitchner, executive secretary, National Agricultural Chemicals Associations, Washington 6, D.C.

E. F. Knipling, director, Entomology Research Division, U.S. Department of Agriculture, Agricultural Research Service, Beltsville, Md.

Daniel L. Leedy, chief, Branch of Wildlife Research, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, U.S. Department of the Interior, Washington 25, D.C.

Robert L. Rudd, assistant professor of zoology and assistant zoologist in the Experiment Station, University of California, Davis, Calif.

Committee on Pest Control and Wildlife Relationships

Ira L. Baldwin (chairman), special assistant to the president, University of Wisconsin, Madison 6, Wis.

George C. Decker, head, Economic Entomology Section, State Natural History Survey, Urbana, Ill.

Ira N. Gabrielson, president, Wildlife Management Institute, Washington 5, D.C.

Tom Gill, executive director, Charles Lathrop Pack Forestry Foundation, Washington 6, D.C.

George L. McNew, managing director, Boyce Thompson Institute for Plant Research, Yonkers 3, N.Y.

E. C. Young, dean of Graduate School, Purdue University, Lafayette, Ind.

Mitchell R. Zavon, professor of industrial medicine, University of Cincinnati, Kettering Laboratory, Cincinnati 19, Ohio.

Subcommittee on Evaluation of Pesticide Wildlife Problems

George C. Decker (chairman and member of the parent committee).

Edward L. Kozicky, director, Conservation Department, Olin Mathieson Chemical Company, East Alton, Ill.

Daniel L. Leedy, Fish and Wildlife Service, U.S. Department of the Interior, Washington 25, D.C.

George L. McNew, managing director, Boyce Thompson Institute for Plant Research, Yonkers, 3, N.Y.

L. D. Newsom, head of entomological research, Agricultural Experiment Station, Louisiana State University, Baton Rouge 3, La.

H. P. Nicholson, chief, Pesticide Pollution Studies, Public Health Service, Department of Health, Education, and Welfare, Atlanta 23, Ga.

Robert L. Vannote, national advisor, American Mosquito Control Association, Morris Plains, N.J.

Mitchell R. Zavon, professor of industrial medicine, University of Cincinnati, Kettering Laboratory, Cincinnati 19, Ohio.

Subcommittee on Policy and Procedures for Pest Control

Tom Gill (chairman and member of the parent committee).

E. D. Burgess, director, Plant Pest Control Division, Agricultural Research Service, U. S. Department of Agriculture, Washington 25, D.C.

C. C. Compton, division representative, Shell Chemical Company, Washington, D.C.

W. W. Dykstra, Fish and Wildlife Service, U.S. Department of the Interior, Washington, D.C.

R. L. Furness, chief, Division of Forest Insect Research, Forest Service, U.S. Department of Agriculture, Portland 8, Ore.

R. D. Hale, Conservation Foundation, New York 16, N.Y.

E. L. Kolbe, forester, Western Pine Association, Portland, Ore.

S. W. Simmons, Communicable Disease Center, Atlanta 22, Ga.

Subcomittee on Research Needs

Ira N. Gabrielson (chairman and member of the parent committee).

James A. Beal, director, Division of Forest Insect Research, Forest Service, U.S. Department of Agriculture, Washington 25, D.C.

Clarence Cottam, Welder Wildlife Foundation, Sinton, Tex.

Samuel A. Graham, School of Natural Resources, University of Michigan, Ann Arbor, Mich.

C. H. Hoffmann, assistant director, Entomological Research Division, U.S. Department of Agriculture, Beltsville, Md.

Donald A. Spencer, Pesticide Regulation Division, Agricultural Research Service, U.S. Department of Agriculture, Washington 25, D.C.

Clarence M. Tarzwell, Taft Sanitary Engineering Center, U.S. Public Health, Cincinnati 26, Ohio.

John A. Zapp, Jr., director, Haskell Laboratory, E. I. duPont de Nemours and Company, Wilmington 98, Del.

THE BROWNSTONE TOWER

"Please send me all information about . . ." Who in Washington has not received such requests, either directly or from a buck passer? What should one do with such innocent inquiries? Destroy the faith of children in Santa Claus by ignoring them, or by telling them the facts of life? Or should one try to send *some* information? I have not adopted any one formula. As I like to think of myself as an altruist who tries to encourage science talent, I ignore only very stupid letters. To most I try to offer some helpful advice, often writing a note on the bottom of a letter and returning it to the sender. This I did on a letter of March 5 from a girl in Philadelphia. My note caused the child's mother to rush to her defense, whereupon I tried to make amends. This correspondence quoted below, except for names of those involved, might be helpful to some, amusing to others. It represents a large unresolved problem in scientific communication.

March 5, 1962

Dear Sirs:

I am working on a science project for the Delaware Valley Junior Science competition. My project is on the mosquito and how it carries the malaria parasite. I would appreciate it greatly if you would send me some information on this topic as soon as possible as it is needed by March 15, 1962.

Sincerely,
L. S.

6 March 1962

Dear L:

Hurry to the nearest public library and look up your subject in one of the standard encyclopedias. The National Research Council does not rush information to students who need it for science projects. Please learn to use libraries

Sincerely yours,
Frank L. Campbell
Executive Secretary
Division of Biology
and Agriculture
NAS-NRC

March 7, 1962

Dear Mr. Campbell:

Enclosed is a letter written by my daughter, and your reply of March 6th; it is to your reply that I now make reference.

It was not her intention to impress you with the fact that this was a "rush job." L— has been working very diligently on this science project, and has been to three (3) libraries and has obtained to this point fifteen (15) references on the subject. One of the books entitled "Medicine in Action," by Margaret O'Hyde has a list of thirty (30) "Sources of Further Information." Due to her eagerness to obtain as much literary information as she could (in addition to her fifteen (15) reference books, plus the two (2) sets of encyclopedias we have at home) she wrote to you, as you were on the list of "Sources of Further Information."

It is quite feasible that you receive many inquiries from students "looking for an easy out"; however, in this case you truly were a very poor judge, as L— happens to be a straight "A" student in all subjects.

I am just wondering at this time, how many more truly interested and eager students received the same sarcastic reply.

Yours very truly,
(Mrs.) V.R.S.

March 27, 1962

Dear Mrs. S:

Thank you very much for your letter of March 7. It is unusual for anyone to acknowledge my inadequate but sincere attempts to help young people who write to this Division of the National Academy of Sciences-National Research Council. To be sure, you were less than pleased with my suggestion that L—learn to use libraries.

because, unknown to me, she had already exhausted her local library resources. I am sorry that neither of us knew enough about the other to make a really helpful contact. In this one instance I shall try to close the gap.

I wonder what image you have of the National Academy of Sciences-National Research Council. You may imagine it to be a large Government agency employing many people who do nothing but answer requests for information, to which you as a taxpayer are entitled. Actually this is a relatively small private organization, whose principal duty is to advise the Government through the voluntary services of many scientists who serve without compensation and for a limited time on committees dealing with various scientific problems. These committee activities do lead to publications, usually containing facts and recommendations. All we have to offer the public are these publications, which are listed in the enclosed catalog. You will note that a charge is made for most of them and that few of them would be of any use to a secondary school student. In other words, we have practically nothing in print that we can drop into an envelope and send to a good student like L— to supplement information she has already obtained. Nor can we take the time of specialists, whom we cannot pay, to answer inquiries from students. We have only one information officer on the staff of NAS-NRC. It is his duty to inform public information outlets of the activities of our committees; he has neither the time nor the knowledge to reply to letters from students. Nevertheless, our information officer and the whole professional staff of NAS-NRC want very much to do what they can to encourage science talent in young people. That is why we take time to reply to carefully written, naive letters, like that from L—, instead of dropping them into the waste basket (the cruder sorts *do* go into my wastebasket).

Going back to L—'s letter, which you kindly returned to me, I remind you that she told me nothing about her previous studies in malariology. She merely defined her science project and on March 5 asked for "information on this topic as soon as possible as it is needed by March 15, 1962." Assuming that she had no information at all and knowing that I could not take time to do her library work for her, I urged her on March 6 not to depend on strangers to help her, but to meet her imminent deadline by using her local libraries. I'm sure you know now that I was not being "sarcastic" but was trying, too briefly, to give her sound advice.

I want to thank you particularly for citing "Medicine in Action," by Margaret O'Hyde as the source of our address to which L— wrote for "further information." I had often wondered how young students all over the country get the name of this Division. You have given me one answer.

I am a native of Philadelphia and graduated from the West Philadelphia High School (1916) and the University of Pennsylvania (1921). There were no "science projects" in those days, but I had some extraordinarily good teachers who were a source of inspiration to me. I still think that the student-teacher relationship is most important and leads naturally to self-improvement in libraries and laboratories. I hope L— is enjoying similar privileges and will have a useful and satisfying career in whatever she chooses to do later.

Very sincerely yours,
Frank L. Campbell

Abelson Named Editor of Sicence

The new editor of SCIENCE is Philip H. Abelson, who served as president of the Washington Academy of Sciences in 1961. He succeeds Graham DuShane, another member of the Washington Academy, who is now dean of graduate sciences at Vanderbilt University.

In addition to being editor of SCIENCE, Dr. Abelson plans to continue his research activities as director of the Geophysical Laboratory of the Carnegie Institution of

Washington, and to serve as one of the editors of the JOURNAL OF GEOPHYSICAL RESEARCH.

As editor of SCIENCE, Dr. Abelson will have the opportunity to guide the development of this very important journal to meet the rapidly changing needs of the scientific community. His broad editorial experience and his own achievements in research fit him well for this task.

Dr. Abelson graduated in chemistry from the State College of Washington (now Washington State University) and earned a master's degree in physics at the same institution. He received the Ph.D. degree from the University of California in 1939. He has made major scientific contributions in the fields of biochemistry, chemistry, engineering, geophysics, microbiology and physics. During World War II Dr. Abelson was a key figure in the Manhattan Project. He was awarded the Navy's Distinguished Civilian Service Medal for his war work.

Achievement Award Nominations Requested

The WAS Committee on Awards for Scientific Achievement has announced that nominations for the Academy's annual scientific achievement awards are currently being solicited.

Each year the Academy gives awards for outstanding achievement in five areas—biological sciences, engineering sciences, physical sciences, mathematics, and teaching of science. Award winners are honored at the Academy's annual dinner meeting in January.

All members of the Academy are invited to submit nominations as early as possible. Information on nomination procedures can be obtained from the general chairman of the Awards Committee, Professor John S. Toll of the University of Maryland (WA 7-3800; home OL 4-0404).

Science in Washington

SCIENTISTS IN THE NEWS

Contributions to this column may be addressed to Harold T. Cook, Associate Editor, c/o U.S. Department of Agriculture, Agricultural Marketing Service, Room 2628 South Buildings, Washington 25, D.C.

AMERICAN UNIVERSITY

Alfred Weissler, adjunct professor in the Departments of Chemistry and Physics, has received a research grant from the Office of Naval Research for the study of "Cavitation Intensity Measurements by Chemical Means."

APPLIED PHYSICS LABORATORY JOHNS HOPKINS UNIVERSITY

R. E. Gibson gave a lecture to the Brookings Institution *Conference on Public Affairs,* held for Federal science executives at Williamsburg, Va., April 8-14, Dr. Gibson's talk was entitled, "Systems Approach to the Management of Research and Development."

A. M. Stone was recently appointed as a fellow member of the Hudson Institute. This is a non-profit research organization devoted to studies of national security and international order.

GEOLOGICAL SURVEY

Thomas B. Nolan, director of the Survey and recent past president of the Geological Society of America, received an honorary Doctor of Laws degree from the University of St. Andrews, Scotland, at its commencement on June 29.

HARRIS RESEARCH LABORATORIES

Alfred E. Brown, president of Harris Research Laboratories, has been presented with a certificate of award by the Metropolitan Washington Board of Trade, for distinguished service as chairman of the Science Committee of the Science Bureau. He has just completed his term. Dr. Brown also has been elected to the Board of Directors for a three-year term.

Harris Research Laboratories again participated in the Summer Institute for High School Science Teachers sponsored by the National Science Foundation. This was the seventh year of HRL participation. Ten outstanding science teachers from various parts of the country spent half their time working on research programs at HRL to broaden their science background; the other half of their time involved course work at American University.

Several members of the staff attended the Gordon Research Conferences, held last summer at New London, N. H., as follows: **Milton Harris** and **John Menkart** attended the Textile Conference, **Anthony M. Schwartz** attended the Friction and Wear Conference, and **Henry Peper** attended the Conference on Interfaces.

NATIONAL BUREAU OF STANDARDS

Allen V. Astin is chairman of a Federal Council for Science and Technology panel, composed of heads or deputy heads of Government research organizations, which for the past year has been studying ways to improve the Government's capabilities for conducting and managing its expanding program of research and development.

NAVAL RESEARCH LABORATORY

Herbert Friedman, superintendent of the Atmosphere and Astrophysics Division, presented the fifth in a series of Forum lectures on space science for overseas broadcast by the Voice of America on February 5. Dr. Friedman's lecture was about research on solar flares.

Leland A. DePue presented a talk on May 7 at the 29th International Foundry Conference in Detroit. The title of his talk was "The Influence of Silicon on Gun Metal Alloys."

Maurice M. Shapiro, superintendent of the Nucleonics Division and head of the Cosmic Ray Branch, has been awarded a Guggenheim fellowship for 1962-63. He will spend the academic year as visiting professor at the Weizman Institute of Science in Rehovoth, Israel. During his absence, **John McElhinney** will serve as acting superintendent of the Nucleonics Division, and **Bertram Stiller** will be acting head of the Cosmic Ray Branch.

SMITHSONIAN INSTITUTION

The following scientists have recently joined the staff of the Smithsonian Institution's Museaum of Natural History: **J. Lawrence Angel,** formerly associate professor of anatomy at Jefferson Medical College, as curator, Division of Physical Anthropology; **Stanwyn G. Shetler,** recently of the University of Michigan, as assistant curator, Division of Phanerogams; **Philip S. Humphrey,** formerly assistant curator of orinthology, Peabody Museum, and assistant professor of zoology at Yale University, as curator, Division of Birds; **George E. Watson,** recently of Yale University, as assistant curator, Division of Birds; **Paul J. Spangler,** formerly of the Insect Identification and Parasite Introduction Laboratories, Department of Agriculture, as associate curator, Division of Insects; **W. Donald Duckworth,** recently of North Carolina State College, as associate curator, Division of Insects; and **Donald F. Squires,** formerly of the American Museum of Natural History, as associate curator, Division of Marine Invertebrates.

USDA, BELTSVILLE

Lawrence Zeleny made a four-week tour of ten European countries in May under the auspices of Great Plains Wheat, Inc., during which time 11 group meetings and 20 conferences were held on the subject of the wheat sedimentation test. The purposes were to assist in standardizing procedures and equipment in Europe, to furnish information and answer questions concerning the test, and to correct misconceptions concerning the use of the test in the United States. Dr. Zeleny found that a number of the larger European flour millers are using the test routinely, and that the test is being used rather widely and successfully as an aid in wheat-breeding programs.

L. D. Christenson has been promoted to head the Fruit and Vegetable Insects Research Branch, Entomology Research Division, ARS. He succeeds **B. A. Porter,** who was retired in July.

Calvin Golumbic represented the Market Quality Research Division, AMS, at the 13th International Seed Congress of the International Seed Testing Association in Lisbon, Portugal, in May.

C. H. Hoffman was guest speaker before the Washington, D. C. Chapter of the Soil Conservation Society of America, on May 16. Subject of Dr. Hoffman's talk was "Role of Agricultural Chemicals in Relation to Water Pollution and Wildlife."

USDA, WASHINGTON

H. L. Haller spoke at the annual meeting of the American Chemical Society in Washington, D. C., on March 21, on the role of chemical research in food protection.

George W. Irving, Jr., gave a paper at the same meeting of the American Chemical Society, on the role of chemical research in giving cotton and wool fabrics new properties that help them compete with synthetics.

Harold T. Cook was awarded an alumni citation in recognition of outstanding achievements and services by DePauw University at the 123rd Annual Commencement in June. In August, Dr. Cook gave a series of six lectures on the principles of postharvest plant pathology, at a conference for college teachers of general botany and biology which was held at Washington State University, Pullman, Wash., under the sponsorship of the National Science Foundation.

W. T. Pentzer was chairman of local arrangements of the U.S. National Committee for the International Institute of Refrigeration, for the meeting of several commissions and the technical board of IRR in Washington last August. About 225

persons attended, representing 14 countries. Fifty-eight papers were presented.

UNCLASSIFIED

Hugh L. Dryden, deputy administrator of the National Aeronautics and Space Administration, was awarded the Langley Gold Medal of the Smithsonian Institution on April 27 at the annual meeting of the American Philosophical Society in Philadelphia. The medal was awarded to Dr. Dryden in recognition of his "important applications of experimental science to the problems of flight and for his wise and courageous administration of much of America's research and technical developments that now make possible the conquest of air and space."

Richard A. Weiss, Department of Defense, is a member of the Federal Council for Science and Technology.

CALENDAR OF EVENTS

October 18—Society of American Foresters

Slide-illustrated lectures:

(1) C. A. Gillett, managing director, American Forest Products Industries, Inc.. "The Organization, Work, History, and Objectives of AFPI."

(2) J. C. McClellan, chief forester and assistant managing director, AFPI, "The Presentation of Recreational Use of Forest Industry Lands in the United States."

Dinner meeting, 6:30 p.m., YWCA, 17th and K Streets, N.W.

JOINT BOARD ON SCIENCE EDUCATION

The Joint Board on Science Education has reorganized for a busy school season with the election of Ralph I. Cole of Melpar as its chairman. Mr. Cole, who holds degrees in both electrical engineering and physics, is manager of military projects planning at Melpar. He has been on the Joint Board for two years, and served last year as its secretary. He is also a past chairman of the D. C. Council of Engineering and Architectural Societies.

The newly elected vice-chairman of the Board is John K. Taylor of the National Bureau of Standards. Lowell E. Campbell of USDA's Agricultural Research Service is secretary, while Churchill Eisenhart of NBS is treasurer.

Three new members were appointed to the Board during the summer. Academy appointees are Howard E. Finley (Howard University) and Theodore H. Lashof (National Bureau of Standards). The new D. C. Council appointee is Mr. Campbell, while Joseph H. Broome (Minneapolis-Honeywell) was reappointed to membership on the Board.

Chairman Cole has announced the appointment of the following to serve as chairmen of the committees indicated: School Contracts Committee—Walter H. McCartha (Department of Defense); Finance Committee—Russell W. Mebs (National Bureau of Standards); Science Fairs Committee—Theodore H. Lashof (National Bureau of Standards); Teacher Awards Committee—Joseph E. Guidry (Bureau of Reclamation); Curriculum and Advisory Committee—Howard A. Meyerhoff (Scientific Manpower Commission); Frontiers of Science Lectures—Howard E. Finley (Howard University); Research Participation Committee—Leo Schubert (American University); editor of THE REPORTER, and director of science projects—John K. Taylor.

The Joint Board adopted a budget of $7825 to carry on its various activities during the coming school year. These include the sponsorship of the five local area science fairs, an extensive program of awards to outstanding local teachers, the Frontiers of Science lecture series for students, and publication of THE REPORTER. An extensive program of lecture-demonstrations available under the title, "Visiting Scientists and Engineers," and a series of Saturday conferences on science education also are being planned under a National Science Foundation grant to the Academy, which is administered by the Joint Board.

The budget of $7825 mentioned earlier must be raised through contributions from

local scientific societies and other organizations interested in promoting science education. Affiliated societies are reminded that they can help support this comprehensive program by making provision for a contribution to the Board in their own budgets.

Wade M. Edmunds, recently retired electrical engineer with the Rural Electrification Administration, is the new executive secretary of the Joint Board's science projects carried on under NSF grant. He replaces Gravatt Coleman, who deferred his retirement from the telephone company to serve in this capacity for the past two years. Mr. Coleman has built a new home in Virginia's Northern Neck, and has now retired in earnest "to fish."

Mr. Edmunds is a native of South Dakota who received his E.E. degree from Wisconsin. He has done graduate work at Arizona and has also studied nuclear engineering at the Argonne National Laboratory. His early engineering experience was in Mexico and Venezuela. For 25 years he was in Government service, and was special advisor on nuclear projects for REA at the time of his retirement.

Mr. Edmunds will spend half time in the Academy-Joint Board office at 1530 P Street. About two-thirds of his tour will be devoted to Joint Board work, and the rest to Academy affairs. The office hours are from 9:00 a.m. to 1:00 p.m., Monday through Friday.

The Joint Board has prepared an annual report of the activities carried on last school year under a grant from the National Science Foundation. This booklet describes the "Visiting Scientists and Engineers" program, contains summaries of the various science-education conferences held last year, and includes reports on the various experimental educational programs carried out by several schools under Joint Board sponsorship. Copies of the report are available on request to the Joint Board office.

JUNIOR ACADEMY NEWS

This year, the Washington Junior Academy of Sciences has vigorous plans and high hopes. The opening meeting will be held on October 6 in the Hall of Nations at Georgetown University at 10:00 a.m. The guest speaker will be Marie C. Taylor of Howard University, who will talk on "Effortless Achievements by Plants."

This fall the Junior Academy will again sponsor trips to the Fels Planetarium, Franklin Institute, and Academy of Natural Science, in Philadelphia. The science club workshop for officers of area school science clubs will be held in November. During the Christmas holidays, the Junior Academy will hold its annual science convention. In January, a meeting will be held to present summer jobs in science which are available in the Washington area. In the spring come the joint meetings with the Chemical Society and the Washington Academy of Sciences. Finally, the National Science Fair finalists will present their projects at the election meeting in May.

The Junior Academy plans to publish the papers presented at the science convention, sometime in January. It also hopes to publish an edition of the Redbook, a report of the year's activities.

This year's officers are Stewart Wood, president (AP 7-2943); David Zalkind, vice-president; Virginia Fano, secretary; and Stanley Shapiro, treasurer.

—*Stewart Wood*

BOARD OF MANAGERS MEETING NOTES

The Board of Managers held its 545th meeting on March 7 at the American Chemical Society Building. President-elect Specht presided in the unavoidable absence of President Van Evera.

Meetings. Abner Brenner, reporting for the absent chairman, F. N. Frenkiel, reported that at the April 19 meeting of the Academy, Samuel Eilenberg of Columbia University would speak on "New Horizons in Pure Mathematics."

Membership. W. G. Allen, reporting for the absent chairman, M. L. Robbins, presented the names of eight nominees for membership, for First Reading. A. T. McPherson reminded the Board of his feeling that in the selection of nominees for membership, particular attention should be given to younger men who might contribute to the vigor of the Academy, and enjoy at an early age the stimulation that Academy membership could afford.

Grants-in-Aid. On motion of Dr. McPherson, the Board approved a grant of $150 to Ashley B. Gurney of the Department of Agriculture, on assignment to the National Museum, for a project on collection and study of Orthoptera of the Great Dismal Swamp.

Encouragement of Science Talent. Abner Brenner, chairman, announced that a buffet dinner honoring 43 outstanding high school science seniors would be held at Georgetown University on April 4.

Election of Members. Following the Second Reading of their names by Dr. Allen, seven nominees were elected to membership in the Academy, as follows: Orr E. Reynolds, Frederic G. Burke, Howard J. Laster, George C. Taylor, Norman Herz, James P. Owens, and James P. Minard.

Secretary. The Secretary indicated that transfer of the accoutrements of office from former Secretary Specht had been initiated, and would soon be completed.

Treasurer. The Treasurer reported that his new office assistant was functioning effectively; that about two-thirds of member dues had been received; that separate checking accounts had been established for the Academy, the Junior Academy, and the Joint Board on Science Education; and that he was asking Messrs. Cowie and Roberts to serve as an investment advisory committee. Dr. McPherson suggested that the Treasurer ascertain whether the Brookings Institution would be willing, as in some years past, to advise the Academy on its investments.

Old Business. During a discussion of the proposed Academy directory, Mr. Detwiler presented some approximate cost figures on the annual directory of the Chemical Society of Washington. The cost of the 1960 and 1961 directories, involving 2400 to 2800 names, 35 pages, and runoffs of about 3000 copies each, was from $700 to $750.

New Business. The chairman read a letter addressed to Dean Van Evera from Frank W. Clayton of the Organization of Professional Employees, Department of Agriculture, requesting financial assistance for the high school science fair exhibit held annually in the USDA patio. The Board suggested that the letter be referred to the Joint Board on Science Education, for which it was apparently intended.

The Board approved an allotment of $200 to the Joint Board for the support of its summer research program for gifted high school students, directed by Leo Schubert.

The Board of Managers held its 546th meeting on April 5 at the National Academy of Sciences, with President Van Evera presiding.

Meetings. Dr. Van Evera, reporting for the absent chairman, F. N. Frenkiel, reminded the Board that at the April 19 meeting of the Academy, Samuel Eilenberg of Columbia University would speak on "New Horizons in Pure Mathematics."

Membership. Chairman M. L. Robbins presented the names of ten nominees for membership, for First Reading.

Grants-in-Aid. Chairman A. T. McPherson reported no recommendations to the Board, and requested cooperation in encouraging young scientists to apply for grants for the coming summer vacation period.

Policy and Planning. Chairman Wayne Hall presented the application of the Baltimore-Washington Section of the American Ceramic Society for affiliation with the Academy. The Board approved a motion to recommend acceptance of the application by the Academy's membership.

Encouragement of Science Talent. Chairman Abner Brenner reported a most successful dinner was held April 4 at George-

town University, when certificates of merit and technical books were presented to 44 outstanding senior high school students of the Washington area. The program included presentation of certificates and books by Dr. Van Evera, and a talk by Chester I. Page on "Mathematics: A Useful Game." The Board approved the Committee's expenditure of $35 to $50 more than had been budgeted for the affair.

Dr. Brenner indicated that manuscripts of the 26 papers presented at the Junior Academy meeting in December were still being assembled for publication in the spring of 1962.

Science Education. In the absence of Chairman J. K. Taylor, Dr. Van Evera reported that the National Science Foundation had renewed (through August 31, 1963) the following three grants: Support of State Academy of Science programs ($10,550); support of Visiting Scientist programs ($5,550); and publication of *The Reporter* ($2,500).

Election of Members. Following the Second Reading of their names by Dr. Robbins, eight nominees were elected to membership in the Academy, as follows: Edward J. Chapin, Robert O. Fournier, Joseph L. Gillman, Jr., Harry K. Herschman, George L. Hutton, George Sandoz, John R. Townsend, and Glen W. Wensch.

Secretary. The Secretary indicated that transfer of the Secretary's records from Dr. Specht to himself had been all but completed. Negotiations were under way with the Treasurer to consolidate the Academy's address files, in the hope that a single master file could be set up and supervised by the part-time assistant in the Academy office.

Treasurer. The Treasurer reported balances as follows: Senior Academy, $8,073.40; Junior Academy, $5,088.22; Joint Board, $6,976.39. Dividends received in March amounted to $609.96, and other receipts to $1,952.96. The treasurer reported a modest number of unpaid dues, but no resignations attributable to the recent dues increase.

New Business. Leo Schubert urged Board members to stimulate area high school students to submit applications for summer research in area laboratories. Final date for receipt of applications was April 23. It was indicated that interest is increasing in area laboratories in making opportunities available for outstanding students; currently, there are more opportunities than applicants.

Dr. Van Evera announced that President-elect Specht expected to undertake a two-year assignment in Japan beginning January 1, 1963, making it impossible for him to serve as President during the coming calendar year. He asked the Board to consider courses of action in this situation, in view of the Bylaws, so that appropriate steps could be taken at the next Board meeting.

The next meeting was set for May 3, instead of May 4 as originally scheduled.

The Board of Managers held its 547th meeting on May 3 at the American Chemical Society Building, with President Van Evera presiding and H. Specht acting as Secretary.

Appointments and Announcements. Dr. Van Evera announced that W. W. Smith and Maurice Apstein had been appointed as new members of the Committee on Policy and Planning.

Meetings. The speaker at the next meeting (third Thursday in May) was announced as Marshall Nirenberg of NIH, who was to speak on genetic coding.

Grants-in-Aid. Chairman McPherson reported on a plan for the support of "family research projects," the object of which is to solicit applications from one or both of the scientists parents of high school students, for grants that would enable such junior scientists to carry out research projects with their parents during the summer vacation. There is a precedent for such grants: the Board had previously approved a grant to the 15-year-old son of an entomologist to carry out insect collections in the Dismal Swamp area with his parents. Dr. McPherson pointed out that

such family collaboration was common in the past, extending to such renowned investigators as Marie Curie and her daughter, Irene Curie Joliot. Regulations now forbid such collaboration in the Government, and it is only rarely found in private laboratories; but he felt that reestablishment of such collaboration would be useful. He asked that written applications be sent to him at NBS; no special form is required. Grants in the amount of $50 to $150 could be entertained.

Policy and Planning. Chairman Hall reported that the Committee had discussed changes in the Bylaws to broaden the basis of regular membership, but that at the present time agreement had not been reached on the wording of the qualifications. When the matter is stabilized it will be brought before the Board.

Dr. Campbell brought up the recent Board action to permit affiliation of the Baltimore-Washington Section of the American Ceramic Society, and pointed out that this action removed the restrictions which previously had been applied against affiliation of societies with geographical jurisdictions existing beyond the Washington metropolitan area. Dr. Campbell suggested that the Society of Teachers of Mathematics, which earlier had been denied affiliation, might well again apply with the expectation of receiving favorable consideration; also, that the Baltimore-Washington Section of the Society of Plastics Engineers might desire to be reconsidered. Dr. Van Evera pointed out that still other groups, such as the Washington Section of the Psychological Society, might feel it desirable to approach the Academy again.

Membership. Chairman M. L. Robbins presented the names of 13 nominees for membership, for First Reading.

Treasurer. Dr. Henderson summarized the year's fiscal transactions. He reported that about 190 members had not paid current dues.

Editor. Dr. Van Evera reported that Editor Detwiler was on his way to India, but that Dr. Campbell and Mr. Farrow were currently processing the page proofs of the May *Journal.*

Election of Members. Following the Second Reading of their names by Dr. Robbins, 10 nominees were elected to membership in the Academy, as follows: Rucker Carrington, Roy C. Dawson, David C. dePackh, Charles G. Durbin, Blake M. Loring, Vincent E. McKelvey, George A. Moore, Howard E. Noyes, Thorndike Saville, Jr., and Harold P. Weinberg.

New Business. Dr. Schubert reported that activity in support of summer work in science laboratories by high school students, was coming along very well. Of a hundred applications, some 80 students had been selected. In response to a question, he indicated that the support per student amounted to $85; the financing came from various sources, including the Academy.

Dr. Van Evera announced that Gravatt Coleman, employed in the Academy office on Joint Board affairs, was leaving in July, and that Wade Edmonds had been engaged to take his place, on a half-time basis.

Dr. Van Evera also announced that a new chairman of the Meetings Committee would have to be appointed, since Dr. Frenkiel had agreed to carry this respon sibility only through the spring months. He briefly discussed a suggestion that meetings be held at various places in the metropolitan area (NIH, Walter Reed Hospital, Navy Medical Center, etc.), in order to sample the attendance from these areas; and he hoped that a broad interdisciplinary approach could be taken in regard to the program. He hoped also to copy the Chemical Society practice of having dinner meetings beforehand, since these seemed to be quite effective in stimulating attendance and interest.

Dr. McPherson suggested that, because of the current expeditious conduct of Board meetings, it might be appropriate at the meetings to schedule brief reports on the activities and hopes of the affiliated societies, with regard to the help which the Academy and the Board could give

them. In the ensuing discussion, Dr. Campbell asserted that even Board members appeared to have too little knowledge of the Academy's objectives. He briefly discussed the activities of the Maryland Academy of Sciences, which under its new president, Nigel Wolfe, proposes to set up a science center for Baltimore and the State, hoping in this way to attract many new affiliated societies; he pointed out that affiliation is largely a matter of having something to offer. He urged that Dr. McPherson's vision of a separate building and facilities for the Academy offices should be taken seriously.

Mr. Farrow announced the sudden death of Arthur Sidwell, chairman of the local section of the Institute of Food Technologists, the Academy's newest affiliate.

The next Board meeting was set for June 4.

The Board of Managers held its 548th meeting on June 4 at the National Academy of Sciences, with President Van Evera presiding.

Grants-in-Aid. On motion of Chairman McPherson, the Board approved a grant of $75 to Karen Ann Thomas of Fairmont High School, for a project concerned with statistical studies of tree leaves.

Policy and Planning. Chairman Hall discussed a report of the Committee that was circulated to the Board with the minutes of the 547th meeting. He explained that the Committee proposes to enlarge membership in the Academy by adding a new class of membership for persons interested in supporting science but not otherwise qualified for membership. Present members would become fellows. The intent is to enlarge the usefulness of the Academy to the scientific community in and around Washington.

A statement indicating necessary changes in the Bylaws which would be needed to implement the proposal was present to the Board, and amended after discussion. The Board then approved the amended statement and directed the Secretary to submit the Bylaws changes to the Academy's membership for approval at the 1962 elections.

Membership. Chairman Robbins presented the name of one nominee for membership—C. W. Hiatt, III—for First Reading. In view of the forthcoming summer recess, the Board agreed that if no objections were received by the Secretary before June 19, Dr. Hiatt should be considered as having been elected.

Following the Second Reading of their names by Dr. Robbins, 13 other nominees were elected to membership in the Academy, as follows: Pierre J. Ausloos, R. Carson Dalzell, Leo Friedman, David Garvin, Edward A. Kane, Edward C. Knoblock, Buford K. Meade, Marshall W. Nirenberg, Hideo Okabe, Louis J. Schoen, James B. Small, Merrill J. Whitman, and Robert W. Zwanzig.

Science Education. Chairman Taylor reported that the Committee's annual report was being prepared for publication. He expected that next year's program, for which funds already had been received, would continue in the same pattern as in the past year.

Secretary. Dr. Irving reported that his office, now in possession of the Academy's official records, had been briefed by Dr. Specht, the previous Secretary, on the complex mechanics of handling the membership files.

Treasurer. Dr. Henderson presented a brief fiscal report, indicating that all members delinquent in dues had received a second billing. Prompted by suggestions at previous Board meetings, he will invest Academy bank surpluses in 90-day 2.7-percent Treasury bills, that are subject to continuation for a second 90-day period. Dr. Henderson also reported that he had considered the Academy's stock investments in the light of present market conditions, and intended to take no action with respect to these investments unless directed to do so by the Board. The Board took no action.

New Business. Dr. Henderson reported that the Cosmos Club had requested indi-

cation of the Academy's intentions concerning monthly meetings during 1962-63. Since the Board was about evenly divided when asked to express preferences for meeting at the Cosmos Club or at various other places in the metropolitan area, it was felt that the latter course should be explored, but that as a safeguard, reservations should also be made for holding the meetings at the Club. Such reservations are subject to cancellation on suitable prior notification. Dr. Van Evera agreed to reserve the Club's Powell Auditorium for the third Thursday of each month from October 1962 through May 1963.

The next meeting of the Board was set for October 2.

SCIENCE AND DEVELOPMENT

August 17 marked the completion of one year of operation of the world's first isotope-powered, automatic weather station. It was installed on Axel Heiberg Island in Canada's Northwest Territories, only 700 miles from the North Pole, by scientists from the Weather Bureau, the Martin Company of Baltimore, and the Canadian Department of Transport. This unattended station measures wind direction and speed, barometric pressure, and temperature, and transmits them every three hours to the Joint Canadian-United States Weather Station at Resolute, Canada. The information has been used to improve weather forecasts and pilot briefings. Eventually, the Weather Bureau hopes that hundreds of these automatic stations will be placed in mountainous and polar regions, oceans, and deserts, where it is not practicable to establish and maintain manned weather stations.

Lamb meat gets its characteristic flavor from the fat, probably from minor constituents called carbonyls, according to a recent report by Irwin Hornstein and Patrick F. Crow of the Department of Agriculture at Beltsville. Similar results have been obtained in earlier work with beef and pork. Cooked patties made from ground lamb with all the fat removed had only the general taste of meat; they had no characteristic lamb flavor. Aromas produced by heating rendered lamb fat had a strong mutton odor. Further research showed that if the carbonyls were removed, the remaining fat did not have a mutton aroma when heated.

The Hall of Life Sciences, constructed as the west wing of the National Academy of Sciences, was dedicated on June 27. Construction was made possible by a million-dollar gift from the Equitable Life Assurance Society in 1959. The new wing will house the many activities of the Academy and its National Research Council in the biological, medical and behavioral sciences. It contains two stories and a ground floor, and is constructed in the same architectural style as the main building. The exterior is of Imperial Danby marble quarried in Proctor, Vt. The first floor provides an 800-square-foot conference room and eight offices. The second floor has a conference room of the same size and 14 offices. There is an 88-by-28 foot refectory on the ground floor that can be used as a cafeteria. or as a banquet hall for Academy dinners.

X-ray technologists at the Naval Ordnance Laboratory have developed a "cinefluorographic" system for determining the effect of separations, cracks, and voids in solid missile propellants on motor performance. The system utilizes an X-ray source and a 35-mm camera coupled to a nine-inch image intensifier tube which has a light intensification of 3,000. As the rocket motor burns, its changing internal dynamics are recorded by the movie camera focused on the tube. Results so far indicate that small uniform voids located in the center of the solid propellant merely result in a slight increase in the burning area with no observable effect on pressure. But multiple voids located along a crack nearer the side of the rocket motor may cause a blowout.

A small acoustics research device developed by the Naval Ordnance Laboratory to determine the velocity of sound in sea water may have possible use for controlling quality in the production of commercial products ranging from gasoline to milk. The device is called a velocimeter. It is essentially a 5-inch long stainless steel tube equipped with a signal-generating crystal on one end and a receiving crystal on the other. The velocity of a sound impulse transmitted through a liquid sample is determined by recording the time the pulse traverses the known distance through the sample. Since the velocity of sound in a liquid depends upon the impurities present, the velocimeter may be used to detect the presence of impurities.

Automatic stereomapping equipment, designed to produce topographic data faster and more accurately than equipment currently in use, is being tested at the Army Engineer Geodesy, Intelligence and Mapping R&D Agency (GIMRADA) at Fort Belvoir. This system obtains topographic data from the processing of profiling a stereophotogrammetric model. The inputs of the system are glass diapositives of overlapping photography, camera calibration data, and ground control information. The outputs are contours, orthophotomap, and elevations of a number of selected points within the stereomodel.

The Army Engineers also have an nounced the development of a lightweight 24-volt battery for military use. Called the 4-HN Battery, it was produced by a private firm under contract. It weighs 38 pounds, compared to 74 pounds for the battery currently used by the military, and has half the volume displacement of its counterpart. A lead-acid, 21-ampere-hour, 12-cell battery, it can be used to crank any engine up to about 40 horsepower. It outperforms its bigger counterparts when starting at –65° F.

American University's Biology Department has received a grant of $8,000 from the Atomic Energy Commission, for the acquisition of undergraduate teaching equipment in nuclear technology as applied to life sciences. Last year the Department received a similar grant of $15,000. The equipment will be used in various courses in physiology, which all biology majors must take.

Forty-five outstanding scientists from 14 foreign countries and the United States will conduct research in this country during the present year as fellows of the Carnegie Institution of Washington. Stipends connected with the fellowships total $152,500, the largest sum so far granted for this purpose in any one fiscal year by CIW. The number of fellows, also, is the largest for any year since the program was begun in 1947. The program is partly financed by the Carnegie Corporation of New York, which has appropriated $250,000 for the purpose, to be used at the rate of $50,000 annually. Of the 45 fellows, 19 will work here at the Geophysical Laboratory, and 13 in the Department of Terrestrial Magnetism.

Delegates to the Washington Academy of Sciences, Representing the Local Affiliated Societies*

Philosophical Society of Washington	R. D. Myers
Anthropological Society of Washington	Regina Flannery Herzfeld
Biological Society of Washington	Delegate not appointed
Chemical Society of Washington	Alfred E. Brown
Entomological Society of Washington	Frank L. Campbell
National Geographic Society	Alexander Wetmore
Geological Society of Washington	G. Arthur Cooper
Medical Society of the District of Columbia	Frederick O. Coe
Columbia Historical Society	U. S. Grant, III
Botanical Society of Washington	Harold T. Cook
Society of American Foresters	Harry A. Fowells
Washington Society of Engineers	Howard S. Rappleye
American Institute of Electrical Engineers	William A. Geyger
American Society of Mechanical Engineers	William G. Allen
Helminthological Society of Washington	Doys A. Shorb
American Society for Microbiology	Howard Reynolds
Society of American Military Engineers	Delegate not appointed
Institute of Radio Engineers	Robert D. Huntoon
American Society of Civil Engineers	Thorndike Saville, Jr.
Society for Experimental Biology and Medicine	Kathryn Knowlton
American Society for Metals	John A. Bennett
International Association for Dental Research	Gerhard Brauer
Institute of the Aerospace Sciences	Francois N. Frenkiel
American Meteorological Society	Jack Thompson
Insecticide Society of Washington	Milton S. Schechter
Acoustical Society of America	Richard K. Cook
American Nuclear Society	George L. Weil
Institute of Food Technologists	Richard P. Farrow

*Delegates continue in office until new selections are made by the respective affiliated societies.

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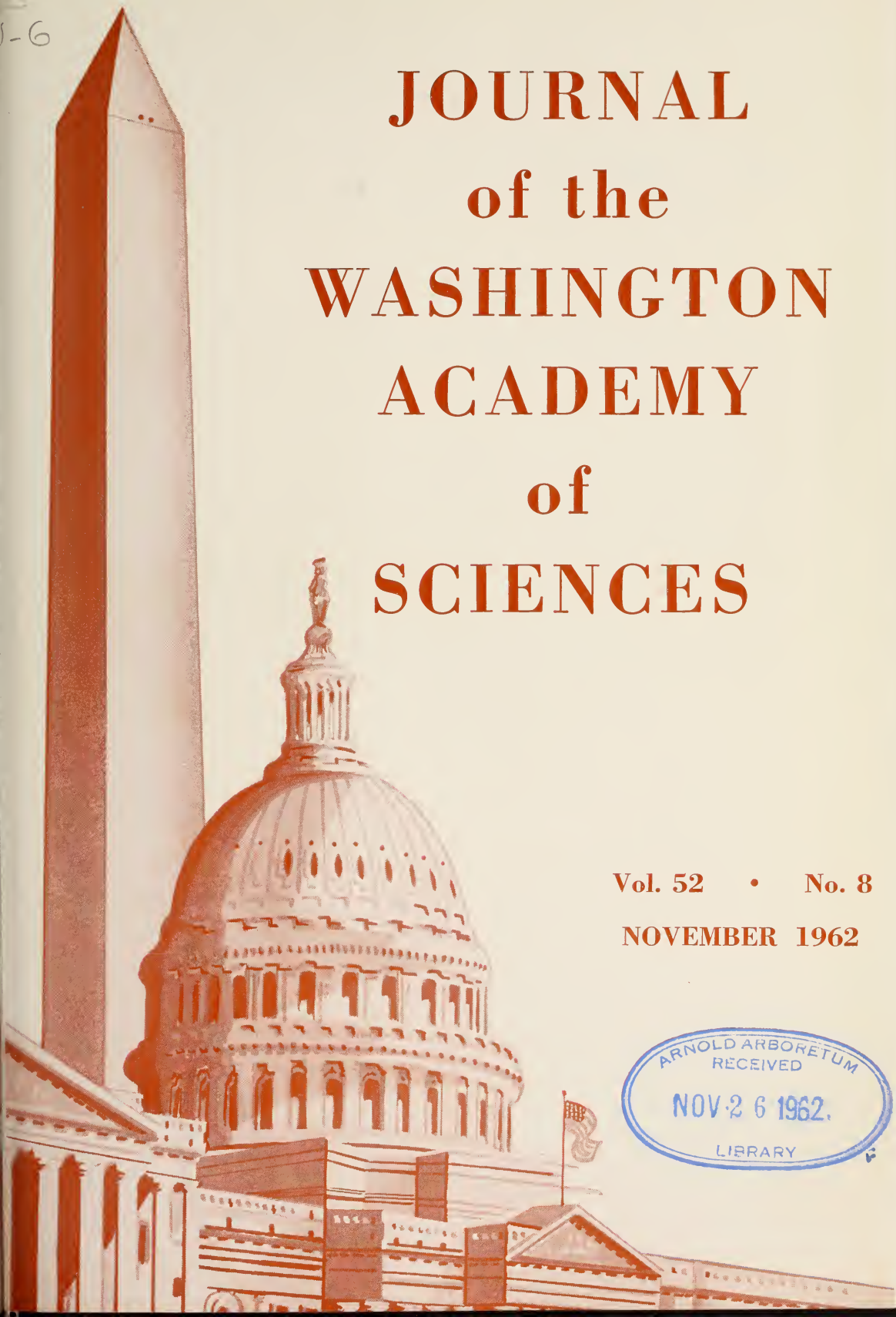

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NOVEMBER 1962

JOURNAL OF THE WASHINGTON ACADEMY OF SCIENCES

Editor: Samuel B. Detwiler, Jr., Department of Agriculture

This Journal, the official organ of the Washington Academy of Sciences, publishes historical articles, critical reviews, and scholarly scientific articles; notices of meetings and abstract proceedings of meetings of the Academy and its affiliated societies; and regional news items, including personal news, of interest to the entire membership. The Journal appears nine times a year, in January to May and September to December.

Subscription rate: $7.50 per year (U.S.) or $1.00 per copy; foreign postage extra. Subscription orders 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."

Back issues of the Journal and Proceedings of the Academy have been taken in charge by the Johnson Reprint Corporation of New York City, which will handle sales on a commission basis. This firm expects to be set up early in 1963 for the direct handling of orders for back numbers. Meanwhile, requests for back numbers should continue to be addressed to the Academy Office at 1530 P St., N.W., Washington, D.C.

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 Academy of a change of address.

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Electrical Energy from Microbiological Processes

Frederick D. Sisler

General Scientific Corporation, Washington, D. C.

The concept that living organisms can produce electricity is as old as the concept of electricity itself, which was formulated during the eighteenth century. One recalls the dispute at that time between Luigi Galvani and Alessandro Volta, as to the nature and cause of the "animal electricity" observed in Galvani's frog muscle experiments and "fish electricity" in Volta's studies of electric fish. It is of historical interest that this dispute led to the discovery by Volta of the galvanic cell, or electrochemical battery, and to the foundation of the field of electrophysiology by Galvani. As to the latter, practically all of the early work on electrical phenomena of biological systems was concentrated on the higher animals. That simple unicellular organisms, such as bacteria, exhibit electrical effects, seems to have escaped notice of the electrophysiologists until the present century.

With the advent of modern instrumentation techniques for the measurement of microbiological processes, it became apparent that single cells change the oxidation-reduction potential of the medium in which they grow and metabolize. Thus bacteria, for example, by virtue of their enzyme activity and their ability to couple exergonic and endergonic chemical reactions, may raise or lower the electronic charge in the chemical components of the medium. Through their ability to change the oxidation-reduction potential, or the hydrogen ion concentration, or the concentration of the metabolites, bacteria and other microorganisms posses the inherent ability to create conditions which could yield electrical energy under appropriate conditions.

For many years microbiologists have been measuring the oxidation-reduction or redox potential of cultures of microbes and their media. The purpose of these measurements for the most part was to study the oxygen requirements of the cells rather than their electrical properties. Actually, however, when such redox measurements were made they represented the potential values of an electrical half-cell.

Potter in 1911 was among the first to point out and demonstrate that a microbial half-cell, when connected to a sterile medium half-cell, could generate electrical energy. His studies were prompted in part by the investigations of Haacke and Klein, who measured electrical production by green plants (plant electricity) around the turn of the century. Potter's researches in the electrophysiology of microorganisms was a truly pioneering endeavor and a classic example of carefully controlled experimentation and accurate interpretation. Potter used a galvanometer to measure electrical current, and a capacitor connected to the galvanometer for E.M.F. Potter recognized the importance of ruling out possible spurious recordings of E.M.F. from causes other than microbial activity. His controls and check tests eliminated E.M.F. differences due to (1) differences in temperature between the media, (2) osmotic or concentration effects, (3) evaporation currents, (4) thermo-electric effect at platinum-to-copper junctions, (5) electrode oxidation, (6) galvanic effects of dissimilar metals, and (7) local charge of

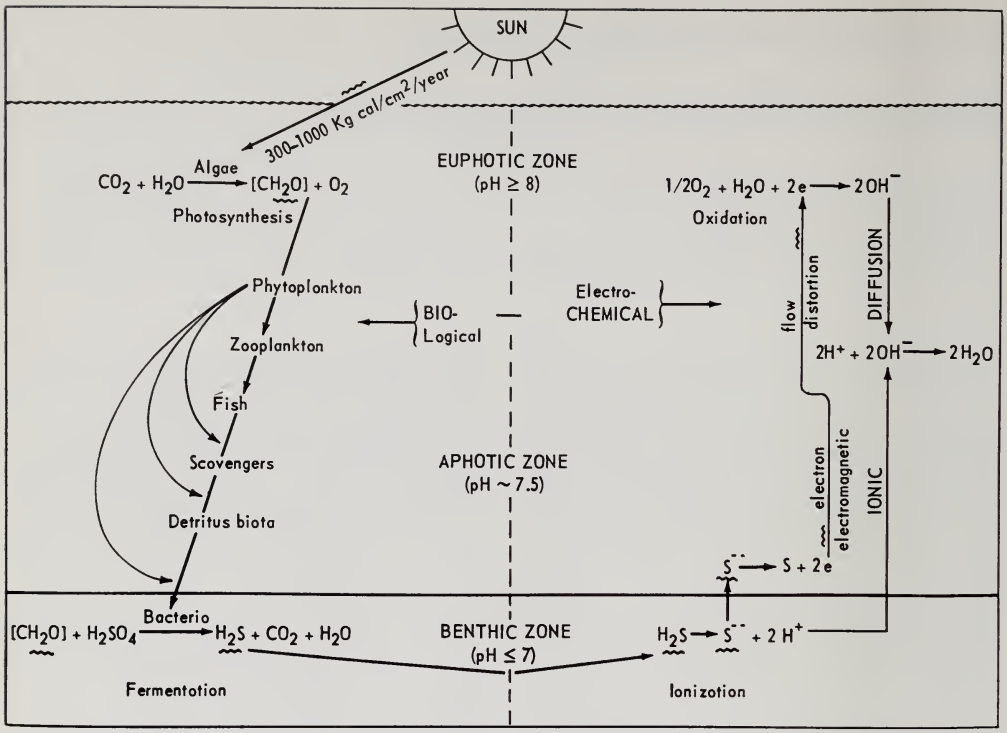

Figure 1. Example of a natural biochemical fuel cell system in the ocean. (Reproduced from "New Scientist," by permission.)

platinum electrodes as may occur from friction.

Working with cultures of yeast in sugar solution and various bacterial species in nutrient media, Potter recorded the following potentials:

Saccharomyces	0.32 volts
Bacillus coli communis	0.35
B. fluorescens	0
B. violaceus	0
Sarcina lutea	0

The zero potential of the last three species was attributed to unsuitable culture media. The peak potential of 0.32 volts, registered by yeast cells in sugar solution, was reached in less than 10 minutes at 25°C. following a short lag phase of no E.M.F. immediately after adding the cells to the substrate. The potential/time slope appeared to be independent of the concentration of the sugar solution between 5 and 20 percent, but dependent on the initial temperature and number of cells used as inoculum. No increase in E.M.F. was observed with platinum electrodes of greater area or thickness than those used in the initial tests, or with larger quantities of yeast cell—sugar solution. Potter also showed that the enzyme systems invertase, with sugar, and diatase, with starch, produced a small potential, i.e., 0.02 and 0.05 volts respectively. Throughout his experiments on bio-potentials, he used a standard electric cell rather than a reference electrode, such as the calomel half-cell, to establish a reference potential.

By connecting six of his cells in series and using carbon electrodes, Potter produced a microbial-powered battery which yielded a current of 1.25 milliampere. This was perhaps the first man-made "living" battery of its type ever designed. He noted that in several respects, such as current direction, his microbial cell was similar to a galvanic cell. An interesting sidelight here is that Potter may have been the first to design a true "galvanic cell," in that Luigi

Galvani's early experiments with electricity dealt with that of living organisms.

Cohen in 1931 pointed out that a bacteria-powered electrical cell that he had assembled was capable of performing work. By connecting his cells in series, he reported that he was able to obtain a current of 2 ma. at a pressure of 35 volts. His unit cell consisted of 10 cc. of culture in medium which was connected to a sterile control. The electrical output was 0.2 ma. at 0.5 volts for at least 5 minutes.

Cohen worked with cultures of *Bact. dysenteriae, C. diphtheriae, Bact. coli, B. subtilis,* and *Proteus vulgaris.* The difference in reduction potential between these cultures and sterile controls ranged between 0.15 and 0.90 volts after several days' growth in a beef extract—peptone phosphate broth of pH 7 at 30°C. He attributed the rapid discharge of these cells to lack of poise. Performance was improved somewhat by addition of poising agents such as potassium ferricyanide.

Cohen's disclosure was forecast ten years previously by extensive experiments of W. M. Clark with collaborators in his laboratories at Johns Hopkins University. Clark's work and observations on oxidation-reduction of living cell suspensions did much to clarify the mechanisms involved in these phenomena, as well as to point out the electromotive limitations of such systems (Clark 1960, 1962).

The development of applications of microbial batteries of the type described above, that would produce electric power for useful work, has not received public attention until fairly recently. Several reasons could account for this situation. One is the rapid discharge of the bio-cells under load. As Cohen observed, most microbial media do not contain sufficient poising agents for a substantial charge to accumulate. A second reason may be attributed to unfavorable reaction kinetics leading to sluggish electromotive response. Another possible reason lies in the general concept that biological systems are too unstable and unpredictable for serious consideration as electric energy converters under practical conditions. Still another reason may be the general misconception that living cells cannot tolerate a large electric charge, and therefore could not possibly be used to generate electric power. Since electric fish can generate pulses of current of 50 amperes and more than 500 volts without committing suicide, it appears that living cells have an amazing tolerance for electricity.

The tremendous progress that has been made in recent years in such fields as microbial physiology, biochemistry, and biophysics throws a more optimistic light on those other above-cited limitations to the development of practical electric power from microbiological processes. As an example, we may cite the rapid strides now being made in the isolation, in pure form, of stable cell enzymes, co-enzymes, and other large molecules concerned with respiration and energetics of living cells. Biocatalysis is another fast-expanding field which promises to produce more favorable reaction kinetics involved in bioelectric energy conversion systems.

Although we may expect a continual improvement in microbiological processes involved in the production of electrical energy as we expand our knowledge in bioenergetics, we are faced with upper limitations on energy yield imposed by chemical thermodynamic laws. For example, if one considers the chemical-to-electrical-energy conversion of an ideal substrate of microorganisms, viz. a carbohydrate, the maximum yield would hardly exceed one milliwatt-hour of electrical energy from one gram-calorie of carbohydrate. Because of adverse osmotic effects, most microbial cells do not thrive in a medium where the carbohydrate content exceeds 20 percent. Since the concentration of the chemical fuel in a microbial battery is limited to this extent, the resultant potential electric energy capacity is likewise limited. In other words, one would expect a microbial battery to be quickly discharged, assuming a reasonable reaction rate, unless provisions

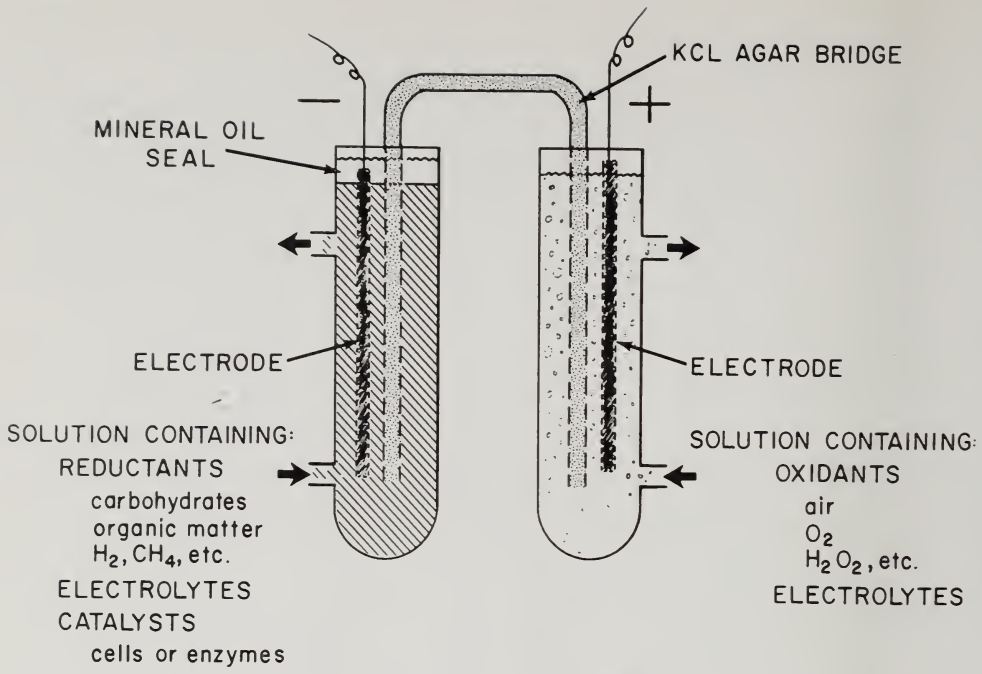

Figure 2. Biochemical fuel cell. (Reproduced from "New Scientist", by permission.)

are made to replenish the chemical substrate more or less continuously. One obvious solution to the above limitation would be to apply the principle of the fuel cell, where fresh fuel is fed continuously into the reaction chamber.

A fuel cell is an electrochemical device, in which part of the energy derived from a chemical reaction maintained by the continuous supply of chemical reactants is converted to electrical energy. Grove is generally recognized as the originator of the fuel cell because of his description of a device he made to demonstrate reverse electrolysis in 1842. Although the fuel cell concept has been known for over a hundred years, it was not until fairly recently that a concerted effort has been made to develop the device for widespread usage. Conventional fuel cells employ various fuels capable of oxidation, including hydrogen, water gas and hydrocarbon gases, coal dust, oxidizable metals, and organic compounds such as petroleum, alcohol, etc. Oxidants include oxygen, air, peroxides, chlorine, acids, etc. Usually a catalyst is employed to accelerate the reaction rate.

As mentioned above, the application of the fuel cell principle, where fuel is continuously fed into a reaction chamber, appears to be one solution to the capacity limitation of microbiological electrical energy production. A device referred to as a biochemical fuel cell has been described, which combines the fuel cell concept with the microbial battery (Sisler 1961). In such a device, the output of electrical energy is limited only by the rate of oxidation of the substrate (chemical energy source), by the fugacity of the system, and by the microorganisms or their enzymes.

Thus far, current densities obtained in a biochemical fuel cell have been low in comparison with those of improved conventional fuel cells. Where non-consumable electrodes have been employed, the current output per cell is less than one milliampere at 0.7 volts using lactate as an energy source, sea water as an electrolyte, and a marine strain of *Desulfovibrio*, an anaerobe which oxidizes carbohydrate with sul-

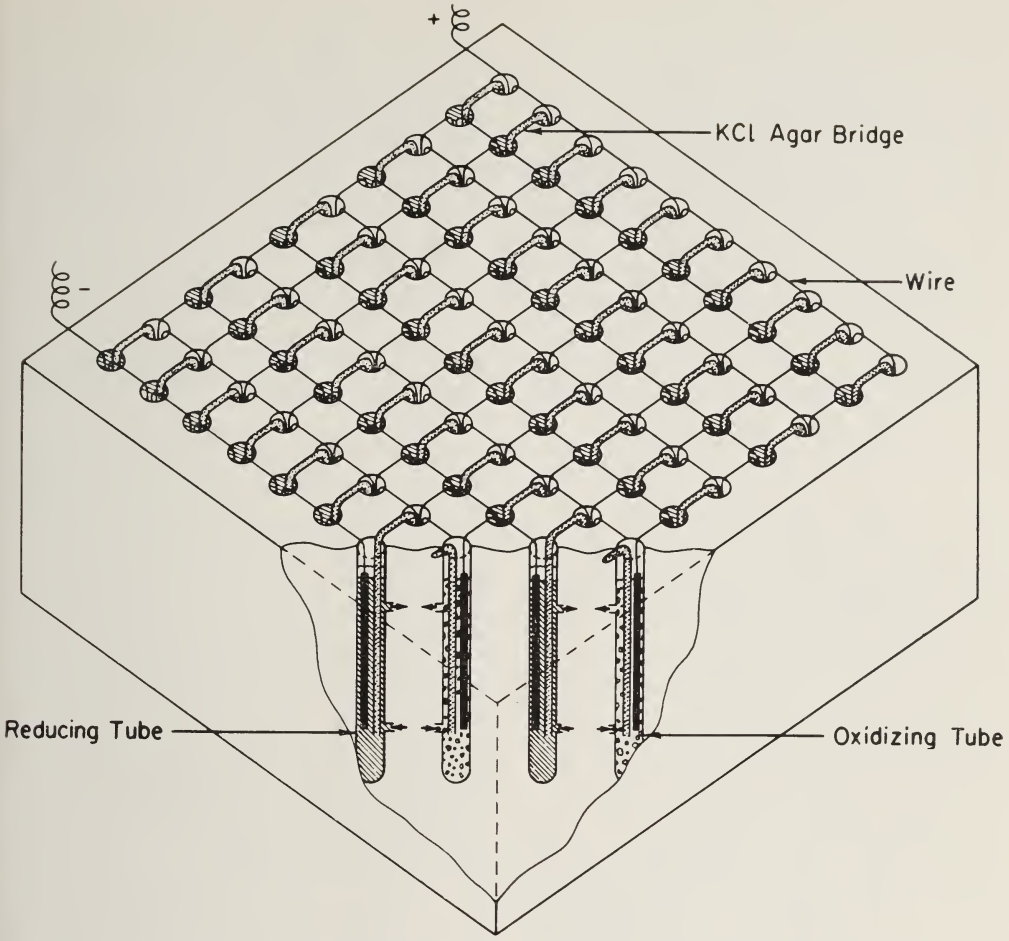

Figure 3. Design of a compound biochemical fuel cell system for experimental purposes.

fate, as the self-reproducing catalyst.

If consumable electrodes are employed in combination with a biochemical fuel cell or microbial battery using organic nutrients as fuel, a considerable increase in current densities may be obtained. Such devices have been under development by the Navy. Project "BEEP" (for Biological Electrical Energy Production) is one project of a program to examine the feasibility of using biological engineering principles for military purposes. This project is under the supervision of Lt. Cmdr. Frank W. Anders, director of the Advanced Concepts Division, Bureau of Ships. With various combinations of electrodes, microbial cells including bacteria, yeasts and algae, and enzymes, current densities have been obtained which range between 0.1 to 10.0 amperes per square foot of electrode surface. Another such project is "BIG" (for Bioelectric Generator). Both "BEEP" and "BIG" are, besides developing bioelectric energy conversion systems, exploring the possibilities of tapping the oceans for new energy sources.

Independent investigators have shown that the ocean environment may provide unique sources of energy which could be tapped for man's use. For example, the natural electrolytes and dissolved organic matter in sea water have led to the development of a highly efficient sea battery (Sarbacker 1962). Sarbacker's design employs

magnesium and iron electrodes, the latter coated with sulfate-reducing bacteria and other microorganisms. Prototypes of the Sarbacker Sea Battery have been operating for months at sea with constant output. In principle, part of the electrical energy comes from the ionization of magnesium, or electrochemical corrosion, and part from the oxidation of hydrogen and organic matter by sulfate-reducing bacteria growing on iron electrodes.* Where sea water electrolytes such as magnesium and sulfate ions are involved in the electrode reactions, the electric potential will be limited partially by the thermodynamic equation, sometimes referred to as the Nernst equation:

$$E = E_0 - \frac{RT}{2F} \ln K.$$

K is the equilibrium constant of the reaction between the metal and ions. At 25°C. this equation reduces to:

$$E = E_0 \pm \frac{0.05915}{\pm z} \log K,$$

indicating a change of potential of 0.059/z volts per tenfold change in concentration of the reactants.

Nernst equation limitations would not influence sea battery operation provided there is some slight water circulation. In a closed system, however, the electrolyte as well as the corrosive electrode would have to be replenished at intervals.

There exist also in the ocean environment natural counterparts of a biochemical fuel cell or sea battery. For several years the writer has been investigating bioelectric phenomena of microorganisms in the sea. Initially these investigations were prompted by the concept that submarine telluric currents may have played a part in the formation of petroleum. Field and laboratory tests showed that a portion of the stray electrical currents measured in the sea bottom were caused by microbiological processes rather than geophysical forces such as differential solar heating of the earth, a possible mechanism to account for telluric currents. Further examination of natural processes in the sea led to the concept that this environment can be considered a gigantic biochemical fuel cell. Ways and means of successfully tapping this energy source remain to be developed. One obstacle to exploiting this natural electrical source is the lack of more efficient and practical means of large-scale storage of weak electric currents.

In view of today's emphasis on energy conversion processes, one may look forward to the continued exploration and development of electrical energy from microbiological processes. At the present time, prototype microbial electric cells have been developed which have the power to operate radio receivers and transmitters, sonobuoys, electric lights, small boats, and a number of other devices. Other applications of this principle appear evident in such matters as utilization of waste material, improved electronics (bioelectronics), space habitability and exploration research and development, civil defense, corrosion prevention, energy for underdeveloped countries, medical, sanitary and other types of instrumentation, military uses, and many others. Moreover, a more thorough study of microbial electrophysiology should throw new light on the nature of living systems besides other natural phenomena in the fields of geology and paleontology.

* The role of sulfate-reducers in rapid corrosion of iron is well established. Starkey of Rutgers University has shown that such action leads to the production of large galvanic currents. The iron of the sea battery described above is not extensively corroded because of the sacrificial electrode effect of the magnesium.

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The Metropolitan Washington Science Bureau—Its Origin and Development

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The 1962 "Directory of Scientific Resources in the Washington, D. C. Area," published on October 11, is tangible evidence of the growth of research and development facilities in the Metropolitan Washington area. The group responsible for the publication of this document is a new organization in the local scientific community, the Science Bureau of the Metropolitan Washington Board of Trade. In addition to preparing and publishing a directory of scientific resources in the Washington area, the Science Bureau has accomplished many other things since its birth early last year. However, the activities of the Science Bureau are still not well known to the broad scientific community. Many members of the Academy have asked me not only about the workings of the Science Bureau, but also about its beginnings, its objectives, the people associated with it, and its accomplishments. I hope to discuss all of these points in this article.

The impact of science and technology on industrial, governmental, and educational activities has been enormous in recent years. This is particularly evident in defense, space, health and welfare, and allied activities. Many members of the Academy are familiar with such figures as the twelve-billion-dollar one which is the total expenditure for research and development activities in America in 1961, and the estimated one of 13.5 billion dollars, an increase of 12.5 percent, for 1962. Approximately two-thirds of these dollars were provided by the Federal Government. I am sure that you have all heard what these expenditures mean in terms of numbers of scientists and engineers now employed, and the new numbers that will be needed if the present rate of growth of R&D continues. There are today somewhat less than a million engineers and scientists in the country. Approximately 150,000 additional people are being trained each year, and the National Science Foundation estimates that there will be more than two million scientists and engineers by 1970.[1]

The enormous R&D expenditures in recent years, particularly those supported by Government, have been translated into a proliferation of research and development activities, or a science complex, in the Metropolitan Washington area. While much publicity about the Boston and California science complexes appears regularly in technical and popular press media, the growth and development of the local science complex has been relatively unnoticed. In fact, the growth of R&D activities here has been so rapid that not only have people outside the technical community been unaware of the situation, but also many people squarely within the R&D complex here have not fully grasped its scope. For example, did you know that there are in the Washington area approximately 200 private re-

search and development firms concerned primarily with the physical and life sciences? that the number of such R&D firms here has more than doubled since 1955? that there are approximately 21,000 scientists and engineers employed in the area? that the total number of scientists here is now approximately 6,400, a 22 percent increase over last year? and that the local area ranks first in the country in the number of technical people per thousand population?

Obviously, this growth is not only of great interest to scientists, but also it is of importance to the local community because there are many advantages in having R&D industry and the highly skilled people engaged therein in a community. Civic leaders strive to attract R&D industry because it contributes to the tax base, is clean, and does not present nuisance problems typical of many industries. R&D activity brings in technical people not only of higher income, who in turn contribute their expenditures and taxes to the welfare of the community, but also of high intelligence, who are active in local government, are interested in fighting for better schools, work for the support of adult education, colleges, and universities, and engage in cultural activities such as symphony orchestras, art galleries, and theaters. Scientists also like to associate with other scientists, so that the presence of scientists in an area tends to attract additional scientists to that area.

During the late 1950's, various people in the R&D community recognized this growth of scientific and technical activities in the Washington area, and appreciated its value both for their own organizations and for the area. Informal sessions among such people indicated that the disciplines encompassed by the various R&D organizations were varied. Many leaders in these organizations hardly knew each other and rarely communicated with each other, despite the fact that they had such common problems as the need for attracting highly qualified technical people to the Washington area. Moreover, unlike the two cultures of the scientific community on the one hand, and the remainder of the world on the other, and their communication problems which C. P. Snow discussed in his book, "The Two Cultures", we found in the scientific community widely separated "subcultures" which were unaware of each other's existence. There were the defense-oriented and the non-defense oriented organizations, the documentation and computer people, and people in the foundations and academies. It was found that the industrial R&D community had only haphazard relationships with the university people, and, indeed, that scientific people in the universities had no organized communications with their colleagues in other universities, directed toward the goal of improving university services for the industrial scientific complex.

Because the industrial R&D people, with their growing needs, were most anxious to know about, and coordinate information about, the scientific resources of the area, it is only natural that they were most active in seeking a new means, such as a Science Bureau, for fulfilling these needs. Of course, there are many professional scientific societies affiliated with the Academy, and the engineering societies affiliated with the D. C. Council of Engineering and Architectural Societies, which are concerned with the professional needs of their membership; but the Science Bureau was not to be concerned with professional activities. Our purpose in the early days was to get together to determine the scope of the local scientific community and what the needs of the R&D industry were, to increase its growth and reputation. Since R&D industry has a very tangible value to the economic well-being of the community, the Metropolitan Board of Trade had an interest in our activities: and in 1959, a Science Advisory Committee of the Metropolitan Washington Board of Trade was formed. Many people were involved in the discussions which followed; some of those who played leading roles were William Eaton, Martin Mason, Philip Reily, Arch Scurlock, Harold Timken, Jr., Julian Ray, Karl Mayer, Dewey Starnes, James Reeves,

John Geist, John Gearing, Leon Thomas, Colonel Stribling, and M. H. Trytten.

Preliminary deliberations resulted in preparation of a report, "Progress and Prospects of Research and Development in Metropolitan Washington." In the development of this report it became clear to the 30 or so people involved that the science-related organizations in Washington had to be understood and recognized as a homogeneous "industry" or "science community" in order to permit tangible progess in the solution of some of its problems. The plan to achieve such an industrial R&D group resulted in the formation of the Science Bureau guided by a Science Committee and various subcommittees, all composed of volunteers from the local R&D community. It was thus that the Science Bureau of the Metropolitan Washington Board of Trade was born, in January 1961. I was selected as chairman of the Science Committee, which was composed of the following:

Donald M. Allison, Jr., president, Vitro Electronics
Robert T. Bower, director, Bureau of Social Science Research, Inc.
Hugh P. Donaghue, president, Datatrol Corporation
Joseph H. Engel, associate director, MIT Operations Evaluation Group
Carl L. Frederick, president, Pyroxite Corporation
J. D. Graves, general manager of Alexandria Department, American Machine and Foundry Company
Walton J. Greer, president, Welex Electronics Corporation
H. H. Greger, president, Trans-Tech, Inc.
Lloyd W. Hazleton, president, Hazleton Laboratories, Inc.
James L. Hollis, president, Rixon Electronics, Inc.
C. Lincoln Jewett, manager of Washington Office, Arthur D. Little, Inc.
Ellis A. Johnson, director, Operations Research, Johns Hopkins University
Martin A. Mason, dean of School of Engineering, George Washington University
Louis C. McCabe, president, Resources Research, Inc.
Russell W. McFall, vice president and general manager of Maryland Division, Litton Systems
Gomer T. McNeil, president, Photogrammetry, Inc.
Ralph E. Mock, executive vice president, Materials Testing Company, Inc.
DeWitt O. Myatt, executive director, Greater Washington Industrial Council
Walter B. Nelson, vice president, Computer Usage Company, Inc.
Henry C. Nickel, manager of Nuclear Power Department, Allis-Chalmers Manufacturing Company
Harry J. Older, president, The Matrix Corporation
Leon Ourusoff, director of research, Washington Gas Light Company
Jacob Rabinow, president, Rabinow Engineering Company
Julian H. Ray, president, Washington Technological Associates, Inc.
William H. Reynolds, chairman of Board, American Instrument Company
Paul E. Ritt, director of research, Melpar, Inc.
Herbert W. Robinson, president, CEIR, Inc.
Eugene P. Rubacky, president, Drug Detection & Development Organization, Inc.
L. E. Saline, manager of Information Systems Section, General Electric Company
Arch C. Scurlock, president, Atlantic Research Corporation
George B. Shaw, general manager of ACF Electronics Division, ACF Industries, Inc.
Tad Stanwick, president, Pneumo-Dynamics Corporation
G. Russell Tatum, president, Vitro Laboratories
Louis S. Taylor, administrative director, W. R. Grace & Company Research Division
Leon L. Thomas, vice president, Systems Planning & Research Corporation
Bruno O. Weinschel, president, Weinschel Engineering Company
Geoffrey Woodard, president, Woodard Research Corporation

William H. Press, executive vice president of the Board of Trade, was enthusiastic about this activity, and he appointed Gordon Kennedy, Jr., a qualified economist on the staff of the Board of Trade, as Science Bureau manager. This was an excellent choice, since Mr. Kennedy worked diligently and effectively with our Committee. Mr. Kennedy left the Science Bureau last spring, and M. W. Veren was appointed to take his place.

It soon became obvious that to reach our broad objective of increasing the growth, reputation, and prosperity of scientific enterprise in the Metropolitan Washington area, many things could be done in the area of information collection and dissemination, in areas concerned with improvement in educational facilities, particularly in scientific graduate education, and in

developing means for attracting top-flight scientists and engineers to the area.

Because many problems affecting the science community involve educational and governmental institutions, the founding group arranged to have these groups eligible for membership in the Bureau. At present, the Bureau is composed of private research and development organizations, universities, and Government research organizations. Thus, Metropolitan Washington now has a Bureau which is a focal point for cooperative action not only among private R&D firms themselves, but also between industry and university. As far as we are aware, this is the first attempt of a scientific community in an area to form such a concerted group to span the interests of so many diverse R&D resources.

The first meeting of the Committee was held in March 1961. It was decided to hold monthly luncheon meetings, and such meetings have been successfully held, with no summer break, up to the present time. At these meetings, plans are discussed and activities are reported. All activities are channeled through subcommittees composed of able and energetic members of the R&D community. The Bureau is organized on a fiscal year basis, and all original appointments were made to serve through June 30, 1962. The original subcommittees and their chairmen were: (1) *Policy and Planning*—William W. Eaton, chairman: (2) *Education*—Philip K. Reily, Jr., chairman: (3) *Information Development and Dissemination*—John C. Geist, chairman: (4) *Membership*—Harold Timken, chairman.

In its early deliberations, the Policy and Planning Subcommittee set the following policy: "The purpose of the Science Bureau is to serve science-related organizations in the Washington area by furthering the growth, reputation, and prosperity of local scientific enterprise. Its purpose is *not* to serve the scientific interests of scientists: this is the province of the individual professional societies, academies and councils. The Bureau's activities will be directed more toward community-wide endeavors than toward specific concerns. It will also serve social and psychological science organizations as well as those concerned with the physical and life sciences. Membership dues will be related to the size of the organization."

The primary objective of the Education Subcommittee is to help to improve the stature of higher education, and particularly graduate resources, in the sciences in the Washington area. The subcommittee is approaching its objective along two lines:

(1) The principal approach is to identify and review the educational needs of the Washington scientific community, and to recommend means for fulfilling them. This approach should produce the information on (a) major needs of the Washington R&D community in the field of higher education, and the extent to which these needs are presently unfilled; and (b) recommended means for improving the utilization of our present educational resources to achieve a graduate-level institution or institutions of international reputation to fulfill future needs.

(2) A second approach was to cooperate with, and to review the direction and progress of efforts by, several groups in the community which are interested in establishing in Washington a major new graduate institution of the highest caliber.

Through the work of the Information Development and Dissemination Subcomittee we wished to make known the fact that there is indeed a science complex in Washington, with extensive capabilities in many areas. Information development was concerned with collection of information, data, and analysis of data ranging from something as simple as a central file of information about local science organizations, to something as complex as a study to determine how much of the national research expenditure is made in the Washington area, and in which activities.

Information dissemination was concerned with the following: (1) A central office, with competent staff, capable of providing the answers to questions about

Washington organizations' capability in research and development; (2) publication of a periodic scientific newsletter; (3) publication of a specific personnel recruitment piece which could be adapted to the needs of many organizations; and (4) release to the press of timely news items about Washington scientists and engineers, and about local organizations. These activities help to create and support a nation-wide image of Washington as a science center.

The Science Committee meetings are not only concerned with subcommittee reports, but also include other activities such as panel discussions and talks by prominent people associated with local institutions. Specific illustrations of programs are: (1) Presentation by Spencer M. Smith, Jr., of the University of Maryland, of the results of a survey supported by the Small Business Administration, on "Problems of Research and Development Firms in Washington"; (2) presentation by Martin A. Mason of a new tuition plan now in effect in the School of Engineering at George Washington University; (3) a panel discussion by the technical personnel managers of the Goddard Space Flight Center, Vitro Laboratories, Litton Systems, Inc., and Operations Research, Inc., on the recruiting problems facing their organizations; (4) a panel discussion, held on the day of Colonel Glenn's space flight, of contributions of local R&D firms to the Mercury space program; and (5) a presentation by Col. James O. Vann, commander of the Armed Services Technical Information Agency (ASTIA) on its role in helping R&D organizations to obtain information.

Before summing up the accomplishments of the Science Bureau during the past 18 months, I should point out that we have had excellent cooperation from the local press about R&D activities. Almost daily, stories or announcements about technical people and their organizations may be found in the *Post*, the *Star*, and the *News*. The *Daily News* honored local R&D with a special edition on "*Science in the Nation's Capital*," which described both private and Government science activities.

It is always appropriate to report membership growth in the initial stages of an organization's existence, because this connotes the interest of the R&D community. There has been solid accomplishment here in fine membership growth: we now have 70 regular members, 14 associate members, and 8 academic members.

In the field of Information Development and Dissemination, the most tangible accomplishment was the publication, in July 1961, of an extensive directory entitled "*Scientific Resources in the Washington, D. C. Area.*" This was the first document of its kind in this area. It lists all of the R&D resources in the Washington area under the following groupings: Part I, Research and Development Firms, Physical and Life Sciences; Part II, Research Groups, Social and Psychological Sciences; Part III, Documentation, Operations Research, and Computer Specialists; Part IV, Scientific Foundations and Institutions; Part V, Federal Government Research Facilities; Part VI, Scientific Activities of Colleges and Universities; Part VII, Scientific Academies, Associations and Societies; Part VIII, Libraries.

Each organization is listed by name and address, executive officer, fields of interest, facilities maintained in this area, activities carried out in this area, date of founding, number of people, and number of scientific and engineering people engaged.

This first issue of the directory attracted nation-wide attention in the technical press. *Chemical and Engineering News*, the American Chemical Society's weekly journal, devoted a page to the Directory under the title, "*R&D Becomes Capital's Growth Industry.*" More than 5,000 copies of the directory were sold and distributed. The second edition was issued on October 11, 1962; it also was widely reported by the technical press. Summary tables from this second edition * are as follows:

* Available from The Metropolitan Washington Science Bureau, 1616 K St., N. W., Washington 6, D. C. Price $2.50.

Table I.—Summary of Organizations, Employees, Scientists, and Engineers in the Washington Area, August 1962

	Organizations	Total employees	Scientists and engineers
Research and development	198	24,611	6,423
Social science groups	56	982	575
Documentation, operations research, and computer	34	3,116	1,018
Government laboratories	32	43,214	13,112
Total	320	71,923	21,128

Table II.—Growth of Research and Development, Washington Area

	New organizations	Organizations in existence
1962 (July '61-Aug. '62)	32	198*
1961 (Jan.-June)	7	190
1960	24	183
1959	21	159
1958	15	138
1957	16	123
1956	14	107
1955	11	93
1954	12	82
1953	6	70
1952	10	64
1951	6	54
1950	9	48
1949	1	39
1948	8	38
1947	3	30
1946	7	27
1945	4	20
1943	2	16
1942	1	14
1900-1941	10	13
1848-1899	3	3

* Because of mergers, transfers, or other business reorganizations, the number of organizations in existence is 198, 8 more than were in existence in 1961.

Table III.—Size of Research and Development Organizations, Washington Area, August 1962

Employment size group	Organizations		Employees
1-5	22		86
6-10	28	79	222
11-15	20		265
16-20	9		166
21-30	23		623
31-40	12	46	436
41-50	11		530
51-100	22		1,542
101-200	26		3,537
201-300	7		1,716
301-500	9		3,206
501-1,000	3		2,008
1,035 (Atlantic Research Corp.)	1		1,035
1,174 (Page Communications Engineers, Inc.)	1		1,174
1,326 (ACF Electronics)	1		1,326
1,840 (Vitro Laboratories)*	1		1,840
2,135 (Johns Hopkins, APL)	1		2,135
2,764 (Melpar)	1		2,764
Total	198		24,611

* Both Vitro Corporation divisions account for 2,265 employees.

Table IV.—Employees in Research and Support, by Research Activity, 32 Federal Installations, Washington Area, 1962

Activity	Employment	Activity	Employment
Weapons development	13,308	Weather and astronomy	1,594
Medical	11,824	Documentation	1,347
Space	4,572	Postoffice	350
Agriculture	4,357	Roads	303
Standards	2,601	Mines	180
Mapping	2,519	Natural history	155
		Coastal areas	104

Another high spot of the year in publicity about the Washington science complex was the feature article, "*Washington Turns into Capital for Nation's Science Concerns*," in the *New York Times* for March 11, 1962. The Science Bureau also has had radio and TV coverage.

We have established a "News and Notes" newsletter by which we distribute notices, reports of meetings, and information of interest to the science industry in the area. The Bureau office has answered hundreds of inquiries in regard to the local R&D complex. Plans are well along for a recruitment piece which can be adapted to individual use by the Washington R&D industry. This will be a boon to the smaller firms which cannot afford elaborate brochures of their own.

Our efforts in the field of education have aroused the most interest locally, and have been a source of great satisfaction to the people working on this subcommittee. For the first time in history, scientists and engineers from industry, universities, and Government are getting together to discuss problems of mutual interest. Moreover, we have greatly stimulated interchange of ideas among the universities themselves. Specific accomplishments and projects initiated have included:

1. Initiation of a study of the educational needs of the Washington area, which is now being conducted by Research Analysis Corporation. Irving H. Siegel, director of the Economics and Costing Division of RAC, has been assigned to the project. The study is concerned with determining ways to improve and augment the area's graduate educational capabilities in the sciences: identifying roads to increased participation in academic programs by members of Washington's research and development community; and improving the interaction and cross-fertilization within the Washington academic, governmental, and industrial complex. This study was started in June, and Dr. Siegel has visited and interviewed many people in universities and R&D industries since that time. We are awaiting the final report, which is scheduled for completion by the end of November.

2. Preparation of a list of university people who are available as consultants to the R&D industry.

3. Preparation of a list of qualified industrial scientists who are available for part-time teaching and other assistance to universities.

4. Interest in a study by the five universities in the District of Columbia which have joined to develop cooperative efforts and exchanges of credits at the graduate level.

We have helped to develop a real understanding of the value of being located in an area with a strong university complex. In recent years, it has become obvious that strong R&D industrial growth has occurred in areas containing universities with strong scientific graduate schools, and excellent technological institutions.[1, 2, 3] It is no coincidence that the science industry in Southern California is located near UCLA and California Institute of Technology, or that the Boston science complex is located near Harvard and MIT. We found that in both communities, R&D industry was often started by people who came from those educational institutions. Close relationships continued between R&D industry, started by these scientific entrepreneurs, and universities in the area. Moreover, top-notch scientific and engineering graduates from the universities were recruited by the local R&D industry. Because scientific brainpower enjoys being associated with creative scientists and engineers, this complex had a magnetic effect, attracting scientists of high caliber from outside the particular areas. One need merely recall the number of Nobel prize winners in science who work in these geographical areas.

Whereas R&D industry in the Boston, Southern California and San Francisco Bay areas derived their birth, growth, brainpower, and stimulus from nearby universities, many of Washington's R&D industries were started by scientists and engineers who came from Government laboratories.

Therefore, Washington is unique in that its R&D industry had strong Government laboratories as its counterpart of the universities in the other areas. It becomes obvious that if our Government complex is augmented by educational institutions of the highest caliber in science and engineering, Washington could easily become the outstanding science center of the nation.

In addition to these tangible accomplishments of the Science Bureau, there have been intangible ones. We have been amazed at the benefits that have resulted from having people, particularly from various disciplines from industry and universities, get to know each other better at our meetings. Not only has the social aspect been important, but at several sessions representatives of particular companies, in brief talks, have told the Committee about their companies and activities. This has helped all of us to appreciate and to benefit from the many resources available locally.

I am delighted to have had the opportunity to be the first chairman of the Science Committee, and to have participated in the rapid growth of the Bureau. I am most pleased with the present chairman, Philip K. Reily, whose enthusiasm and leadership will assure the continued growth of the Science Bureau, and help make Washington an even greater scientific center than it is today.

References

(1) Wiesner, J. B. Proc. Maryland Science-Industry Conference, pp. 37-44 (January 1962).

(2) Fischer, John. Harper's Magazine, pp. 11-15 (September 1961).

(3) Linville, T. M. The American Engineer, pp. 33-35 (March 1962).

Achievement Award Nominations Requested

Chairman John S. Toll of the WAS Committee on Awards for Scientific Achievement has called attention of the membership to the Academy's annual scientific achievement awards program.

Each year the Academy gives awards for outstanding achievement in five areas—biological sciences, engineering sciences, physical sciences, mathematics, and teaching of science. The 1962 winners of these awards will be presented at the dinner meeting of the Academy in January 1963. It is appropriate that all members of the Academy be aware of these awards, and, if they so desire, actively participate in making nominations. These nominations, however, must be submitted in accordance with established procedures, which are listed below:

Eligibility. Candidates for the first four awards must have been born in 1922 or later; there is no age limit on the Teaching of Sciences Award. All candidates must reside within a radius of 25 miles from the zero milestone behind the White House. It is not necessary that a candidate be a member of a society affiliated with the Washington Academy of Sciences.

Recommendation. Sponsor's recommendation should include (1) general biography of candidate, including date of birth, residence address, academic experience with degrees and dates, and post-academic experience with particular detailed reference to work for which an award is recommended; and (2) list of publications with reprints, particularly of that work for which recognition is suggested. If reprints are not available, complete references to publications must be included.

Citation. Particular attention should be given to preparation of a citation (80 type-

writer spaces or less) which, in summary, states the candidate's specific accomplishments and which can be used in connection with presentation of the award to the successful candidate.

Re-nomination. Former nominees may be re-nominated with or without additional evidence, provided the sponsors make known their desires by letter to the general chairman.

Initial compliance with the request for biographical and publications data will facilitate evaluation of the nominations without delay. For further information, phone

John S. Toll (general chairman)
University of Maryland
WArfield 7-3800, Ext. 294
Don Marlowe (Engineering Sciences)
Catholic University
LAwrence 9-6000, Ext. 246
Ugo Fano (Physical Sciences)
National Bureau of Standards
EMerson 2-4040, Ext. 7820
Robert Berliner (Biological Sciences)
National Heart Institute
496-2116
F. Joachim Weyl (Mathematics)
Office of Naval Research
OXford 6-4356 or OXford 7-4311
Leo Schubert (Teaching of Science)
American University
WOodley 6-6800, Ext. 265

NBS Announces First Stratton Awards

The National Bureau of Standards has announced that three of its staff members—James R. Wait, Peter L. Bender, and Raymond L. Driscoll—are the first recipients of the newly-established Samuel Wesley Stratton Awards. These awards, which were presented on September 21 by NBS Director Allen V. Astin, are given in recognition of outstanding contributions by NBS scientists. Each award consists of a sculptured bronze plaque and $1500.

The awards are named for the first director of the National Bureau of Standards. In 1901, Dr. Stratton organized NBS as a unique scientific institution, and during a 21-year tenure of office, he firmly established its position in the scientific and industrial community.

Dr. Wait was cited for "his contributions to a better understanding of the mechanisms of electromagnetic radiation and radio wave propagation." Dr. Bender and Mr. Driscoll were honored for "their contributions to precision electromagnetic measurement and, particularly, the determination of the gyromagnetic ratio of the proton." Their work provided a better standard for magnetic fields and made possible more accurate values for many other fundamental constants of physics.

Dr. Wait, a consultant to the director of the Bureau's Boulder (Colo.) Laboratories, is internationally known in the field of radio wave propagation. He has published over a hundred papers, and was the first editor of Section D (Radio Propagation) of the Journal of Research of the National Bureau of Standards. Dr. Wait was born in Ottawa, Canada in 1924, and educated at the University of Toronto. He received the B.A.S. degree in 1948 and the M.A.S. degree in 1949 in engineering physics, and the Ph.D. degree in 1951 in electromagnetic theory. Before joining the Bureau's staff in 1955, he investigated theoretical problems in antenna research at the Defense Research Telecommunications Establishment in Ottawa. Dr. Wait received the Exceptional Service Award from the U.S. Department of Commerce in 1959.

Dr. Bender joined the Bureau's Washington staff in 1956 as a postdoctoral research associate, and became a regular staff member a year later. In addition to his work with Mr. Driscoll on the gyromagnetic ratio of the proton, Dr. Bender has applied the principle of optical pumping to other measurements of atomic constants and to the development of a rubidium clock. In 1959 he received an Exceptional Service

Award from the Department of Commerce for this work. He is now at the National Bureau of Standards—University of Colorado Joint Institute for Laboratory Astrophysics at Boulder.

Born in New York City in 1930, Dr. Bender did his undergraduate work at Rutgers University. After receiving the B.S. degree in physics in 1951, he spent a year studying at Leiden University in the Netherlands as a Fulbright scholar. From 1952 to 1956 he studied at Princeton University, receiving an M.A. degree in mathematics and the Ph.D. degree in physics.

Mr. Driscoll, an NBS staff member since 1936, has won worldwide recognition for his determination of the national ampere in absolute measure, as well as for his work in atomic constants. Born in James City County, Va. in 1905, Mr. Driscoll received the B.S. degree in mathematics from William and Mary College in 1928 and the M.A. degree in physics from the University of North Carolina in 1936. Before joining the NBS staff, he conducted research for General Electric Company and the Bureau of Mines. In 1959 Mr. Driscoll received an Exceptional Service Award from the Department of Commerce; and in 1950 he received a Meritorious Service Award for his work in absolute electrical measurements.

Academy Bylaws Changes Proposed

Proposed Bylaws revisions, designed to enhance the Academy's usefulness to the local scientific community by providing a new class of membership, will be voted upon by the Academy in the near future.

These revisions would establish the new class of members from among persons interested in supporting science but not otherwise qualified for membership; present members would become fellows. The changes were proposed by the Committee on Policy and Planning and endorsed by the Board of Managers, and will be sent to the membership sometime in December, for ratification by mail ballot.

Other proposed Bylaws changes would remove the numerical limitation on membership in the Academy, drop the honorary membership category, and extend the Academy's geographical boundaries for resident members and fellows.

The proposed changes are given below, together with parenthetical explanatory notes where appropriate.

Article II—Membership

Section 1. The membership shall consist of three general classes: members, fellows, and patrons. (Now, membership consists of three general classes: members, honorary members, and patrons.)

Section 2. Members shall be persons who are interested in and will support the objectives of the Academy and who are otherwise acceptable to at least two-thirds of the Committee on Membership. A letter or application form requesting membership and signed by the applicant may suffice for action by the Committee; approval by the Committee constitutes election to membership. (This class of membership will increase the sphere of influence of the Academy and increase its financial support.)

Section 3. Fellows shall be persons who by reason of original research or other outstanding service to the sciences, mathematics, or engineering are deemed worthy of the honor of election to Academy fellowship, which may be attained only through nomination as provided in Section 4. (This category of membership includes all of the present members; it bases fellowship in the Academy on "original research" as of now and adds "outstanding service to the sciences" as a second criterion. This is particularly appropriate to an Academy serving Washington, D. C.)

Section 4. Nominations of fellows shall

be presented to the Committee on Membership on a form approved by the Committee. The form shall be signed by the sponsor, a fellow who has knowledge of the nominee's field, and shall be endorsed by at least one other fellow. An explanatory letter from the sponsor and a bibliography of the nominee's publications shall accompany the completed nomination form. (A letter from the sponsor is often included now and is of much value to the Membership Committee in passing on the applicant.)

Section 5. Election to fellowship shall be by vote of the Board of Managers upon recommendation of the Committee on Membership. Final action on nominations shall be deferred at least one week after presentation to the Board, and two-thirds of the vote cast shall be necessary to elect.

Section 6. Persons who have given to the Academy not less than one thousand (1,000) dollars or its equivalent in property shall be eligible for election by the Board of Managers as patrons (for life) of the Academy. (Unchanged.)

Section 7. Life members or fellows shall be those individuals who have made a single payment in accordance with Article III, Section 2, in lieu of annual dues. (Minor change to add "fellow" class.)

Section 8. Members or fellows in good standing who have attained the age of 65 and are retired, or are retired before the age of 65 because of disability, may become emeritus. Upon request to the treasurer for transfer to this status, they shall be relieved of the further payment of dues, beginning with the following January first; shall receive notices of meetings without charge; and, at their request, shall be entitled to receive the Academy periodical at cost. (Minor change to add "fellow" class.)

Section 9. Members or fellows living more than 50 miles from the White House, Washington, D. C., shall be classed as nonresident members or fellows. (Raises present limitation of 25 miles to 50 miles for resident class of membership, and is in keeping with improved transportation facilities.)

Section 10. An election to any dues-paying class of membership shall be void if the candidate does not within three months thereafter pay his dues or satisfactorily explain his failure to do so. (Unchanged.)

Section 11. Former members or fellows who resigned in good standing may be reinstated upon application to the Secretary and approval of the Board of Managers. No reconsideration of the applicant's qualifications need be made by the Membership Committee in these cases. (Minor change to add "fellow" class.)

Article III—Dues

Section 1. The annual dues of resident fellows shall be $10.00 per year. The annual dues of members and of nonresident fellows shall be $7.50 per year. Dues for fractional parts of a year shall be at the monthly rate of one-twelfth the annual rate. No dues shall be paid by emeritus members and fellows, life members and fellows, and patrons. (Dues for members are set lower than those for fellows on the basis of probable ability and willingness to pay.)

Section 2. Members and fellows in good standing may be relieved of further payment of dues by making a single payment to provide an annuity equal to their annual dues (see Article II, Section 7). The amount of the single payment shall be computed on the basis of an interest rate to be determined by the Board of Managers. (Same as in present Bylaws for members.)

Section 3. Members or fellows whose dues are in arrears for one year shall not be entitled to receive Academy publications. (Same as in present Bylaws for members.)

Section 4. Members or fellows whose dues are in arrears for more than two years shall be dropped from the rolls of the Academy, upon notice to the Board of Managers, unless the Board shall otherwise direct. Persons who have been dropped from membership for nonpayment of dues may be reinstated upon approval of the Board and upon payment of back dues for two years together with dues for the year of reinstate-

ment. (Minor change to add "fellow" class.)

Article IV—Officers

Section 1. The officers of the Academy shall be a President, a President-elect, a Secretary, a Treasurer, an Editor, a Managing Editor, an Archivist, and a Custodian of Publications. All shall be chosen from resident fellows of the Academy by a vote of all members and fellows. (Minor change to give voting privilege to new class of members.)

Sections 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, and 12 unchanged.

Section 13. Not later than December 15 the Secretary shall prepare and mail ballots to members and fellows. Independent nominations shall be included on the ballot, and the names of the nominees shall be arranged in alphabetical order. When more than two candidates are nominated for the same office the voting shall be by preferential ballot in the manner prescribed by the Board of Managers. The ballot shall contain also a notice to the effect that votes not received by the Secretary before the first Thursday of January, and votes of individuals whose dues are in arrears for one year, will not be counted. The Committee of Tellers shall count the votes and report the results at the annual meeting of the Academy. (Minor change to give ballots to new class of member.)

Section 14. (Unchanged.)

Article VIII—Cooperation

Sections 1 and 2 unchanged.

Section 3. Each affiliated society shall *select* one of its members as *Delegate* to the Academy who is a resident member or fellow of the Academy. (Based on past experience, affiliated societies will on occasion desire to name Delegates who are not fellows of the Academy.)

Section 4 unchanged.

Transitional Arrangements

1. All present members are to become fellows.

2. All present honorary members are to become emeritus fellows (regardless of age), subject to no further charges for dues.

THE BROWNSTONE TOWER

This is being written just before the deciding game of the rain-interrupted "World Serious." I have been impressed by the remarkable ability of Mr. Povich to write a rainy-day column based on nothing but his desire to keep the Series warm in the minds of his readers. So, while shaving this morning, I decided to try a Povich myself—a miscellaneous Povich.

It had been my intention to devote this column to the District of Columbia Chapter of the Sigma Xi, of which I have been a member for many years without knowing much about it. Thanks to the secretary, Harriet L. Frush (National Bureau of Standards), I am now better informed, but do not feel that I am ready to give it full treatment. However, I should like to point out that this Chapter, founded in 1915, is the only one not affiliated with a degree-granting institution. It is the natural home for members of Sigma Xi who come to Washington to do scientific work in a non-academic environment. The Chapter elects only three members each year, persons who have distinguished themselves in research but who have not previously been available for election to Sigma Xi. They are asked to talk about their work at the annual meeting and dinner of the Chapter, at which they are initiated.

An extra dinner meeting of the Chapter is being planned for Monday, December 3, under the direction of President Philip H. Abelson. The meeting will be largely social and will be held in the Great Hall of the National Academy of Sciences. Dinner will be served in the cafeteria in the basement of the new wing (Hall of Life Sciences of the National Academy). A panel represent-

ing government, industry, and the universities will discuss "Research Resources of the Washington Area." It is hoped that members of the D. C. Chapter will try to identify members of Sigma Xi who ought to be transferred to it and will urge them to attend this meeting, preferably as their guests. The D. C. Chapter now cooperates with the Washington Academy of Sciences by sending notices of the Academy's meetings to the Chapter members; thus we are here returning the favor, and hope that collaboration between the two local general scientific organizations will continue to grow.

There is a relatively new luncheon club in town that seemed to arise by spontaneous generation, as indeed it should, for it is known as the "Eunuchs." There are in Washington many biologists who are no longer productive either in research or in teaching. They are engaged in helping others to be productive biologists. They are administrators, directors of grant programs, executive secretaries of societies, etc. Though they believe in the value of their work, they are more certain of the values they left behind in teaching and research. One of them, feeling somewhat emasculated, dubbed these desk-bound biologists "Eunuchs." They are to be found in various Government and private agencies and organizations, and if not disturbed would pursue their own programs with quiet intensity, hardly aware of what went on around them. So it was proposed by Milton O. Lee that the Eunuchs meet for lunch once a month, not to give undivided attention to a speaker, but merely to get acquainted with one another, as chance might dictate. Once the time and place of periodic meetings were made known, no notices would be sent out. And there would be no officers or bylaws. The proposed simplicity of the meetings was very appealing. One would go when able without knowing whom he might meet. In practice the business was not quite so simple, because it was hard to find a place where an unpredicted number of people could sit together for an inexpensive lunch not ordered in advance. So it became necessary for someone to serve as the Eunuchs' Eunuch, a post to which I appointed myself. We think we have solved the problem of a suitable meeting place; henceforth the Eunuchs will gather in the cafeteria in the basement of the new wing of NAS-NRC on the third Thursday of each month at 12 o'clock. Any male biologist who feels emasculated will be welcome at these luncheons. If he has not previously attended, I should appreciate advance notice of his intention. Someone remarked that we should not expect cross fertilization at our meetings, but breezy company is guaranteed.

I suppose we should be grateful to Miss Carson for temporarily diverting our attention from the really serious facts of life; namely, the expansion of heterogeneous human populations in a world without effective international law and loaded with lethal weapons that make pesticides seem entirely benign. Certainly, I am grateful for the excuse she gave me to place in the October issue of this Journal some of the conclusions of the NAS-NRC Committee on Pest Control and Wildlife Relationships. At the time there were only a few pages of manuscript on hand. Since then I have taken every opportunity to call to the attention of the editorial staff of the Journal, the members of the Committee on Policy and Planning, the delegates from the affiliated societies, and the officers of the Academy *the need of the Journal for interesting feature articles that can be understood by any member.* Such articles are generated naturally in the meetings of the Academy and of its affiliated societies. I now remind every reader of these lines of his opportunity to publish in the Journal and hope he will take advantage of it. To be acceptable a manuscript must be connected with the Washington scene; i.e., it must have been written by a Washington scientist or presented at a meeting in Washington, or must be concerned with some aspect of

scientific life in Washington. What a great Journal we shall have here when people become really aware of its possibilities!

—Frank L. Campbell

ACADEMY OFFICE NOTES

Disposition of Back Journals

The Carnegie Institution of Washington is the gracious host of the Washington Academy of Sciences at 1530 P Street, N.W. Nearly a year ago the Institution requested the use of some of its storage space which was occupied by back issues of the Academy's Proceedings and Journals. It is true that vast stretches of shelves were filled with bound and unbound copies of these publications. There were also 628 volumes of a monograph published by the Academy, called "Parasitic Cuckoos of South Africa." About 900 copies of the "Index to Proceedings and Journal" filled a number of shelves, together with numerous volumes of reprints of particularly important articles. Many copies of a maroon-covered booklet of historical interest, published in 1918 and entitled, "Scientific Aspects of the War," also occupied a certain amount of space.

Late last spring, the Institution again made it clear that it needed the storage space that the Academy was occupying. The Johnson Reprint Corporation of New York had already been approached, and had purchased two complete sets of the Journal to refer to in coming to a decision about taking over the back issues. After some hesitation, the firm made an acceptable offer in September, and this was approved by the Academy's Board of Managers at its meeting on October 2. The firm agreed to remove, at its own expense, all back issues of the Journal and Proceedings, and available reprints and monographs; to advertise this material: and to give the Academy 50 percent of the net income from sales. It also agreed to pay the Academy a 10 percent royalty on the net price of any reprints that may be made and sold.

Treasurer Malcolm Henderson attempted to estimate the tonnage, purchased 200 book cartons, and arranged for porters from the Carnegie Institution to work after hours and on Sunday in packing the material. The work proceeded systematically for nearly a week. Some of the back issues and "Cuckoo" books were stored in a remote corner that had to be entered by crawling through a low archway. More cartons and large rolls of gummed paper had to be ordered. Dr. Rehder, the custodian of publications, found that he had 53 cartons of Journals still in storage at the Smithsonian Institution.

When the Herculean task was finished, 406 cartons and packages awaited shipment, many of them weighing about a hundred pounds each. Each received a label showing the contents, the name of the sender, and the receiver.

On moving day—October 11—a 40-ton trailer truck drove into the alley alongside the Carnegie building and—unable to make a sharp right turn—came to a halt 40 feet from the shipping entrance. Unfortunately the porters were occupied elsewhere: so Dr. Henderson, Editor Detwiler (who just happened to be passing by), and I took over the job of loading the truck. After we had loaded three-fourths of the material, the porters appeared to finish the job. The load was estimated at about 15 tons.

The shelves are clear, the dust has settled, slipped-discs were miraculously avoided, and the weighty published product of the members of the Washington Academy of Sciences is now in the hands of the Johnson Reprint Corporation of New York.

—Delight Hall

Science in Washington

SCIENTISTS IN THE NEWS

Contributions to this column may be addressed to Harold T. Cook, Associate Editor, c/o U.S. Department of Agriculture, Agricultural Marketing Service, Room 2628 South Building, Washington 25, D. C.

APPLIED PHYSICS LABORATORY, JOHNS HOPKINS UNIVERSITY

A. M. Stone attended a conference on future strategy at the Hudson Institute, Harmon, N. Y., September 21-23. Dr. Stone is a fellow member of the Institute, which is devoted to problems of national security and international order.

GEOLOGICAL SURVEY

Clarence S. Ross and **George T. Faust** attended the 11th Clay Minerals Conference in Ottawa, August 14-18. Dr. Faust was appointed to the Subcommittee on Nomenclature and Liaison, of which Dr. Ross has been a member for several years.

Raymond L. Nace visited Moscow, Russia, and Tashkent, Uzbek SSR, during August, as consultant to the Advisory Committee on Arid Zone Research of UNESCO. He spent the month of September in Paris on detail as a consultant to the Department of Natural Sciences of UNESCO.

HOWARD UNIVERSITY

Lloyd N. Ferguson, head of the Department of Chemistry, returned in August from a year's sabbatical leave under a National Science Foundation science faculty fellowship, spent at the Swiss Federal Institute in Zurich. During the year he gave talks at the Institute and at the University of Saarbrucken, Saarlandes, Germany.

Moddie D. Taylor is on leave for the school year 1962-63 to take up a National Science Foundation science faculty fellowship. He plans to study mathematics and physics at area universities, and will be in residence at Catholic University.

John R. Sutter, formerly of Louisiana Polytechnic Institute, has been appointed assistant professor of chemistry.

J. L. Shereshefsky, professor of chemistry, read two papers before the 36th National Colloid Symposium, Stanford University, June 25-27. They were "Surface Tension of Liquids in Microscopic Capillaries" (with J. Wilson, J. Bryant, and J. Carter), and "Monolayers of Myristyl and Cetyl Esters of Oxalic, Malonic, Succinic, Glutaric, Adipic and Pimalic Acids" (with H. Carter, E. Nichols, and P. Robinson). Dr. Shereshefsky was a faculty member and principal investigator of a summer workshop at Goddard Space Flight Center, NASA, at Greenbelt, Md. The workshop, composed of faculty members and graduate students of several universities, was concerned with problems related to simulation of space from the aspects of vacuum, radiation, magnetism, and heat transfer.

NASA

Hugh L. Dryden, deputy administrator, will receive the 1963 John Fritz medal of the American Society of Mechanical Engineers for his "scientific, engineering, and administrative leadership in all phases of aeronautics and of space exploration."

NATIONAL BUREAU OF STANDARDS

Lewis V. Judson, physicist in the Office of Weights and Measures, has received a ruby-studded pin symbolizing 45 years of service with NBS.

Charlotte M. Sitterly received an honorary D.Sc. degree from Swarthmore College, her alma mater, at its 89th Commencement on June 11. Mrs. Sitterly has received recognition throughout the world for her fundamental research in the field of atomic spectra, for her investigation of the new element, technetium, in the sun's atmosphere, and for her discovery of the element gold in the sun.

Karl G. Kessler has been appointed chief of the Atomic Physics Division. He succeeds L. M. Branscomb, who has transferred to the NBS-University of Colorado Joint Institute for Laboratory Astrophysics at Boulder.

The Molecular Kinetics Section of the Physical Chemistry Division has been divided in order to acknowledge and recognize differences in technique and approach to the study of chemical kinetics. **Robert E. Ferguson,** who had been chief of the original Section, will now head the Elementary Processes Section: he will continue to place emphasis on microscopic techniques. **James R. McNesby** will be chief of the Photochemistry and Radiation Chemistry Section, which will emphasize macroscopic techniques.

Recent talks by NBS personnel have included:

Before the International Symposium on Molecular Structure and Spectroscopy, Tokyo: **H. C. Allen, Jr.:** "Sum Rules for Vibration-Rotational Energy Levels Including Centrifugal Distortion"; **D. R. Lide:** "Microwave Spectra and Internal Rotation of Some Butadiene Derivatives"; **D. E. Mann:** "The Infrared Spectra of Matrix-Isolated HCl and HBr"; **E. K. Plyler:** "The Determination of Molecular Constants from High Resolution Spectra"; **C. M. Sitterly:** "A Report on Atomic Spectra."

S. N. Alexander: "Machines of the Near Future"—Gordon Research Conference on Scientific Information Problems in Research, New Hampton, N. H.

F. L. Alt: "Syntactic Resolution of Semantic Ambiguities"—International Federation of Information Processing Societies, Munich.

R. G. Bates: "Quantitative Interpretation of pH Measurements in Alcohol-Water Solvents"—7th International Conference on Coordination Chemistry, Royal Institute of Technology, Stockholm.

G. M. Brauer: "Improved Zinc Oxide Eugenol Type Cements"—13th International Dental Congress, Cologne, Germany.

A. Brenner: "The Speed of Plating Processes: Movement of Solute, Attainment of the Steady State, and Formation of Metal"—American Electroplaters' Society, Milwaukee.

C. Eisenhart: "On the Realistic Evaluation of the Precision of a Measurement Process"—Section on Physical and Engineering Sciences, 122nd Annual Meeting of the American Statistical Association, Minneapolis.

G. T. Furukawa: "Some Investigations to Improve Energy Measurements in Low Temperature Calorimetry" — Calorimetry Conference, University of California, Berkeley.

M. S. Green: "The Theory of the Critical Point of a Simple Fluid"—California Institute of Technology, Department of Chemical Engineering, Pasadena, Calif.

M. Greenspan: "Audio-Frequency Compliances of Prestressed Quartz, Fused Silica, and Aluminum" — Fourth International Congress on Acoustics, Copenhagen.

J. L. Hague: "Past, Present, and Future of Standard Analyzed Samples"—American Society for Testing Materials, New York.

R. B. Hobbs: "Paper Testing"—University of Maine, Orono.

J. D. Hoffman: "Theoretical Interpretation of Some Aspects of Crystallization of Bulk Polymers with Chain Folding"—American Chemical Society, Atlantic City.

H. S. Isbell: "Study of Ring Structure of Aldoses by Oxidation with Bromine"—International Symposium on Carbohydrate Chemistry, University of Birmingham; and "Carbon-14 and Tritium for Research"—Cotton, Silk, and Man-made Fibres Research Association, Shirley Institute, Manchester, England.

C. C. Kiess: "Evidence for Nitrogen Dioxide in the Martian Atmosphere"—American Astronomical Society, Yale University, New Haven.

J. Kruger: "Optical Studies of the Formation and Breakdown of Passive Films Formed on Iron Single Crystal Surfaces in Organic Inhibitor Solutions"—Second International Symposium on Passivity, University of Toronto.

G. M. Kline: "Polymer Research at the U. S. National Bureau of Standards"—Fourth Annual Symposium on Polymer Research, Politechnika Lodzka, Lodz, Poland.

D. E. Mann: "Recent Developments in Matrix-Isolation Spectroscopy"—Gordon Research Conference on High Temperature Chemistry.

L. Marton: "A Study of Atomic Beam Packets in Flight"—Third International Symposium on Rarefied Gas Dynamics, University of Paris, Paris.

A. G. McNish: "Accuracy of Determinations of the Physical Constants"—National Physical Laboratory, Teddington, England.

E. J. McDonald: "Reducing Sugars"—International Commission for Uniform Methods of Sugar Analysis, Hamburg, Germany.

G. C. Paffenbarger: "The Formulation of Federation Dentaire Internationale Specifications" — 13th International Dental Congress, Cologne; and "Dimensional Changes in Dentures"—American Dental Society of Europe, Scheveningen, Holland.

H. S. Peiser: "The Characterization of Large Single Crystals by High-Voltage X-Ray Laue Photographs"—Eleventh Annual Conference on Applications of X-Ray Analysis, Denver Research Institute, University of Denver.

E. K. Plyler: "Methods of Measurement in the Far Infrared Region"—Materials Central, Aeronautical Systems Division, International Symposium on Far Infrared Spectroscopy, Cincinnati.

R. J. Rubin: "Nonequilibrium and Transmission Coefficient Problems in Exchange Reactions"—Gordon Research Conference on Chemistry and Physics of Isotopes; and "Machine Calculations of Time-Dependent Properties of Disordered Lattices"—International Conference on Crystal Lattice Defects, Physical Society of Japan, Kyoto.

R. D. Stiehler: "Standardization in Rubber Industry" — Industrial Rubber Products Division, Rubber Manufacturers Association, Seaview Country Club, Absecon, N. J.

W. T. Sweeney: "Dental Research at the National Bureau of Standards"—National University of Dublin, Dublin, Ireland; and "Research in Relation to Filling Materials"—British Dental Association, Nottingham, England.

R. S. Tipson: "Some Applications of Infrared Spectroscopy to Sugars"—International Symposium on Carbohydrate Chemistry, University of Birmingham; and "The Nomenclature of Sugar Conformers"—Department of Chemistry, University of Edinburg, and Cotton, Silk, and Man-made Fibres Research Association, Shirley Institute, Manchester, England.

NATIONAL INSTITUTES OF HEALTH

Chester W. Emmons, chief of the Medical Mycology Section, Laboratory of Infectious Diseases, National Institute of Allergy and Infectious Diseases, conducted a Symposium on Influence of the Environment on the Epidemiology of the Mycosis at the Eighth International Congress for Microbiology.

Heinz Specht has been appointed chief of the Pacific Office of International Research in Tokyo, Japan. Prior to his new appointment, Dr. Specht was chief of NIAMD's Laboratory of Physical Biology.

COAST AND GEODETIC SURVEY

Charles A. Whitten has been appointed chief of the Electronic Computing Division in the Office of Physical Sciences. He had served as chief of the Triangulation Branch, Geodesy Division, since 1946.

B. K. Meade has been appointed chief of the Triangulation Branch, Geodesy Division. He had been assistant chief of that Branch for many years.

Donald A. Rice attended the fourth triennial meeting of the International Gravimetric Commission, held in Paris September 10-15.

David G. Knapp attended a Symposium on Equatorial Aeronomy, held September 18-27 in Lima and Huaychulo, Peru. He presented a paper. "A New Longitude Effect

in the Geomagnetic Solar-Daily Variation" (with John Gettemy).

Dean S. Carder, chief seismologist of C&GS, attended the 32nd International Meeting of the Society of Exploration Geophysicists at Calgary, Alberta, September 16-20. Dr. Carder also attended a meeting of the Air Force Office of Scientific Research in the same city on September 21.

Carl I. Aslakson was moderator of a panel at the St. Louis convention of the ACSM-ASP on September 13. The subject of the discussion was "Field Measurements and Geodetic Requirements for the Space Age." Among the subjects discussed were lunar mapping, precision geodetic measurements required for Telstar, Project Mercury geodetic requirements, the highly accurate Mistram surveys, and the standardization of error definition.

USDA, WASHINGTON

Hazel K. Stiebeling, deputy administrator, ARS, after attending the scientific sessions of the World Poultry Congress and the 50th anniversary of the Poultry Science Association, at Sydney, Australia, August 10-18, served on a six-week detail from USDA to the UN Food and Agriculture Organization. Enroute to Rome from Sydney, Dr. Stiebeling stopped at Kuching (Sarawak), Bangkok (Thailand), and New Delhi (India) to see FAO work in progress; and she spent the month of September in Rome preparing a report for FAO's director general on the development, present status, and outlook for home economics activities in FAO, with recommendations regarding personnel and organization.

NAVAL RESEARCH LABORATORY

W. A. Zisman, superintendent of the Chemistry Division, has been selected as recipient of the Kendall Company Award in Colloid Chemistry for outstanding contributions to colloid science. The award presentation will be made at the 1963 national meeting of the American Chemical Society in Los Angeles. The award includes an honorarium of $1000. The specific scientific accomplishment on which the award is based is Dr. Zisman's contribution to the understanding of the principles involved in the wetting of liquids on solid surfaces.

DEATHS

Herbert B. Brooks, one of the country's senior electrical scientists, died October 1 at Suburban Hospital, aged 93. He had retired in 1939 as chief of the Electrical Instruments Section at the National Bureau of Standards.

Dr. Brooks, a native of New Bremen, Ohio, left high school at the age of 16 to join the Edison Electric Illuminating Company at Piqua, Ohio, becoming superintendent of the plant two years later. In 1898 he resigned to enter Ohio State University, working his way through in five years and receiving the degree of mechanical engineer in electrical engineering. He joined NBS in 1903, and in 1906 became the first chief of the Electrical Instrument Section. In 1926 he received the Ph.D. degree from Johns Hopkins University.

Dr. Brooks' many technical publications covered a wide range of subjects and reflected his interest in instrument design. Among the numerous instruments developed by him are four to which his name is attached—a potentiometer, an inductometer, a two-stage current transformer, and an attracted-disk electrometer for high voltages. In 1944 he received the Lamme Medal from OSU for outstanding contributions to engineering; and in 1959 he was the first recipient of the Leeds Medal for outstanding contributions to electrical measurement.

Dr. Brooks came out of retirement during World War II to assist NBS in a military research study. He wrote his last research paper at the age of 88.

CALENDAR OF EVENTS

November 19—American Society for Metals

Dr. Pond, Johns Hopkins University. Subject to be announced.

6:00 p.m., fellowship hour; 6:30 p.m.,

dinner: 8:00 p.m., technical meeting. AAUW building, 2401 Virginia Ave., N.W.

November 19—Naval Research Laboratory Chemistry Colloquium

R. W. Taft, Jr., professor of chemistry, Pennsylvania State University, "Theoretical Organic Chemistry."

10:00 a.m., Auditorium of Building 69, NRL.

November 19—Society of American Military Engineers

Program to be announced.

Luncheon, noon, YWCA, 17th and K Sts., N.W.

November 21—Washington Society of Engineers

"The Experimental House." Exhibits.

7:00 p.m., National Housing Center, 1625 L St., N.W.

November 26-29 — Joint ANS-AIF Meeting and Atom Fair

Includes 10th Hot Laboratory and Equipment Conference.

Shoreham and Sheraton Park Hotels.

November 27—American Society for Microbiology

Carl Lamanna, Life Science Division, Army Research Office, "Role of Microbiologist in Foreign Assistance Programs."

8:00 p.m., banquet. Sternberg Auditorium, Walter Reed Army Institute of Research.

November 27—American Society of Civil Engineers

Luncheon meeting.

Noon, YWCA, 17th and K Sts., N.W.

November 28—Geological Society of Washington

Program to be announced.

8:00 p.m. John Wesley Powell Auditorium, Cosmos Club.

November 29—American Society of Mechanical Engineers

"Fuels" (general topic).

8:00 p.m. PEPCO Building, 9th floor.

JOINT BOARD ON SCIENCE EDUCATION

Biology Conference Well Received

The Joint Board on Science Education opened its fourth series of conferences on science education with a conference on biology teaching held at the NEA Building on Saturday, October 13.

The writer, in opening the meeting, stated that its purpose was "to become better acquainted with our colleagues rather than to solve actual problems." and stressed the importance of making use of the services afforded by the scientific community.

The first speaker of the day was Russell G. Brown of the Botany Department, University of Maryland, whose topic was "Biology Around Us." His outlook, which was essentially ecological, met with the approval of the group. The placement of biology to follow the teaching of chemistry was applauded.

Beginning with the definition of an educated person as one who has a reasonable knowledge of his environment and how it affects him, Dr. Brown discussed environments and their variations. He advocated the taking of pictures for class use as one means of taking students from the known to the unknown. Doing the actual photography rather than using commercially prepared slides did, he felt, make the biological material really live.

Many participants felt that one factor in Dr. Brown's well-known success in acquainting students with biology, is due to the quality of the wonderful slides with which he documents his talks.

Oliver S. Flint of the Smithsonian Institution, the second speaker, defined insects and discussed their use in the classroom. His suggestions for the use of insects for science projects were excellent. He felt that areas, species, habitats, and successions all could be advantageously used. Dr. Flint spoke of experiments demonstrating the economic importance of insects. Investigation of the life history of insects is important, since many are at the present time unknown and such knowledge would be of great value.

The idea of ecological succession, whether limited to the rotting of a log or expanded to an extended geographical area,

would be of tremendous interest and value.

So vital were the ideas presented by Dr. Flint that it was requested that he prepare a reading list; this he graciously consented to do. The writer assured the participants that this list would be published in the *Reporter*.

The next speaker was Father Robert F. Mullan, S. J., who gave a report on the Summer Biological Science Seminar held at Gonzaga High School, June 11-July 13. Nine organizations of national eminence participated in the seminar, which consisted of reading recommended by the AAAS; lectures on such subjects as chemotherapy, endocrinology, genetics, immunity, space biology, and world health problems; tours of local research laboratories; and lectures on scientific and technical writing.

The final speaker of the day was Ernestine Thurman of the National Institutes of Health, who spoke of the need for more women in science. She discussed the ways in which each girl may find her own field and work for success in that field, and pointed out that each girl who succeeds results in more girls being accepted in the field of science. The home, friends, and school should encourage an interest in science on the part of girls, for such interest is never lost. In marriage, a girl uses her interest in science in help for her husband; and certainly such interest frequently inspires an interest in science on the part of her children.

The hundred participants were unanimous in their opinion that it was a most stimulating day, made particularly enjoyable by the wonderful lunch and general hospitality of the Joint Board on Science Education.

Project Ideas Now Available

The Joint Board's very popular book, "Project Ideas for Young Scientists," has been received from the printer. This paperback book has been extensively revised and enlarged, and should furnish a wealth of ideas for science projects that involve investigation or research. Any of these ideas would make good student projects; many would challenge more mature students; and some could be investigated at a high level of professional research.

The revised edition has had five chapters added to it. Two of these are concerned with the mechanics of organizing a science fair, and were included at the request of out-of-town purchasers of the first edition, who wanted to know how things were done locally. Some helpful information on actual construction of a science display also is given. A chapter on engineering projects, and one on pharmaceutical science projects, are newcomers. A chapter, "Just Titles," lists some 200 thought-provoking titles that could be studied extensively or to a lesser extent, as desired.

For the benefit of newcomers, "Project Ideas" contains suggestions for investigations at student level that were submitted by many scientists of the Washington area. The book was edited by the writer in collaboration with Phoebe Knipling and Falconer Smith. Each idea is described briefly, and references are given for further work. With this book, students should not find it necessary to "hound" a teacher or scientist for ideas for science projects. In fact, they should be encouraged not to do so.

The first edition of the book sold some 4000 copies, about 90 percent outside of the local area. Copies were distributed to local libraries; many libraries outside of the area were purchasers. Reviewers were unanimous in praise of the book. For example, the editor of the Journal of Chemical Education states in his review, "A book that is worth many times its cost is rare indeed; this should prove to be such a volume."

Copies of "Project Ideas for Young Scientists" may be obtained from the Joint Board Office. The price is: Single copies, $1.25; 10 to 49 copies to one address, 10 percent discount; 50 or more copies to one address, 20 percent discount. All prices are postpaid. Please enclose check for payment for single copies, payable to the Joint Board on Science Education. Larger orders may be billed if more convenient.

—*John K. Taylor*

BOARD OF MANAGERS MEETING NOTES

October Meeting

The Board of Managers held its 549th meeting on October 2 at the National Academy of Sciences, with President Van Evera presiding. In the absence abroad of Dr. Irving, Dr. Henderson served as acting secretary.

Announcements. Dr. Van Evera announced that John S. Toll of the University of Maryland had been named chairman of the Awards Committee. Also, he pointed out that in view of the extended foreign assignment proposed for Heinz Specht, the Academy is lacking a president-elect to take office in 1963.

Meetings. Dr. Van Evera, acting as Meetings Committee chairman, announced that at the general meeting of October 18, a panel composed of C. H. Hoffman, Walter W. Dykstra, and Russell Stevens would discuss the subject, "Insecticides: Benefit or Peril."

Membership. Chairman Mary L. Robbins presented the names of five nominees for membership, for First Reading.

Policy and Planning. Chairman Wayne C. Hall reported that favorable discussions had been held with American University officials, looking toward establishment of the Academy's headquarters in a new science building that is being planned for the University campus. The subject will be further explored.

Science Education. Chairman John K. Taylor presented an extensive report of the Committee's activities, particularly as concerns the recent Interacademy Conference on Science Education. He also reported that several other conferences, concerned with science teaching, had been scheduled—the next such meeting, on physics, was to be held on November 3.

Treasurer. Dr. Henderson reported balances as follows: Academy, $8,427.60; Joint Board, $12,201.80; Junior Academy, $3,570.16; total interest earned on Treasury bills, $115.60; dividends and other interest income received during the previous four months, $1431.24. He also reported sale of two complete sets of the Journal for $780.48, and sale of 800 face value New York City bonds for $752.93.

Dues-delinquent members were tabulated as follows: Last paid in 1959, 12; in 1960, 14; in 1961, 83. The Board agreed that the 12 members in arrears since 1959 should be dropped from membership, unless their dues were received within the next month.

Dr. Henderson reported that the Academy's property—four investment trusts—had depreciated in value almost exactly by the same amount as the Dow-Jones Average, and was currently worth (at DJ = 575) about $65,000. The Board agreed to his request that he be authorized to continue the workmen's compensation insurance that had been taken out last year for Joint Board staff personnel, and to extend it to cover Academy staff personnel as well.

Journal. Editor Detwiler reported that the September (directory) issue had gone to press, and that the October issue was hard on its heels. The directory has not only an alphabetical listing of members, but also a classification by place of employment and a classification by membership in affiliated societies.

New Business. Dr. Van Evera outlined a proposal by the Johnson Company of New York, to take over custody of back issues of the Journal, and sell them on a 50:50 basis. The Board accepted the offer.

Dr. Van Evera again referred to the problem caused by the recent resignation of Heinz Specht as president-elect. He suggested that if the Academy should decide to operate on a fiscal-year basis, the present officers might continue until June 1963, thus giving the new president-elect (presumably elected in January) a six-month overlap. No action was taken.

In a discussion of the proposed new By-laws changes, whereby two membership categories—members and fellows—would be established, the treasurer suggested (1) that all members of affiliated societies should become members of the Academy auto-

matically, on their request; and (2) that all officers of the constituent societies should automatically be fellows.

The matter of paying for the Science Calendar was raised. It is the Academy's turn to issue the Calendar this year; and it seems likely to cost $400, of which the D. C. Council of Engineering Societies is expected to pay half. After some discussion it was agreed to add $400 to the Academy's budget and to request half of this from the D. C. Council.

SCIENCE AND DEVELOPMENT

Controlled-environment tests at the Agricultural Research Center, Beltsville, have shown that an ozone concentration of 100 parts per billion for 4 hours is sufficient to cause "weather fleck" injury to tobacco leaves. "Weather fleck" is a widespread disease of tobacco that occurs when weather conditions prevent polluted surface air from mixing with air at upper atmosphere levels, allowing toxic concentrations of ozone to develop. Concentrations of 10 to 30 parts per billion occur naturally in the atmosphere. However, ozone is formed in excessive amounts when sunlight contacts air contaminated by fumes from auto exhausts, industrial plants, and other sources. The research was done by Howard E. Heggestad, Harry A. Menser, Gustave Silber and John J. Grosso of the Agricultural Research Service, USDA.

A joint Weather Bureau-Navy project to study modification of hurricanes will begin this year. Called "Project Stormfury," it will be headed by R. H. Simpson, under the general direction of F. W. Reichelderfer, chief of the Weather Bureau, and Capt. W. R. Franklin, director of the Naval Weather Service. The object of the experiment is to create instabilities in the hurricane wind system which will cause the ring of maximum winds near the eye to expand outward and by doing so diminish their intensity. It will involve the use of specially modified Navy aircraft for seeding operations, and improved new devices for the generation and dispensing of silver iodide crystals for cloud seeding. The project is expected to continue for about three years.

Seven Geological Survey engineers, four from the Washington area, were to go to Antarctica to conduct field surveys for topographic mapping in late September or early October. The expedition personnel will obtain control and other mapping data in previously unmapped areas, and will serve as navigators of traverse parties engaged in various types of scientific work. This is the sixth consecutive year that Geological Survey personnel have participated in topographic mapping activities in Antarctica as part of the U. S. Antarctic Research Program. The local members of the survey team are Peter F. Bermel and William R. MacDonald of Washington, and Donald C. Barnett and Ezekiel Soza of Arlington.

The Smithsonian Institution's National Air Museum placed a beautiful photographic mosaic of a large segment of the earth on display on October 5. It is made up of 181 individual exposures from a camera 100 miles above the earth. The mosaic was presented by Capt. A. E. Krapf, USN, director of the Naval Research Laboratory, which sponsored the flight of October 5, 1954, during which the photos were taken. The camera was carried aloft by a two-stage Navy Aerobee rocket. The composite photograph gives a realistic view of the earth showing many recognizable areas; it also shows a clear image of a hurricane over southern Texas and Mexico.

Delegates to the Washington Academy of Sciences, Representing the Local Affiliated Societies*

Philosophical Society of Washington	R. D. Myers
Anthropological Society of Washington	Regina Flannery Herzfeld
Biological Society of Washington	John A. Paradiso
Chemical Society of Washington	Alfred E. Brown
Entomological Society of Washington	Frank L. Campbell
National Geographic Society	Alexander Wetmore
Geological Society of Washington	G. Arthur Cooper
Medical Society of the District of Columbia	Frederick O. Coe
Columbia Historical Society	U. S. Grant, III
Botanical Society of Washington	Wilbur D. McClellan
Society of American Foresters	Harry A. Fowells
Washington Society of Engineers	Carl I. Aslakson
American Institute of Electrical Engineers	William A. Geyger
American Society of Mechanical Engineers	William G. Allen
Helminthological Society of Washington	Doys A. Shorb
American Society for Microbiology	Howard Reynolds
Society of American Military Engineers	Delegate not appointed
Institute of Radio Engineers	Robert D. Huntoon
American Society of Civil Engineers	Thorndike Saville, Jr.
Society for Experimental Biology and Medicine	Falconer Smith
American Society for Metals	Hugh L. Logan
International Association for Dental Research	Aaron S. Posner
Institute of the Aerospace Sciences	Francois N. Frenkiel
American Meteorological Society	Jack Thompson
Insecticide Society of Washington	Robert A. Fulton
Acoustical Society of America	Malcolm C. Henderson
American Nuclear Society	George L. Weil
Institute of Food Technologists	Richard P. Farrow

*Delegates continue in office until new selections are made by the respective affiliated societies.

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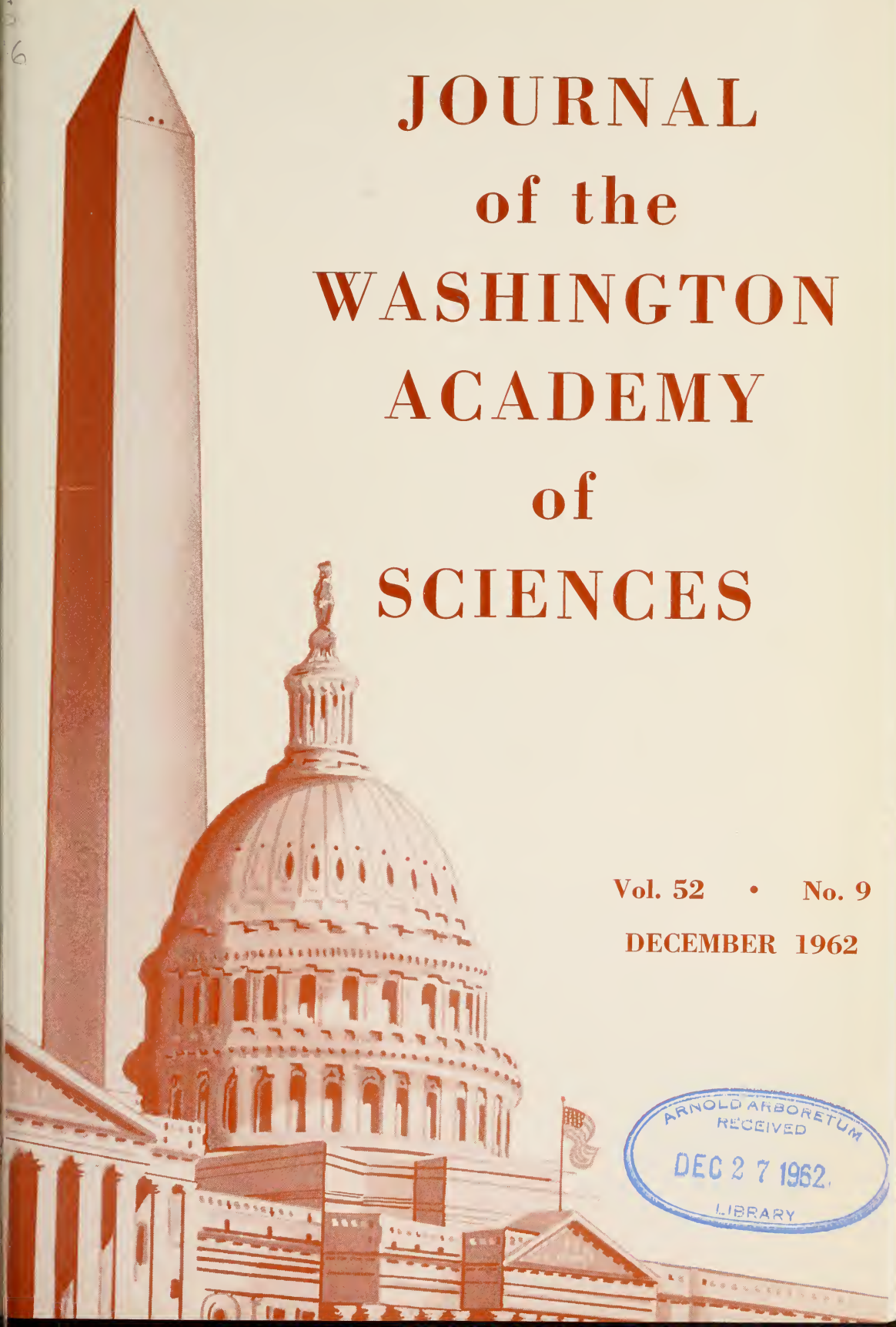

Vol. 52 • No. 9

DECEMBER 1962

JOURNAL OF THE WASHINGTON ACADEMY OF SCIENCES

Editor: Samuel B. Detwiler, Jr., Department of Agriculture

This Journal, the official organ of the Washington Academy of Sciences, publishes historical articles, critical reviews, and scholarly scientific articles; notices of meetings and abstract proceedings of meetings of the Academy and its affiliated societies; and regional news items, including personal news, of interest to the entire membership. The Journal appears nine times a year, in January to May and September to December.

Subscription rate: $7.50 per year (U.S.) or $1.00 per copy; foreign postage extra. Subscription orders 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."

Back issues of the Journal and Proceedings of the Academy have been taken in charge by the Johnson Reprint Corporation of New York City, which will handle sales on a commission basis. This firm expects to be set up early in 1963 for the direct handling of orders for back numbers. Meanwhile, requests for back numbers should continue to be addressed to the Academy Office at 1530 P St., N.W., Washington, D.C.

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 Academy of a change of address.

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Recent Developments in Chemotherapy of Cancer

Ronald B. Ross

Cancer Chemotherapy National Service Center, National Institutes of Health

The program administered by the Cancer Chemotherapy National Service Center, which was instituted to find new and more effective anticancer drugs, has been described in detail in a number of publications. Suffice it here to say that CCNSC began operations about December 1955, and since then has maintained a routine screening program in which 71,900 synthetic compounds (at the latest count) have been evaluated in tumor-bearing animal systems; 10,000 synthetic materials have been tested in an *in vitro* tissue culture program; some 95,000 antibiotic filtrates, representing original fermentations, have been evaluated; and, more recently, approximately 12,000 plant extracts have been tested chiefly in experimental mouse tumor systems. In addition, numerous extracts of animal tissues have been examined for tumor inhibitory properties.

The synthetic compounds tested in this program have been submitted by many university and industrial sources, both in the United States and abroad. These substances cover the chemical spectrum from organic compounds through the organometallics to the classical inorganic types.

Much has been said about the now-classical antitumor agents, which can be categorized broadly into (1) alkylating agents, (2) antimetabolites, (3) antimitotic substances, and (4) antibiotics.

Particular reference to structures of chemical agents discussed in this review, as well as additional information, can be found in other publications (1, 2, 3).

Among the newer alkylating agents, the best known are undoubtedly the sarcolysins (Figure 1), the parent compound being DL-sarcolysin or, in the terminology of the Chester Beatty Research Institute, merphalan. Of the optically-active isomers, L-sarcolysin or melphalan posesses true antitumor activity in experimental systems and has been shown to produce a relatively high remission rate in multiple myeloma, a rare form of cancer, in man. The D-sarcolysin or medphalan is toxic in both experimental animals and man and possesses little, if any, antitumor activity. Of the position isomers, the *o*-sarcolysin or *o*-merphalan exhibits a somewhat better therapeutic index in the mouse and rat tumor systems, but pharmacologically appears to possess little advantage over L-*para*-sarcolysin. It will be noted that L-sarcolysin is a derivative of the naturally-occurring amino acid L-phenylalanine; CCNSC has been very much aware that the stereochemistry of synthetic compounds cannot be ignored in the search for more effective chemical agents.

That the stereochemistry of a molecule can be extremely important in an anticancer drug is borne out by the newest member of the methanesulfonoxy compounds, namely the 1,4-bis(methanesulfonate) of L-threitol (Figure 2). This alkylating agent, submitted by the Leo Pharmaceutical Company (Ballerup, Denmark), exists in the L-, D- and *meso-* forms. In the Dunning rat IRC-741 leukemia system, the L-threitol compound possesses a marked advantage over the D form (inactive) and the *meso* form (about half the activity of the L form). In the Walker 256 rat adenocarcinoma, the same effect is observed although to a lesser

degree. When compared pharmacologically with the now well-known mannitol myleran (D-mannitol, 1,6-dimethanesulfonate; NSC-37438*) on a dose-for-dose basis, the threitol ester was half as toxic as the mannitol derivative when administered intravenously in the monkey. However, the difference in toxicity of these two agents disappeared when they were administered orally. The expectation that the L-threitol compound, so closely related structurally to the well-known drug Myleran (1,4-butanediol, dimethanesulfonate and differing from Myleran only in the presence of two hydroxyl groups on the tetramethylene chain, would be more effective because of its greater solubility than the more insoluble Myleran, may or may not be realized in human trials.

In the classical nitrogen mustard area, the newest agent is illustrated in Figure 3. It has been studied extensively at the University of Miami as well as at the Chester Beatty Research Institute.

In the aziridine or ethylenimine area, particular mention should be made of two members of this series. The compound 2,4-bis(1-aziridinyl)-6-methyl-5-nitropyrimidine (NSC-23436) (Figure 4), when administered orally, preceded by an acid-neutralizing agent such as sodium bicarbonate, has produced observable effects in lymphomas. It should be pointed out that the acid-lability of aziridinyl compounds makes difficult the oral administration of such agents.

An extremely interesting observation has been made at the Southern Research Institute, where 6-(1-aziridinyl)-9-benzyl-9*H*-purine (NSC-34850) (Figure 5) was prepared. This compound which could be regarded as a hybrid of a purine antimetabolite and an alkylating moiety, inhibits the growth of carcinoma 755 moderately well, but in addition inhibits the growth of Walker 256 to a significant degree. The fact that this compound inhibits both Ca-755, a purine-sensitive tumor, and Walker 256, a tumor sensitive to alkylating agents but not to purines, enhances the hope that these compounds may be a truly new class of tumor-inhibitory compounds that owe their activity to irreversible enzyme antagonism, resulting from the fact that structurally they combine an alkylating function with a metabolite carrier.

In added reference to hybrid types of antitumor agents, the compound shown in Figure 6, which is a hybrid of a purine and a nitrogen mustard converted to a methanesulfonoxy compound, has shown a remarkable biological specificity when tested in a series of alkylating-agent sensitive tumor systems designated as Walker 256, Dunning leukemia, Ehrlich ascites, Lymphoma 8, and Yoshida hepatoma. It induced nearly complete destruction of the Yoshida hepatoma while showing little or no effect on the other tumors. It has not yet been subjected to clinical trial.

In what may be termed non-classical alkylating agents, the compound 1,4-bis(3-bromopropionyl)piperazine (NSC-25154) (Figure 7) deserves mention. This compound may be regarded as a substituted diamide and hence does not fit the pattern of the bis(2-chloroethyl)amine mustards. However, this substance is effective, though to a limited degree, in human chronic granulocytic leukemia.

In general, nitrogen mustards derived from carboxylic acid amides are almost totally inactive in experimental systems. The mustard amides must be prepared with care due to the lability of these compounds in hydroxylic solvents. In such solvents, mustard amides undergo a rearrangement to form ester hydrochlorides of chloroethyl ethanolamine (Figure 8). This is an example of an acyl migration, of which there are numerous other examples in both natural products and synthetic organic chemistry.

In stark contrast to the mustards derived from amides, the mustards resulting from reduction of the carbonyl group in the amides to the completely saturated or methylenic carbon, are highly effective in experimental systems. Lithium aluminum hydride—aluminum chloride reduction of

* NSC is our code designation referring to National Service Center.

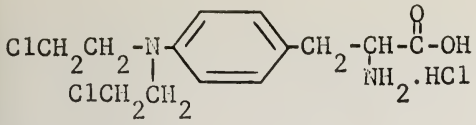


Figure 1.—3-(p-[Bis(2-chloroethyl)amino]phenyl)alanine hydrochloride (sarcolysin)

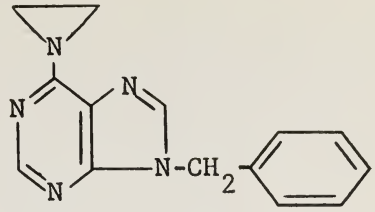


Figure 5.—6-(1-Aziridinyl)-9-benzyl-9H-purine (NSC-34850)

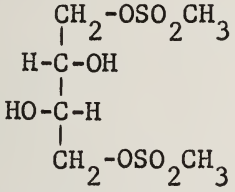


Figure 2.—L-Threitol, 1,4-dimethanesulfonate (NSC-39069)

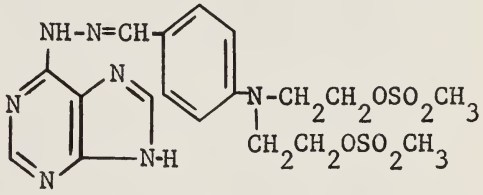


Figure 6.—p-[Bis(2-hydroxyethyl)amino]purin-6-ylhydrazone, dimethanesulfonate ester, hydrochloride (NSC-54012)

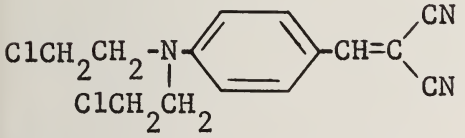


Figure 3.—(p-[Bis(2-chloroethyl)amino]benzylidene)-malononitrile (NSC-48841)

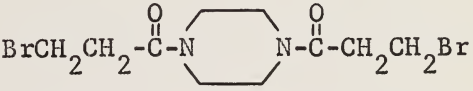
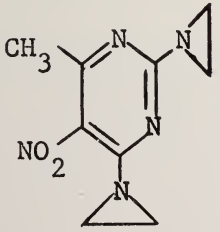


Figure 7.—1,4-Bis(3-bromopropionyl)piperazine (NSC-25154)



NSC-23436

Figure 4.—2,4-Bis(1-aziridinyl)-6-methyl-5-nitropyrimidine

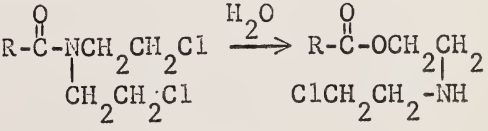


Figure 8.

the mustard amides to the corresponding benzylamine mustards has been extremely successful. The benzylamine mustards have not been examined to any extent in the United States; however, Russian scientists claim that Embitol (Figure 9) is the agent of choice in treatment of lymphomas. It must be admitted that additional agents for treatment of lymphomas would not come amiss, although the *Vinca* alkaloids are filling this gap to a considerable extent.

CCNSC has tested a number of mustards of the benzylamine type, one of which is the mustard derived from piperonylamine (NSC-49221) (Figure 10); this inhibits the Dunning leukemia tumor but is much less effective in the Walker 256 carcinosarcoma.

It is interesting to note that many alkylating agents act as insect chemosterilants, whereby eggs are sterile or metamorphosis is prevented. Possibly the most effective of these is the compound known as Apholate (Figure 11). This compound substantially inhibits Carcinoma 755, Dunning leukemia, and Walker 256 test systems, and produces sterility in both male and female fly species. It has not been afforded extensive clinical trial, in which its insolubility would be a serious drawback.

The second category of classical antitumor agents is that called antimetabolites, to which belong the well-known drugs 6-mercaptopurine and amethopterin (Figure 12). The profound importance of antimetabolites is amply demonstrated by the fact that amethopterin is the only known drug that will produce actual "cures" in one form of human neoplastic disease, the choriocarcinoma of the pregnancy state. This well-known antifolic drug, when evaluated as a chemosterilant, produced sterility only in the female fly, not in the male (4, 5). All other antitumor agents in use today are suppressive agents. That is to say, the drugs suppress the disease to a greater or lesser extent. However, on withdrawal of the drug, the disease very often recrudesces to the detriment of the patient. It must be pointed out that the more efficient suppressive drugs enable the clinician to induce prolonged survival of the patient. It is obvious, therefore, that the greater the number of suppressive drugs that are available to the clinician, the greater is the physician's ability to prolong survival to a very marked degree.

Other recent developments in the antimetabolite area, such as discovery of 5-fluoro-2'-deoxyuridine and 6-azauridine, have been dealt with recently in an excellent review(6) and do not need to be further detailed here.

One of the factors that must be taken into account in developing new antineoplastic drugs, especially for treatment of leukemias, is that the drug should pass the so-called blood brain barrier. Among the newer experimental materials, it has been found that 1-methyl-1-nitrosourea (Figure 13) passes this barrier and destroys leukemic cells in the brain tissues. However, this compound is extremely difficult to handle and decomposes at body temperature (37°C). A far more stable compound, retaining a high degree of efficacy in the intracerebral situation, is 1,3-bis(2-chloroethyl)-1-nitrosourea (Figure 14), which is presently under active development.

An instance in which a substance showing antitumor activity in experimental systems proves not to be useful in human cancer, but has other useful properties is illustrated by 1-aminocyclopentanecarboxylic acid (NSC-1026) (Figure 15). This compound has not shown any appreciable antineoplastic activity *per se*, but possesses the faculty of alleviating the excruciating bone pain associated with multiple myeloma.

A factor which sometimes proves to be a very considerable obstacle is the insolubility of a drug. The bis mercurials, e.g. 2,5 - bis(iodomercurimethyl) - *p* - dioxane (NSC-23105) (Figure 16), the synthesis of which is highly stereospecific yielding the *trans* form, make an interesting series in this respect. The iodo compound is effective in carcinoma 755 and has also been

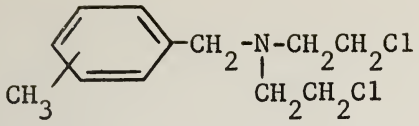
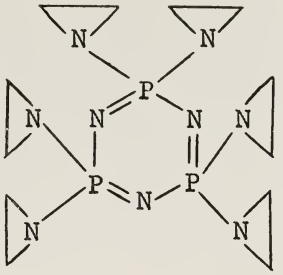


Figure 9.—N,N-Bis(2-chloroethyl)-o(and p)-methylbenzylamine hydrochloride (Embitol)



NSC-26812

Figure 11.—2,2,4,4,6,6-Hexakis(1-aziridinyl)-2,2,4,4,6,6-hexahydro-1,3,5,2,4,6-triazatriphosphorine (Apholate)

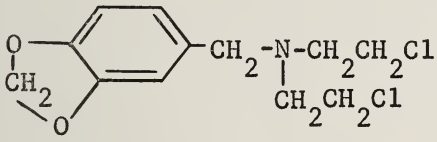
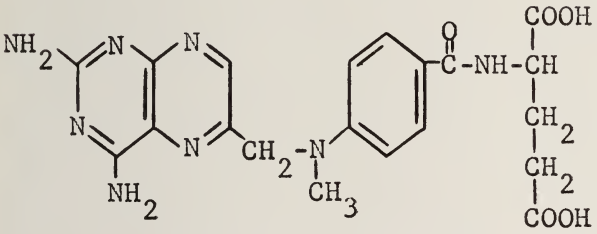
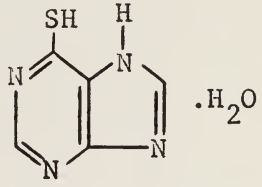


Figure 10.—N,N-Bis(2-chloroethyl)piperonylamine hydrochloride (NSC-49221)



N-[p-([(2,4-Diamino-6-pteridinyl)methyl]methylamino)benzoyl]-glutamic acid (Amethopterin; Methotrexate; NSC-740)



Purine-6-thiol, hydrate (6-mercaptopurine; 6-MP; NSC-755)

Figure 12.

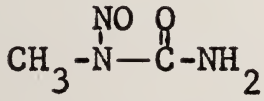


Figure 13.—1-Methyl-1-nitrosourea (NSC-23909)

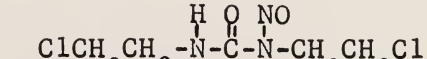


Figure 14.—1,3-Bis(2-chloroethyl)-1-nitrosourea (NSC-409962)

shown to be a potent specific inhibitor of glycerophosphate dehydrogenase (50 percent at $5x10^{-6}M$). Unfortunately, the compound is very insoluble. Anions other than iodine, and esters such as the benzoate, apparently do not possess the therapeutic index shown by the iodo derivative. The iodo compound is inactive orally. When administered intramuscularly it is not absorbed. Hence, the paradox of the more soluble form of a drug being far less active than the insoluble form presents an awkward problem to solve.

There are four new drugs (two *Vinca* alkaloids, Methyl GAG, and hydroxyurea) which by and large profoundly suppress the neoplastic process. It is interesting to note that for only one of these, namely the alkaloid vincaleukoblastine (VLB or Vinblastine) has the metabolic blocking action been investigated as yet. The following quotation is taken from *Canadian Cancer Conference*, Volume 4, page 339 (1961):

"Studies on the reversal of the growth-inhibitory action of VLB *in vitro* have been extended to *in vivo* experiments using the P-1534 lukemia in DBA/2 mice. These *in vivo* studies tend to confirm the hypothesis that the oncolytic action of VLB is due to interference with the cellular metabolic pathways leading from glutamic acid to urea and from glutamic acid to the citric acid cycle."

Despite the similarity in structures (7), Vincaleukoblastine produces a profound fall in white blood cell counts, while the other *Vinca* alkaloid Vincristine (VC: leurocristine) has far less activity on the bone marrow elements. Both VLB and VC remain drugs of fascinating ability to completely suppress Hodgkin's disease; and they have been known to produce marked regression of a few solid tumors. Continued administration of these alkaloids gives rise to certain neurotoxic manifestations, probably the most undesirable being the appearance of paraplegias (loss of sense of feeling and touch in hands and feet, muscle atrophy, etc.). From the data to date, Vincristine apparently does not conquer meningeal leukemia, an observation which is at odds with its known ability to damage the central nervous system. It must be added, as a word of caution, that these are toxic drugs and are still in short supply, since they must necessarily be extracted from various *Vinca* species.

Methyl GAG is the common term for methylglyoxal bis(guanylhydrazone) (Figure 17) and its salts. The antitumor activity of this substance can be demonstrated by both oral and intraperitoneal administration of the compound to mice bearing Leukemia L1210. In man, the compound is active by intravenous injection; no antitumor effect has been noted by the oral route in man. In early clinical trials, one side reaction took the form of hypoglycemia. However, as clinical studies progressed, it was found that nontoxic doses were effective and that, at these drug levels, hypoglycemia was not observed. The drug is most effective in acute myelogenous leukemia both in the child and the adult. Its chief drawbacks are that it must be administered intravenously and that it is a toxic drug. Preliminary clinical trial in acute myelogenous leukemia demonstrates that Methyl GAG effects a higher response rate than does the previous agent of choice, 6-mercaptopurine. More will be heard about this drug in the coming months, particularly because it is evident that Methyl GAG has a biochemical mechanism of action totally different from all other antileukemic drugs. In addition, the structure of the drug has a very high degree of specificity.

It is known that resistance can develop to Methyl GAG and that, in common with Vincristine, the disease recrudesces when drug treatment is discontinued. These two fascinating compounds, then, are also suppressive drugs. However, suppressive drugs can be of life-saving value; one need only consider insulin to be reminded of this fact.

The third drug, hydroxyurea (Figure 18), has not as yet been given as extensive clinical trial as the other three compounds. It can induce sharp falls in the white blood

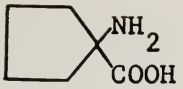


Figure 15.—1-Aminocyclopentanecarboxylic acid (NSC-1026)

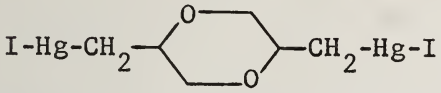


Figure 16.—2,5-Bis[(iodomercuri)methyl]-p-dioxane (Baker's mercury compound; NSC-23105)

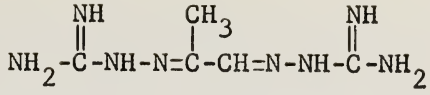
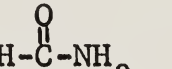


Figure 17.—1,1′-(Methylethanediylidenedinitrilo)diguanidine (methylglyoxal bis(guanylhydrazone); methyl GAG)



NSC-32065

Figure 18.—Hydroxyurea

cell count, and it has produced clinical remission in human leukemias. Interesting aspects of this compound are its low molecular weight, which could be assumed to aid in diffusing across the blood brain barrier but does not do so, since the drug is ineffective in meningeal leukemia; its chemical structure, encompassing three different functional moieties in a compound of such low molecular weight; and finally, a very high degree of structural specificity.

To what circumstances does one attribute the difficulty in finding "cures" for cancers? It now seems evident that neoplastic disease is a profound metabolic disturbance, on the biochemical nature of which we are in the dark, just as much as we are in the dark concerning the etiology of cancer. The human being is indeed a very intricate and delicate mechanism about which we know far too little. There is hope that immunological procedures may hold the key to complete control of cancer. Again, immunology of cancer is an extremely difficult subject, and much work must be done to elucidate this area.

Another current CCNSC program involves in the relationship between viruses and cancer. An excellent background for this endeavor was provided a number of years ago by Peyton Rous of the Rockefeller Institute, after whom the Rous chicken sarcoma virus is named; more recently the work has been extended by scientists in the intramural laboratories of the National Cancer Institute, working with the polyoma virus. Effective antiviral drugs are as difficult to find as potent antitumor agents.

In summary, it is instructive to list the drugs capable of producing profound remissions and even "cures" in some instances, in various types of human cancer. These are as follows:

(1) Amethopterin in choriocarcinoma.
(2) Thio-TEPA + X-radiation in retinoblastoma.
(3) Actinomycin D + X-radiation in Wilms tumor with metastases to the lung.
(4) Progesterone in endometrial cancer with metastases to the lung.
(5) 5-Fluorouracil and 5-fluoro-2'- deoxyuridine in metastases from intestinal tumors.
(6) Thio-TEPA in adjuvant surgery of mammary cancer in pre-menopausal patients.
(7) Methylglyoxal bis(guanylhydrazone) in acute myelocytic leukemia.
(8) Vincristine in acute lymphocytic leukemia, Hodgkin's disease, and lymphomas.
(9) Vincaleukoblastine in Hodgkin's disease and lymphomas.

(10) *o,p'*-DDD in adrenal carcinoma.
(11) Chlorambucil in chronic lymphocytic leukemia.
(12) Myleran in chronic myelocytic leukemia.

This round dozen of clinical agents foreshadows the availability of still other and more effective agents for treating cancer which, combined with the skill of the physician, will give succor to those beset by this most vicious of diseases.

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(3) R. B. Ross. J. Chem. Ed. *36*, 368 (1959).
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(5) A. W. Lindquist. J. Wash. Acad. Sci. *51*, 109 (1961).
(6) A. D. Welch. Cancer Res. *21*, 1475 (1961).
(7) N. Neuss, M. Gorman, H. E. Boaz, and N. J. Cone. J. Am. Chem. Soc. *84*, 1509 (1962).

Use of the "Peek-a-Boo" Information Retrieval Technique for a Personal Reference File

John A. Bennett

Metallurgist, National Bureau of Standards

Almost every scientist and engineer finds it necessary to maintain a personal file of references. This will probably continue to be true despite the tremendous efforts that are being made to make information searching and retrieval faster and more adequate, because the personal file serves a specialized need for each individual. Once he has been made aware of a reference that is of interest to him (by reading of current periodicals or by a large-scale searching and retrieval service), and particularly if he has read the reference so that he knows just what is in it, he must store that information in some way so that he can reach it easily. The Peek-a-Boo system (optical coincidence subject cards) is ideal for such a file; but few people are aware of its advantages, and even fewer use it because of the lack of suitable, inexpensive equipment. The present note is submitted in the hope that it will encourage others to try the system and possibly stimulate production of the needed equipment.

A complete discussion of the Peek-a-Boo technique is given by Wildhack and Stern (see reference), who also describe some of the commercially available equipment for small-scale applications, and detail the methods used in a large-scale instrumentation-referencing application at the National Bureau of Standards. Briefly, any Peek-a-Boo system involves two parts—a numerical list of the items in the file, and a set of approximately punched subject cards. The numerical list can be in any convenient form that is readily accessible. The subject cards are so designed that they have a punch position assigned to every item in the numerical file. For example, in the system as used by the author, the subject cards are 5x8 in. and the punch is designed to provide 50 positions in each of 30 rows, a total of 1500 positions. This means that 1500 items can be entered in the file.

When an item is added to the file, it is first entered on the numerical list. Then each subject card that is appropriate to

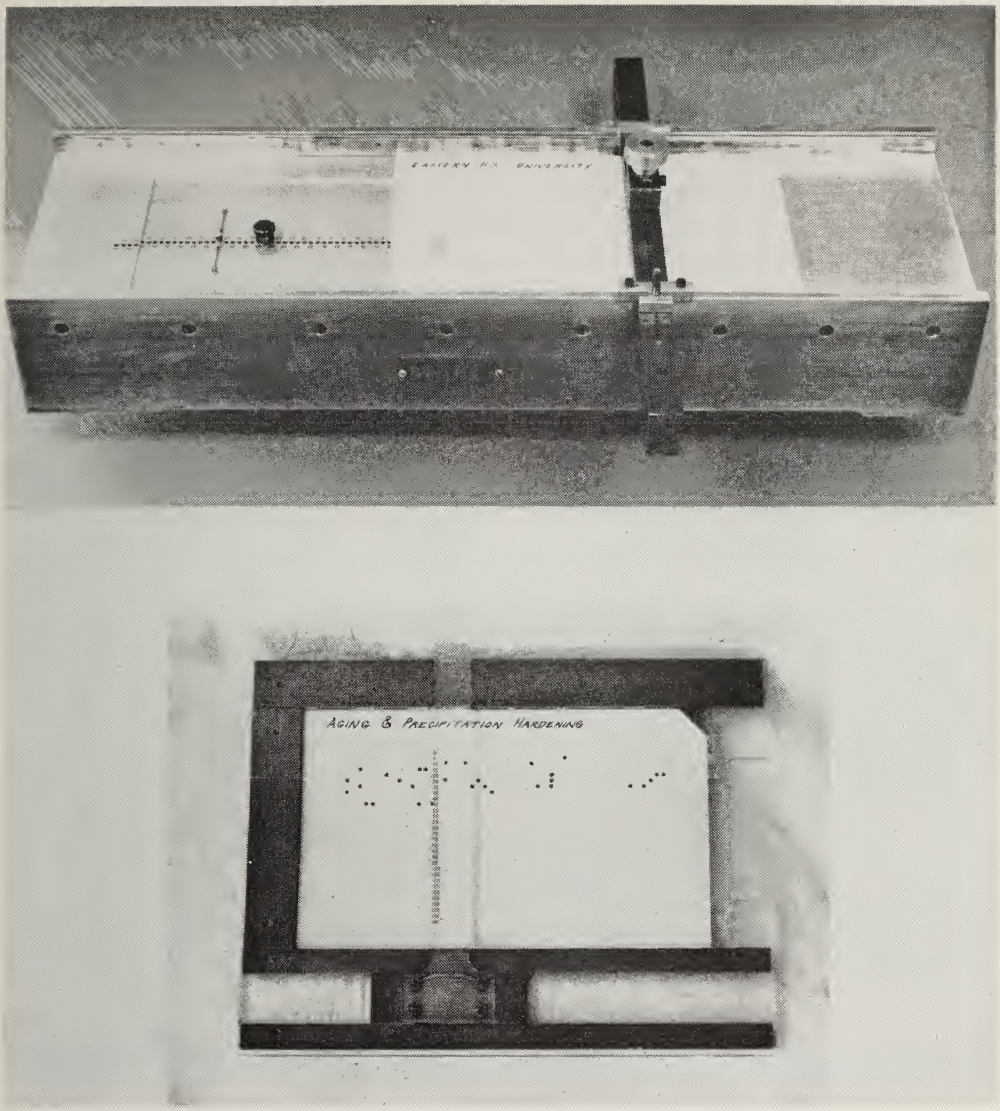

Figure 1. Punch (top) and reader for use with 5x8-inch cards.

the item is punched at the position corresponding to the item number. The subject cards are usually grouped in categories such as name of author, location, material investigated, etc. When searching for an item, one selects all of the subject cards that are appropriate and places them in a pile with the punch positions aligned. Looking at the pile against a contrasting background immediately shows the positions where all the cards are punched; and these positions correspond to all the items in the file that are appropriate to all the selected subject cards. The great value of the system lies in the fact that only cards relating to the subject sought need be used in searching. Because the searching process is subtractive, one usually finds that only a few cards need be selected in order to locate the appropriate items.

Table 1. Summary of Subject Cards

Category	Number of subject cards	Remarks
First two letters of author's name	20	Alphabet equally divided by use of telephone book
Location of author's organization	13	
Type of reference	4	If other than report of original research
Major element in material investigated	8	Individual cards for Al, Cu, Fe, Mg, Ti; others grouped
Form of material	7	If other than wrought
Key word	± 60	Discussed below

In adapting this technique for a personal reference file, I kept the following considerations in mind: (1) The number of items to be filed would be relatively small, because the file would be limited to references of direct interest to me and generally to those that I had read; and (2) both the punch and reader should be simple and small enough to store in a bookcase, so that they would be readily accessible. The figure of 1500 was an estimate of the number of entries over a ten-year period; but a six-year trial has shown a rate less than this. The punch positions are located in a space 6½x3½ inches on the 5x8 inch card, leaving an inch at the top for the title, and ¾ inch on each side to provide mechanical support for cards with many punches.

The punching guide and reader for use with these cards were designed by H. C. Vacher of the NBS Metallurgy Division and constructed by A. N. Graef of the NBS Shops Division. As shown in Figure 1, the guide consists of a channel into which the card is slipped, a plastic plate against which the card is pushed, and a transverse carriage for the punch and die. In use, the desired location of the punch in the card is determined by setting the stop plate for the appropriate column, and the punch carriage is set to the proper row, being held in position by a small pin. The spacing between the punch positions is 0.13 inch horizontally and 0.12 inch vertically, and the diameter of the punch is 0.08 inch, so that no great precision is needed. Ordinary paper cards have been used without any difficulty due to dimensional change with humidity.

The reader has a transparent plastic base on which are brass guide strips for the cards and for the transparent selector bar. In use the reader is placed on a dark desktop and the selected cards are aligned by pushing them against the strips at the top and left. Any holes that are punched in all cards appear dark, and the left edge of the selector bar is aligned with one of these. The number on the bar opposite the hole gives the row position, while the number adjacent to the bar on the top guide strip gives the column.

A system of this kind is extremely flexible, and can be adapted to any individual's requirements. The table below outlines the categories of subject cards that I have used —not because I think that anyone else will use the same ones, but to show the flexibility that is possible.

The key word cards have no system of any kind; the card titles have been arrived at by a trial and error process as the file has been used. Some titles relate to phenomena or processes, such as *aging, fatigue, plastic deformation:* others are descriptive, such as *elevated temperature, electrical and magnetic, time-dependent,* etc. It is surprising what a variety of ideas can be expressed by combinations of two

or three cards, so that the desired item can be found even though one or two other unrelated items may also be selected. For example, an item that was punched on both the *aging* and *fatigue* cards might be a paper on the effect of aging time and temperature on fatigue properties; or it could be one describing the observation of accelerated aging as a result of fatigue stressing. Such duplication has not caused any inconvenience, and the number of subject cards required is much less than would be the case if further division into categories were attempted.

Although it is not necessary, I also use cards (3x5 in.) for the numerical list of items. This makes it possible to have an abstract of pertinent information from the reference and frequently saves a trip to the library, but adds to the time required to make an entry. For many purposes a list showing author, title, and journal reference would suffice.

One of the advantages of the Peek-a-Boo system that makes it particularly applicable to a personal filing system is the fact that it is open-ended. Thus if one's interests change, or there is need for additional classifications, new subject cards can be added without in any way affecting those already in the file. In planning the subject cards for a Peek-a-Boo system, it should be remembered that it is very easy to combine two cards if it develops that they are not being used much; but it is impossible to break down the punches on a card into two or more subjects without going back to all the original items. Consequently it is well to start out with a rather large number of fairly detailed subject headings; from time to time the seldom-used cards can be merged if the number of cards is becoming unwieldy.

Used in the limited way that I have described, this filing system has been extremely useful, and is becoming more useful as it grows. I am convinced that it is well worth the few minutes required to insert an item, as I seldom now have that frustrating thought, "Where on earth did I read that?" The 1500-item capacity on 5x8 inch cards appears to have been a fortunate compromise that provides enough items for many years, without imposing requirements for dimensional accuracy that would necessitate complicated punching and reading equipment or special cards. Unfortunately, I am not aware of any commercially available equipment with a capacity in this range.

Reference

W. A. Wildhack and J. Stern. The Peek-a-Boo System—Optical Coincidence Subject Cards in Information Searching. In Punched Cards, edited by Casey, Perry, Kent, and Berry. 2nd edition, Chapter 6, p. 125, Reinhold, New York, 1958.

The Botanical Society of Washington: A Brief History*

John A. Stevenson

The Botanical Society of Washington is an organization composed of "residents of Washington or vicinity having a professional or other special interest in botanical science." It was formed November 23, 1901 by a union of the Botanical Seminar and the Washington Botanical Club, with a charter membership of 29.

The Botanical Seminar was organized in 1893 by a group of men interested in plant pathology and physiology: B. T. Galloway, Erwin F. Smith, David Fairchild, Theo.

* Reprinted from a brochure, "The Botanical Society of Washington: History, Constitution and Bylaws, and Membership," issued in September 1962. Dr. Stevenson is the archivist of the Botanical Society.

Holm, M. B. Waite, and F. V. Coville. This Seminar or "guzzleshaft" as it was familiarly known to its members, was very informal in its organization, being without officers, formal constitution, or minutes or other records of its proceedings. The meetings were held at the residences of members, the host of the preceding meeting acting as chairman. Membership was limited to 25, unanimous consent being necessary for admission of a new member. Vigorous discussion and free but friendly criticism featured the meetings which were followed by abundant refreshments, which have become a tradition.

The Washington Botanical Club was organized in 1898 by botanists interested primarily in taxonomy and ecology. Charter members were O. F. Cook, Edward L. Greene, A. J. Pieters, C. L. Shear, H. J. Webber, T. A. Williams, J. N. Rose, Gilbert H. Hicks, L. H. Dewey, F. H. Knowlton, C. L. Pollard, J. G. Smith, David White, Frederick V. Coville, and Thos. H. Kearney.

During the brief existence of the club but four additional members were added, unanimous consent by secret ballot being necessary for such action. Several noted botanists, it may be noted, fell by the wayside. E. L. Greene was permanent president.

Both these societies were very successful but the rapidly increasing number of working botanists in Washington made a broader plan desirable. Rather reluctantly the established societies in 1901 appointed a joint committee to draw up plans for such action. This committee recommended a merger of the Club and the Seminar to form the Botanical Society of Washington. Accordingly the two organizations met together for the first time on November 23, 1901, and after the necessary formalities adjourned "sine die," permitting the infant Botanical Society to hold its first meeting. A. F. Woods was elected president, serving through 1903. The suggestion of the organizing committee "that monthly meetings be held in a private room at some suitable restaurant at which an informal dinner and brief period of social intercourse shall be followed by the scientific program" was followed for some years. About 1909 the Society changed to its present plan of regular meetings at the Cosmos Club with occasional meetings on invitation elsewhere. The Society voted at its eighth meeting to hold an open meeting each year to which ladies might be invited. The first of these was held on June 7, 1902, at the Portner Hotel. The custom of calling on the retiring president for an address was inaugurated in 1903, A. F. Woods delivering the first on January 30, 1904, his subject being "Plant Pathology."

The constitution and bylaws as adopted at the first meeting have been changed from time to time as circumstances warranted, the most precedent shattering in that direction being the amendment adopted at the 171st meeting, December 4, 1923, admitting women to membership. In recent years the Society has indulged in occasional field trips in addition to the eight regular monthly meetings (October-May).

The Society affiliated with the Washington Academy of Sciences in January 1903 and annually nominates one of its members to represent it on the Academy's Board of Managers.

The proceedings of the Society have been published in part, during certain years only, in Science and the Journal of the Washington Academy of Sciences. Similarly some of the addresses of retiring presidents have been published in these Journals. The proceedings and presidential addresses as reprints were brought together for the period 1913-1918 and reissued by the Society in three booklets. Further than this the Society has not engaged in publication.

THE BROWNSTONE TOWER

As I sit down to write this column, I am infused with missionary zeal to promote science and music simultaneously. Last night I attended a Schubertiad at the home and studio of John Yard, who works for agricultural science by day and sings and teaches singing at night. The original Schubertiads were small gatherings of the friends of Franz Schubert, joining with him to play and sing his music. At last night's Schubertiad, John Yard took Schubert's place at the piano, and five of John's students sang 13 of Schubert's songs. All have derived from their music personal satisfactions and personal relations of rare quality. What music means to them was perfectly expressed by Franz von Schober. one of Schubert's best friends:

> "Du holde Kunst, in wieviel grauen Stunden,
> Wo mich des Lebenswilder Kreis umstrickt,
> Hast du mein Herz zu warmer Lieb entzunden,
> Hast mich in eine bess're Welt entrückt."

And Schubert made of it a moving hymn to Music. It was not sung last night. but may have been in the mind of Sam Woo, one of the singers, who works for the Voice of America. Conscious of the need for "eine bess're Welt" and of "des Lebenswilder Kreis," he would break our present crises through singing. It is wishful thinking, of course, and he knows it. for the number of people who sing to express their feelings and aspirations is probably not increasing in the global population. Yet the number of people who listen to music, both vocal and instrumental, may be increasing at a greater rate than the total population, thanks to modern science and technology which have given us LP records, magnetic tape recording, Hi Fi systems, radio, TV, and electronic devices that enable people like myself who have a moderate hearing loss to hear well. If I sing in praise of Music, I am equally fervent in appreciation of Electronics.

And now comes the drive for popular support of the proposed National Cultural Center. I am for it. Here is the opportunity for everyone who loves music and believes in it as Sam Woo does to prove it. How proud I shall be, if the Center becomes a reality, to tell a visitor in the future that I helped to build it. When plans for the Center were incubating a few years ago, I thought that provision might be made in the Center for scientific meetings, since pure science is a cultural subject. The idea was passed on to the Washington Board of Trade. but nothing came of it.

Washington scientists are not yet aroused and determined to have a National Science Center. yet the need for a center where large international scientific congresses can be proudly staged is as great as that for a National Cultural Center where the best of national and international performing arts can be presented to residents of and visitors to Washington. In New York and Baltimore and perhaps elsewhere in the United States, plans are being made for science centers to house the local academy of sciences and for other purposes. How much greater is the need in Washington. the scientific capital of the nation—need not only for spacious modern meeting facilities. but also for offices for scientific and science related organizations! A National Cultural Center is attractive to private wealth and society; a National Science Center does not have the same appeal. and probably cannot be built without some Government subsidy. The Washington Academy of Sciences. lacking a satisfactory home of its own. ought to take the lead in making plans for a National Science Center. Its sights have been set too low. Any rent-free space within the building of another organization should be regarded as temporary, and plans should be made and goals set for a great Center.

Washington has not been lacking in leadership necessary to acquire new scientific facilities for public and private organizations. Among private organizations, one thinks of Georgetown University and its Science Center, dedicated last October 13; the Federation of American Societies for Experimental Biology and its new office building on its campus in Bethesda, dedicated on October 12; the National Academy of Sciences-National Research Council and its new Hall of the Life Sciences, dedicated on June 27; and Catholic University of America and its new biology building, dedicated on April 26. I was fortunate to have been invited to attend all these dedications. With what pride and gratitude do the successful leaders view the results of their efforts! May I live to be present when the leaders of a drive to build a National Science Center assemble at last to dedicate it, not only to the service of the scientists of the United States but also to those of the world!

—Frank L. Campbell

Membership to Vote On Officers for 1963

Annual elections of Academy officers for 1963 will be held in December as usual, by mail ballot. About December 15 the secretary will send out the following slate of candidates for approval of the membership:

For president: Benjamin D. Van Evera of George Washington University.

For president-elect: Francois N. Frenkiel of the David Taylor Model Basin; Marion W. Parker of the Agricultural Research Service.

For Secretary: George W. Irving, Jr., of the Agricultural Research Service.

For treasurer: Malcolm C. Henderson of Catholic University.

For manager-at-large, 1963-65 (two to be elected): Allen L. Alexander (NRL), Harold T. Cook (USDA), Mary Louise Robbins (GWU), and John K. Taylor (NBS).

Election of a president is necessitated this year by the recent resignation of President-elect Heinz Specht to accept a foreign assignment.

The new officers will take office at the close of the annual meeting in January.

Previously-elected managers-at-large who will continue in office during 1963 are Alphonse F. Forziati and Leo Schubert (class of 1961-63) and Russell B. Stevens and Harold H. Shepard (class of 1962-64).

Delegates of affiliated societies to the Board of Managers (see inside rear cover of this issue) continue in office until new selections are made by the respective affiliates.

Concurrently with the voting on officers, the membership will be asked to ratify several Bylaws changes recently endorsed by the Board of Managers. (See November issue, page 196.)

Science in Washington

SCIENTISTS IN THE NEWS

Contributions to this column may be addressed to Harold T. Cook, Associate Editor, c/o U. S. Department of Agriculture, Agricultural Marketing Service, Room 2628 South Building, Washington 25, D. C.

APPLIED PHYSICS LABORATORY

R. E. Gibson, director, addressed the School of Advanced International Studies of Johns Hopkins University on October 23, with a lecture entitled "The Impact of Recent Scientific Advances on Politics and Diplomacy."

On October 26, 1962, Dr. Gibson addressed a luncheon group—the Career Science Executives, Office of Career Development—at the Civil Service Commission. The talk was entitled "The Environment of Research."

A. M. Stone lectured on October 22 at the University of Maryland's Institute for Space Research and Technology, on "The Navy Navigational Satellite System."

CATHOLIC UNIVERSITY OF AMERICA

Paul J. Claffey, associate professor of civil engineering, presented a paper entitled, "The Evaluation of User Benefits Accruing Through Highway Improvement." at the Fourth World Meeting of the International Road Federation, held in Madrid during October.

COAST AND GEODETIC SURVEY

Aaron L. Shalowitz, special assistant to the director, is the author of a two-volume legal-technical treatise on "Shore and Sea Boundaries." Volume 1 was recently released for distribution by the Government Printing Office.

David G. Knapp, assistant chief of the Geomagnetism Branch, reported on his recent studies of geomagnetic daily variation along the magnetic dip equator, as a participant in the First International Symposium on Equatorial Aeronomy, held at Concepcion and Lima, Peru, September 18-27.

Charles A. Whitten, chief of the electronic Computing Division, was in Europe October 1-17, for conferences on international geodetic activities and to attend the Symposium on the New Adjustment of European Triangulation. He also attended the centenary celebration of the International Association of Geodesy as the Association's president for the term 1960-1963.

B. K. Meade, chief of the Triangulation Branch, attended a Symposium on the New Adjustment of European Triangulation Networks and the centennial celebration of the International Association of Geodesy, held October 9-13 at Munich, Germany.

HARRIS RESEARCH LABORATORIES

Many staff members attended the 11th annual Chemical Finishing Conference convened by the National Cotton Council in Washington, October 3-5. **Henry Peper** presented a report on "The Effect of Surface Modification on Wet Soiling." This research was carried out on a project supervised by the Southern Regional Research Laboratory of the Department of Agriculture at New Orleans.

Alfred E. Brown, Milton Harris, Anthony M. Schwartz, and **Leonard W. Fine** attended the ACS National Meeting in Atlantic City, September 9-14. Dr. Fine presented a paper on "A New Method of Synthesizing Alpha-Amino Acids" at the meeting; the research leading to this paper was performed at the University of Maryland, under **E. W. Reeve,** as a part of Dr. Fine's program for his Ph.D. degree.

Alfred E. Brown attended a conference of the administrative council of the Metropolitan Washington Board of Trade at Airlie, Va., on September 28, and discussed interrelationships between higher educational institutions and R&D industry in the Washington area.

Norman R. S. Hollies presented a paper on "The Effects of the Thermal Transmission Properties of Clothing Fabrics" at the annual meeting of the Fiber Society in Boston on October 11. **Henry Peper** also gave a talk at this meeting, presenting a progress report on "The Effect of Fabric Surface Modification on Wet Soiling."

Milton Harris attended a meeting of the Industrial Research Institute in Montreal, Canada, from October 31 to November 3.

NATIONAL BUREAU OF STANDARDS

I. C. Schoonover, associate director, has been detailed to the Department of Commerce where he is acting deputy to the Assistant Secretary for Science and Technology.

L. S. Taylor, chief of the Radiation Physics Division, has been appointed acting associate director. Dr. Taylor will perform those functions previously assigned to Dr. Schoonover in his position as NBS associate director.

Talks by NBS personnel:

H. C. Allen, Jr.: "Crystal Chemistry at the National Bureau of Standards"—Symposium on Lattice Defects and Lattice Dynamics, National Physics Laboratory, New Delhi, India.

A. V. Astin: "International Measurement Standards"—American Society for Quality Control, New York.

F. K. Harris: "Precise Electrical Measurements in the Engineering Curriculum" —First Peruvian Congress of Electrical Engineers, Lima, Peru.

J. D. Hoffman: "Fundamental Molecular Science in Postgraduate Engineering Studies"—First Peruvian Congress of Electrical Engineers, Lima, Peru.

R. D. Huntoon: "Research at the National Bureau of Standards and its Role in the Space Program"—Joint Meeting of the Boston Section of the IRE and the Professional Group on Instrumentation, Boston.

L. V. Judson: "Quality Considerations in Quality Control"—17th Midwest Quality Control Conference of American Society for Quality Control, Denver.

The following talks were presented before the annual Instrument-Automation Conference, New York, October 15-18: **D. P. Johnson:** "Design Features of Instruments for the Standards Laboratory"; **J. Mandel:** "Intercomparisons of Laboratory Test Results"; **W. J. Youden:** "Realistic Estimate of Errors in Measurement."

K. G. Kessler: "Standard Wavelengths from Atomic Beams and Zeeman Filters"—International Bureau of Weights and Measures, Comite Consultatif pour la Definition du Metre, Sevres, France; and "Some Researches in Spectroscopy at the National Bureau of Standards"—Lunds Universitat, Sweden.

The following talks were presented before the annual session of the American Dental Association (closed TV program), at Miami Beach: **G. C. Paffenbarger:** "Direct Filling Resins"; and **G. C. Paffenbarger, W. T. Sweeney,** and **J. W. Stanford:** "Research and Practice."

C. H. Page: "A New Type of Computable Inductor" — International Scientific Radio Union, Ottawa, Canada.

NATIONAL INSTITUTES OF HEALTH

Nathan B. Eddy, former chief of the Section on Analgesics, participated in the White House Conference on Narcotics and Drug Abuse, held here on September 27-28. Dr. Eddy acted as panel chairman of several sessions of the Expert Committee on Drugs Liable to Produce Addiction.

SMITHSONIAN INSTITUTION

Albert C. Smith, who has been director of the Smithsonian's Museum of Natural History since 1958, has been appointed an

assistant secretary of the Institution. Dr. Smith is a leading scientist in the field of phanerogamic botany.

T. Dale Stewart has been appointed director of the Museum of Natural History. Dr. Stewart will continue as head curator of the Department of Anthropology.

USDA, BELTSVILLE

R. L. Steere recently visited the Plum Island (N.Y.) Laboratory of USDA and presented a seminar on "Agar Filtration in Virus Purification." Dr. Steere also attended the 5th International Congress of Electron Microscopy and served as chairman of the session on virus reproduction.

John H. Martin returned on September 7, from a 3½-month trip to eight countries of equatorial Africa. He visited 15 experiment stations, conferred with agricultural officials, and observed grain production methods.

Milton S. Schechter, chemist with the Entomology Research Division, Pesticide Chemicals Research Branch, has been given the Harvey W. Wiley Award by the Association of Official Agricultural Chemists for achievements in developing sensitive analytical methods for DDT, benzene hexachloride, and other insecticides in foods, and for the discovery of a route to the synthesis of the outstandingly safe insecticide allethrin and related pyrethrin-type esters.

C. H. Hoffmann participated in the 3rd Seminar on Biological Problems in Water Pollution at Cincinnati, and on August 15 gave a paper on "How Should Agricultural Pollutants be Controlled?"

J. E. McMurtrey, Jr. is recovering from a hernia operation which had made it necessary to be absent from work for about a month.

Karl H. Norris, Instrumentation Research Laboratory, MQRD, AMS, was the research seminar speaker November 15 for the Research Branch of the Canadian Department of Agriculture, Ottawa. Mr. Norris discussed "Instrumentation to Measure the Internal Quality of Agricultural Commodities."

Lawrence Zeleny attended the Seventh Annual Extension Conference of Grain Elevator Operators at Stillwater, Okla., October 4-5, and spoke on the subject of the wheat sedimentation test. This test for wheat quality, devised by the Department of Agriculture, was used for the first time this year as a basis for loan value premiums paid to farmers in connection with the Government's wheat price support program. Sedimentation value replaced protein content as a basis for such premiums.

Frank P. Cullinan, Neil W. Stuart, and **Victor R. Boswell** of the Crops Research Division attended the 16th International Horticultural Congress in Brussels, Belgium, August 30-September 9. Dr. Cullinan visited a number of horticultural laboratories in England before the Congress, and afterward in France, Germany, and Italy. Dr. Stuart conferred with workers in England, Belgium, the Netherlands, and France on production and research problems of commercial ornamental crops, especially those entering into international trade. After the Congress, Dr. Boswell visited a number of vegetable crop research agencies in Poland with a view to developing research contracts under Public Law 480.

Alfred M. Pommer, Nutrition and Consumer Use Research, attended the 8th National Analysis Instrumentation Division Symposium of the Instrument Society of America, held May 1 at Charleston, W. Va., and presided over the session, "Emerging Techniques in Biochemical Analysis Instrumentation."

M. S. Anderson attended the first annual meeting of the newly-organized Peat Producers Association of the United States, held in New York on September 27. He presented a paper entitled, "Scientific Data as an Aid to the Peat Industry."

C. W. Whittaker and his wife have returned from a two-week tour of Mexico.

USDA, WASHINGTON

K. A. Haines, Agricultural Research Service, was a member of the United States

delegation to a meeting of the Food and Agriculture Organization Council held in Rome, October 15-26. The FAO Council, which has 27 member countries, is the governing body of the organization in non-conference years.

UNIVERSITY OF MARYLAND

Zaka I. Slowsky of the Naval Ordnance Laboratory and **George T. Rodo** of the Naval Research Laboratory have accepted part-time professorships in the Department of Physics and Astronomy, to supervise the work of graduate students who are employed in their laboratories.

CALENDAR OF EVENTS

December 6—Society for Experimental Biology and Medicine

Joint meeting with American Association of Clinical Chemists. Program to be announced.

8:00 p.m., Rm. 101, Georgetown University School of Medicine.

December 10—American Society for Metals

Joint meeting with American Welding Society. Discussion of "Welding Using Lasers" by Charles E. Church and William N. Platte of Westinghouse Research Laboratories and Harry Thurman of Westinghouse Electric Corporation.

Dinner at 6:30 p.m., meeting at 8:00, AAUW headquarters, 2401 Virginia Ave., N.W.

December 11—American Institute of Electrical Engineers

John G. Anderson, General Electric Company, "Extra High Voltage Transmission."

Dinner at 6:00 p.m. at O'Donnell's, 1221 E. St., N.W.; meeting at 8:00 in PEPCO Auditorium, 10th & E Sts., N.W.

December 11—American Society of Civil Engineers

Program to be announced.

Dinner at 6:30 p.m., meeting at 8:15 p.m., Powell Auditorium, Cosmos Club.

December 11—Institute of Environmental Sciences

Robert Belsheim, Naval Research Laboratory, "Data Reduction and Analysis." (Eleventh lecture of Dynamic Environment Series.)

7:45 p.m., Rm. 100 Corcoran Hall, GWU, 21st & G Sts., N.W.

December 11 — IRE Professional Group on Microwave Theory and Technology

George F. Hambleton, Army Electronics R&D Laboratory, "Semiconductor Devices in Microwave Applications."

Dinner at 6:00 p.m., Yenching Palace, Connecticut Ave. & Porter St., N.W.; meeting at 7:30, Conference Room of Materials Testing Laboratory, NBS.

December 12—Geological Society of Washington

Program to be announced.

8:00 p.m., Powell Auditorium, Cosmos Club.

December 17—Society of American Military Engineers

Luncheon; program to be announced.

Barker Hall, YWCA, 17th & K Sts., N.W.

December 18 — IRE Professional Group on Information Theory

Salomon Kullback, professor of statistics, GWU, "Error Detection and Correction in Telegraph, Cable, and Radio Communications."

Dinner at 6:00 p.m., O'Donnell's, 1221 E St., N.W.; meeting at 8:00, PEPCO Auditorium, 10th & E Sts., N.W.

December 18—Institute of Environmental Sciences

William R. Forlifer, head of Structural Dynamics Branch, Goddard Space Flight Center, "Environmental Testing." (Twelfth lecture of Dynamic Environment Series.)

7:45 p.m., Room 100 Corcoran Hall, GWU, 21st & G Sts., N.W.

December 19—American Meteorological Society

Program to be announced.

8:00 p.m., National Academy of Sciences.

December 19—Washington Society of Engineers

E. H. Rietzke, president, CREI Atomics. Topic to be announced.

8:00 p.m., Powell Auditorium, Cosmos Club.

December 26—Geological Society of Washington

Program to be announced.

8:00 p.m., Powell Auditorium, Cosmos Club.

December 28—American Society of Civil Engineers

Annual Christmas party.

6 to 9 p.m., Shoreham Hotel.

NEW MEMBERS ELECTED

The following persons were elected to membership in the Academy at the Board of Managers meeting of November 7:

Robert R. Bennett, research geologist, Geological Survey. "In recognition of his contribution to geology and hydrology, especially hydrogeology." (Sponsors: V. T. Stringfield, G. W. Taylor, Jr., R. L. Nace.)

Hyman P. Kaufman, supervisory geodesist, Coast and Geodetic Survey. "In recognition of his contribution to geodesy, and in particular the development of adjustment techniques of triangulation; his contribution of instrumentation; and his correlation of legal and technical precepts." (Sponsors: A. L. Shalowitz, N. F. Braaten, H. S. Rappleye.)

Ruth M. Leverton, assistant administrator, Agricultural Research Service. "In recognition of her research contributions to human nutrition, especially in respect to acid requirements, mineral metabolism, and nutritional status as related to dietary intake." (Sponsors: Hazel K. Stiebeling, G. W. Irving, Jr., Florence H. Forziati.)

Harvey C. Moore, professor of anthropology and sociology, American University. "In recognition of his contributions to anthropological theory, especially concerning cultural process and his field research among the Navaho Indians. (Sponsors: Regina Flannery Herzfeld, W. G. Lynn, R. M. Nardone.)

Gustave Shapiro, chief of the Engineering Electronics Section, National Bureau of Standards. "In recognition of his contributions to the development of electronic miniaturization techniques and components." (Sponsors: M. Apstein, P. J Franklin, P. E. Landis.)

JOINT BOARD ON SCIENCE EDUCATION

Junior Academy Publishes Proceedings

The Washington Junior Academy of Sciences has published the first volume of what is intended to be an annual *Proceedings of the Washington Junior Academy of Sciences.* Consisting of 144 pages, it contains the extended abstracts of 22 talks presented by as many junior scientists at the Junior Academy's annual meeting, held during the Christmas vacation period of 1961.

For a number of years, the Junior Academy has held an annual meeting for the presentation of student papers. Since so many of these have been outstanding, the Governing Council of the Junior Academy felt they should be preserved to benefit a wider audience, including future members of their organization. The Advisory Committee, under the chairmanship of Abner Brenner, agreed to cooperate by reviewing manuscripts and arranging details of publication. The first volume is the result, and one in which all who participated may feel proud.

Twelve hundred copies of the *Proceedings* have been printed. A copy has been sent to each member of the Junior Academy. In addition, a copy has been given to each senior high school in the Washington area for placement in the school library. In the letter of transmittal, it is pointed out that the *Proceedings* has two objectives—to record the scientific accomplishments of local students, and to inspire other junior scientists to achieve. It is also noted that the first contributions of future leaders in science may well be recorded in the pages of the *Proceedings.* This is certainly a strong inducement for a school library to place the publication in its permanent collection.

In order to extend the area of influence of the *Proceedings,* copies are being sent

to all junior academies in this country. No doubt a reciprocal arrangement will result with those junior academies that are now publishing journals. Perhaps the receipt of the *Proceedings* may inspire other organizations not now publishing to undertake such an activity.

The publication of the *Proceedings* has been financed from net proceeds realized from the science tours sponsored by the Junior Academy each year. The Board of Managers of the senior Academy, at its November meeting, voted to underwrite the printing of 200 copies for such members of the Academy who might be interested in the publication. Accordingly, copies are available for free distribution as long as the supply lasts. Requests should be directed to the Washington Academy of Sciences, 1530 P Street, N.W., Washington 5, D.C.

—*John K. Taylor*

SCIENCE AND DEVELOPMENT

The Department of Physics and Astronomy of the University of Maryland has announced graduate study research programs in 14 areas. They are astronomy, astrophysics, cosmic rays, elementary particle theory, quantum field theory, fluid dynamics, gaseous electronics, high-energy physics, molecular physics, nuclear physics, plasma physics, radio-astronomy, general relativity and solid state physics. A number of assistantships and fellowships are offered which provide tuition and stipends starting at $2000.

Two additional Institutes at the National Institutes of Health were authorized by the 87th Congress. They are an Institute of Child Health and Human Development, and an Institute of General Medical Sciences; this will increase the number of Institutes to nine. The new Institute of Child Health and Human Development will be concerned with research on the continuing process of growth and development that characterizes all biological life, from reproduction and prenatal development through infancy and childhood, and on into the stages of maturation and aging. The responsibilities of the new Institute of General Medical Sciences will be the support of research and research training in those scientific areas which provide a common basis for understanding a wide range of disease and health problems.

The "robber flies" (Asilidae) are both beneficial and harmful. Some kill and eat bees, and in some places they destroy whole apiaries and make commercial beekeeping impossible. But they also destroy many insects that are destructive to crops and that way are beneficial to man. There are nearly 5,000 species distributed over most of the earth. The Smithsonian Institution recently published a two-volume report on the taxonomy of these insects by Frank M. Hull.

A new modernized hall of the National Museum, devoted to North American archeology, was opened on November 16. There are 38 display units in the new hall. The first section of the hall consists of a series of displays devoted to the methods and objectives of systematic archeology. The theme is set by a wall map on which are depicted the principal food areas of North America, with superimposed vignettes showing the diversity of lifeways based on the major regional food resources available to prehistoric man. The rest of the hall illustrates, region by region, the diverse character of the archeological materials in the Southeastern United States, the Northeast, the Mississippi-Ohio Valleys, and the Great Plains.

Delegates to the Washington Academy of Sciences, Representing the Local Affiliated Societies*

Philosophical Society of Washington	R. D. Myers
Anthropological Society of Washington	Regina Flannery Herzfeld
Biological Society of Washington	John A. Paradiso
Chemical Society of Washington	Alfred E. Brown
Entomological Society of Washington	Frank L. Campbell
National Geographic Society	Alexander Wetmore
Geological Society of Washington	G. Arthur Cooper
Medical Society of the District of Columbia	Frederick O. Coe
Columbia Historical Society	U. S. Grant, III
Botanical Society of Washington	Wilbur D. McClellan
Society of American Foresters	Harry A. Fowells
Washington Society of Engineers	Carl I. Aslakson
American Institute of Electrical Engineers	William A. Geyger
American Society of Mechanical Engineers	William G. Allen
Helminthological Society of Washington	Doys A. Shorb
American Society for Microbiology	Howard Reynolds
Society of American Military Engineers	Delegate not appointed
Institute of Radio Engineers	Robert D. Huntoon
American Society of Civil Engineers	Thorndike Saville, Jr.
Society for Experimental Biology and Medicine	Falconer Smith
American Society for Metals	Hugh L. Logan
International Association for Dental Research	Aaron S. Posner
Institute of the Aerospace Sciences	Francois N. Frenkiel
American Meteorological Society	Jack Thompson
Insecticide Society of Washington	Robert A. Fulton
Acoustical Society of America	Malcolm C. Henderson
American Nuclear Society	George L. Weil
Institute of Food Technologists	Richard P. Farrow

*Delegates continue in office until new selections are made by the respective affiliated societies.

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