



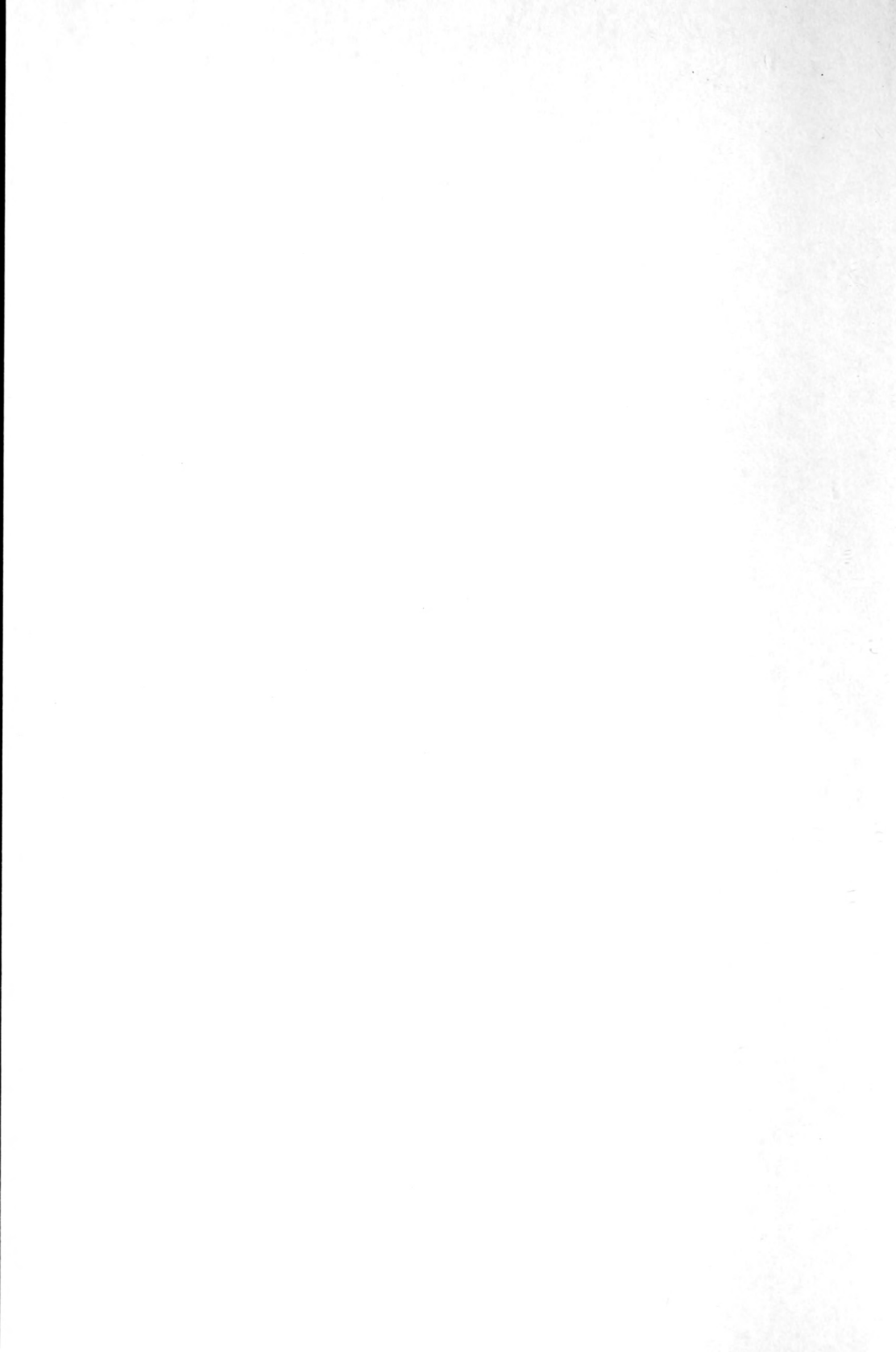
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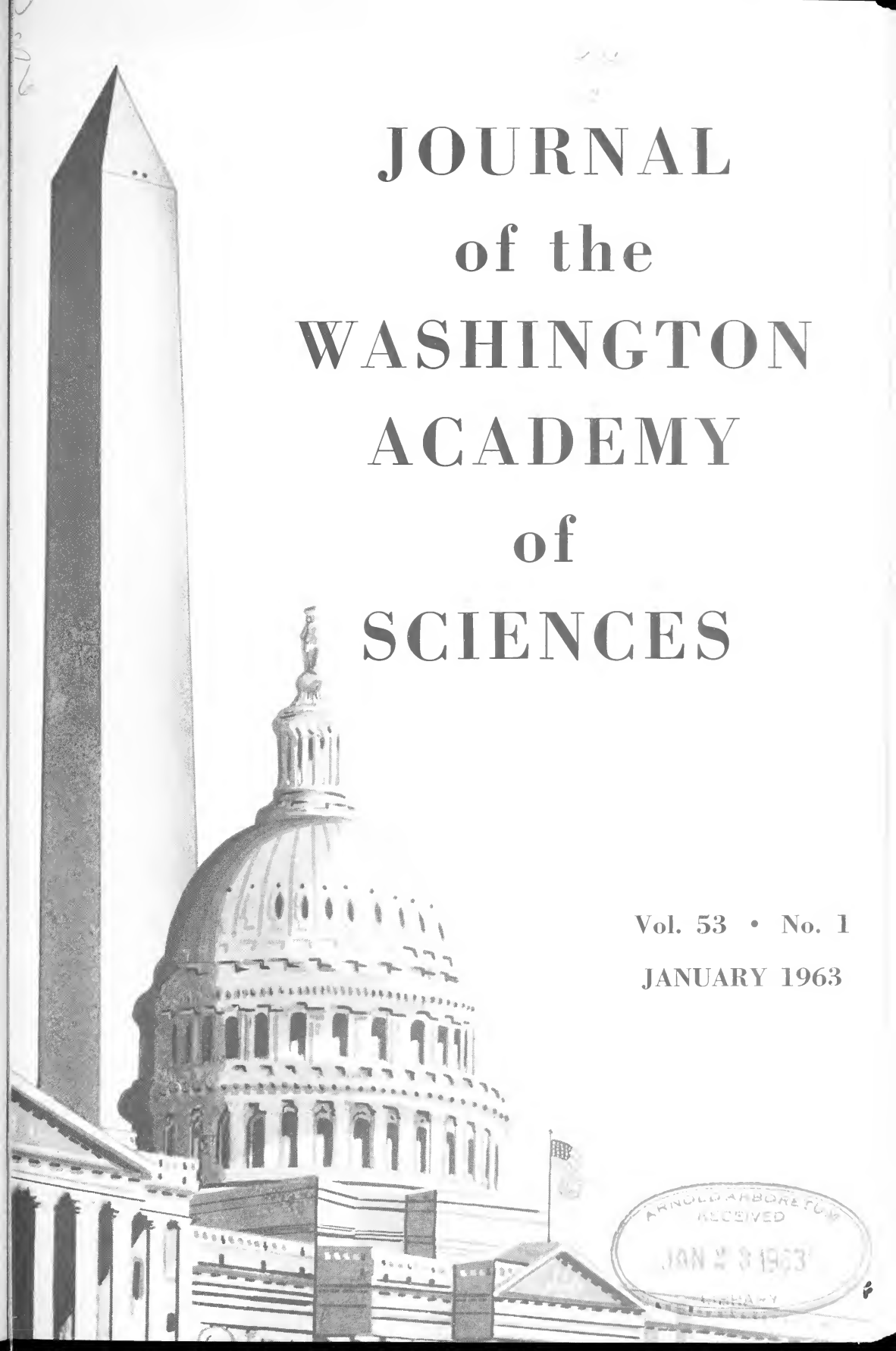
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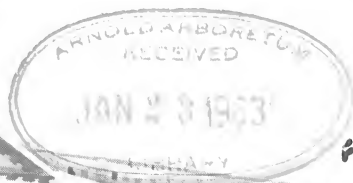


A black and white illustration of the Washington Monument on the left and the U.S. Capitol building in the center and right. The Washington Monument is a tall, slender obelisk. The U.S. Capitol building features a large dome with a statue on top, surrounded by classical columns and arches. The sky is plain white.

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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.

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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.

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Lore Alford Rogers, Pioneer Dairy Scientist

Donald H. Williams

Dairy Industries Supply Association, Washington

As a prominent scientist in the Department of Agriculture from 1902 to 1942, Lore A. Rogers has many friends in the Washington area who remember him warmly. A bright star on USDA's scientific horizon before World War II, Dr. Rogers for the past two decades has been living in Maine, in productive and stimulating retirement. Son of a Maine lumber operator who was prominent in the Penobscot country, he was educated at the University of Maine, and shortly after the turn of the century came to the Department as a bacteriologist and "dairy expert," as men of his training were then called.

For the young discipline of dairy science in the early 1900's, Dr. Rogers was born at the right time. There were a myriad of dairy product problems that needed to be approached by fundamental investigation. The great State extension organizations of today were in their infancy, and the State experiment stations were rather small and inadequate, particularly with respect to dairy research. Industry looked to USDA for help, and dairy science as an organized research discipline took shape in the Department with Dr. Rogers, later a name to conjure with, as its leader.

Over the years Dr. Rogers assembled a research staff in dairy science, as a division within the old Bureau of Animal Industry, which came to be recognized internationally. Later, the Dairy Division achieved status of its own as the Bureau of Dairy Industry, and it was here that Dr. Rogers became chief of the Dairy Research Laboratories, a unit which embraced investigations of dairy products, nutrition, and technology. The product investiga-



tions involved problems on butter, concentrated milk, ice cream, and other dairy products. Vast contributions to the literature of dairy science took place under Dr. Rogers' leadership, as he encouraged academic freedom among his staff in pursuing lines of research into the fundamental bacteriology, chemistry, and technology of dairy processes.

As stated in a recent tribute to him, "alone or jointly he authored almost 100 scientific publications in the field of original research." By training he was a bacteriologist, and one of his earliest papers disclosed the causative factors in the flavor deterioration of butter. Again from the same citation.

"He showed conclusively that butter made from pasteurized sweet cream had better and more uniform initial flavor, and much better keeping quality, than butter made from raw ripened cream. This discovery made almost 60 years ago, revolutionized the theory and practice of butter making, and resulted in a tremendous increase in monetary return to the industry."

It would be futile to attempt a definitive accounting of his professional years, so productive was his searching genius. For 40 years Dr. Rogers exerted scientific leadership of a research group whose accomplishments became milestones in the history of dairy science. Never before had another such group provided the fruits of original investigation and discovery in the field of dairy science. These years saw the advent of sweet cream butter, uniform-quality cheddar cheese, and fundamental studies of the physical chemistry of ice cream. Only now is industry beginning to appreciate fully the significance of the measurements made on the complex physico-chemical system in ice cream, carried out under Dr. Rogers' direction.

Among Dr. Rogers' contributions to bacteriology were studies of the factors controlling growth and multiplication of bacteria, the fermentative production of lactic acid, the use of pure cultures in the manufacture of swiss and cheddar cheese from pasteurized milk, and the development of one of the first processes for curing and marketing consumer-sized packages of cheddar cheese. Dr. Rogers was one of the American bacteriologists to develop very early the preservation of bacterial cultures by dehydration and freezing, a technique which led to his interest in the American Type Culture Collection, and which made the work of this invaluable institution possible; but more on this later.

In the later years of his USDA career, Dr. Rogers' staff examined the possibilities of effective commercial utilization of milk byproducts. At the time, industrial utilization of milk appeared to hold some hope for improving the dairy farmers' income. This period witnessed the development of casein production methods, lactic acid

resins for can coatings, casein plastics and fibers, the extraction of solubilized milk proteins, and alcohol from fermentation of cheese whey, to name only a few of the efforts that he fathered or influenced in the area of chemurgy.

Recognition came duly to Dr. Rogers. He received a Doctor of Science degree from the University of Maryland in 1923, and a second one from his alma mater in 1925. In 1928 his colleagues published a book in his honor. It was entitled, "Fundamentals of Dairy Science," and the designated authorship was simply, "Associates of Lore A. Rogers." This book, revised in 1935, became the classic reference in the field for at least 25 years, and is a lasting panegyric to the stature that Dr. Rogers achieved. Long out of print, it is currently undergoing another major revision, undertaken and supervised by dairy scientists in many places, some now approaching retirement, who as young Ph.D. graduates were employed by Dr. Rogers many years ago. He has always had special pride in the young men who got their start with him and went on to distinguish themselves elsewhere.

Dr. Rogers was president of the Society of American Bacteriologists in 1923. He was a member of the American Public Health Association, the American Dairy Science Association, the Washington Academy of Medicine, and the Washington Academy of Sciences. He was an official delegate to the world dairy congresses held in Stockholm in 1911, in Washington in 1923, in London in 1928, and in Rome in 1934. He has been a member of the Cosmos Club since 1924.

Dr. Rogers has received almost every high honor awarded by the American Dairy Science Association. He was the first recipient of the highly coveted Borden Award (a gold medal and \$1,000) in 1937, and has witnessed the granting of numerous subsequent Borden Awards to his one-time subordinates from the Dairy Research Laboratories. In 1951 Dr. Rogers was elected an honorary member of the

Association; and only last summer he was selected, again from his retirement, to receive the Association's Distinguished Service Award, inaugurated only the preceding year. The citation, portions of which were quoted earlier herein, is a moving reminder of the mark left by this pioneer dairy scientist. Last August, at the age of 87, Dr. Rogers went to the University of Maine (where the Association meeting was being held at the time, and where Rogers Hall for many years has testified to his living memory) to receive this outstanding award.

As this scientist, for so many years widely acclaimed, approached the podium to receive his honor, the Association in body assembled rose and stood in close attention while this modest man, in conversational, intimate tones, eschewed much of the credit for the signal tribute, asserting that time had placed him, youthful, in a virgin field and that he had had available to him an exceptional staff. His highest service, he averred, was to have assembled and left behind his productive research team.

One contribution to science made by Dr. Rogers, though scarcely known, is of inestimable value. He, almost alone, and more than once, salvaged the important American Type Culture Collection from discontinuance in the early 20's and later. This foundation has been custodian of valuable bacterial cultures which have supplied research and industry needs far and wide. Desiccated cultures are distributed by the Collection. Housed as a stepchild, virtually in garrets and basements, from about 1923 until the time of the last war, it faced numerous survival crises before it was ultimately incorporated as a non-profit organization, with Dr. Rogers as chairman of the Board. The Collection was finally housed in its present permanent home at New Hampshire Avenue and M Street N.W., in Washington.

Dr. Rogers retired from the Department of Agriculture 20 years ago and returned to his native heath in Patten, Me., where he still lives. Thus his professional years ended. For a time he operated a small

dairy business in Patten, to do so literally carving out of potato country (the nearby Aroostook) a miniscule milk shed where milk was never before widely produced and shipped commercially. He brought a new industry to a locale traditionally wedded to the single, speculative potato crop. Milk provided the farmer with a steadying balance wheel of revenue, a fact in which Dr. Rogers may take justifiable pride. In this enterprise, with characteristic improvisation he built for himself a small quality control laboratory for testing milk supplies and processed products; he could be observed there, pleasurably applying the time-honored laboratory techniques for standard plate count and the methylene blue test. He even attempted to instrument the latter to obtain less empirical, and more uniform, analytical performance. As the burden of other long-delayed projects and hobbies came to claim more and more of his time, Dr. Rogers, after some years, withdrew from the local dairy business, and was at last truly "retired."

Here begins the remarkable account of his retirement years, in some ways incredible for its breadth and vigor and certainly an inspiration for others. Returning to Maine was for Dr. Rogers the beginning of a second career—the stimulating harvest years. Mrs. Rogers completely shares the enthusiasm and understanding for his current projects, and provides inspiring rapport for their dedicated ventures.

For perhaps 40 years or more Dr. Rogers had spent summer vacations at his woodland camp at Shin Pond, about 10 miles from Patten village. He still spends the pleasant months of the year there. Despite its relative proximity to the village, his weathered shore cabin under a hill makes for a remoteness conducive to contemplative living. One should really say "contemplative recreation," after Isaac Walton, for Dr. Rogers is an ardent fisherman seeking out the elusive trout in wild and undisturbed places.

His camp is accessible only by boat, being at the far end of the Pond and away

from all roads and trails. For many years he favored a logging bateau for his necessary commuting to a secluded parking place at the opposite end of the Pond, where a road is near. His was a familiar profile coming down the Pond at dusk, bent over an outboard motor rigged to the side of the bateau, which had pointed bow and stern—thus denying conventional motor mounting. The peculiar lines of a loaded bateau make the bow ride high, with much of the hull seemingly out of the water, as the heavy craft labors under way. It made a bizarre silhouette.

Extremely seaworthy, reliable, and of a deceptively commodious load capacity (his was approximately 26 feet long), the bateau is not noted for great comfort. Passengers sit on the "floor" or bottom of the boat, in a position not favored by ladies. In later years, out of deference to Mrs. Rogers and not-infrequent camp guests, Dr. Rogers condescended to buy a conventional aluminum boat with a square stern: a "wash tub," he called it, without the legendary beauty of the bateau lines. The new boat is lighter and more manageable for joints and muscles not as lithe and limber as formerly, and both he and Mrs. Rogers manage it handily.

The old bateau, which he made out of a single huge pine tree, is now pulled up on the shore where it seems to fit the scene as always. Only rarely now is it pressed into service, perhaps to convey a stranded grandson across to the road shore.

Dr. Rogers' father, Luther B. Rogers, operated logging camps in the northern Maine wilderness in days when the logging industry was considerably more primitive than today. Some of his son's youth was spent in these camps, where he occupied various roles in the lumbering organization.

Dr. Rogers' account of those days is a fascinating story, and the hours spent with him, hearing about the wild driving streams, the winter camps, and the drive itself, are unforgettable. These are the scenes closest to his heart, and a wistful nostalgia pervades the reminiscences of

obliterated tote roads, ancient "burns," forest fires, skeletons of old dams, and those strange grassy clearings in the remote wilderness where once stood productive hay farms to supply the logging teams of horses and oxen. His memory of these events is clear and dramatic, and he holds one as if in a spell, as he tells of those days of long ago when 40-foot logs—and bateaus nearly as long—came down streams that appear today hardly capable of wetting one's feet.

At his camp in the evening it is not uncommon to find him working on his notes and papers by the sometimes failing light of a propane burner. These are precious hours to share with this man—those sensitive moments by his hearthside when the unhurried pace at the end of day sets the scene for a poetic recall of another day and tempo.

And lucky you are if you are there when he pokes the hot coals off a buried iron bean pot fetched forth from the obscure recesses of his blackened fireplace. More generous with the molasses than are ordinary recipes, his formulas—he does not take baking beans lightly; this is a solemn ceremony—involve the artful combination of seasoning, salt pork, molasses, and careful "par" boiling.

His is not solely the role of raconteur, however, but also that of historian; and his crowded hours are divided now between writing the history of the logging era he knows so well, and another project to be described later. This history is important Americana and an essential chronicling of the Maine scene, for lumber was vital to Maine's early economic growth, and deserves a place in the annals of the State.

We may steal a glimpse of this epic story from his largely-unpublished manuscript as he describes the woods crew. (Two chapters of his work have been published periodically in *Down East* magazine for March and May 1962, respectively.)

"The life and work of these men in the forest bears little resemblance to that of the roistering, drinking, fighting toughs who usually are pic-

tured swarming into Bangor at the end of a winter. Their occupation was one of adventure and disaster. They were exposed to driving rains, freezing cold, and blinding snowstorms; knew the fear and panic of men lost in the wilderness; and were familiar with violent death from falling trees and rushing water. Most of all it was a routine of hard, grinding toil, while fighting the elements in a rough, hostile country—a struggle which developed a hardy, independent race, calloused to discomfort and hardships, and entirely unaware that they might be looked upon as in any way heroic. It is small wonder that when they got out of the woods into 'civilization' they kicked over the traces and celebrated in the only way they knew."

In a particularly descriptive section on "jam-breaking," Dr. Rogers writes:

"The common conception of men running about looking for the 'key log' unduly simplifies the situation. Before any such key log could be found and loosened, rapidly increasing water pressure and more logs wedged the foremost ones so firmly that no single log could be said to be holding the jam. The men loosened all the logs that they could move on the front of the jam, working fast and methodically to pick, roll and pry a channel back into the tangled logs. Suddenly, the jam 'hauled.' The whole mass began to move. The men ran and leaped over the rolling, tumbling logs, heading for shore. The more experienced ones, once they reached land, kept right on going to get out of the way of the men racing behind them. Sometimes a man did not make it to land—and on the shore there would be another mound, marked by a crude wooden cross, or simply a name and a date cut on a tree."

One rich experience shared with Dr. Rogers is a trip to his favorite fishing places—usually some remote and elevated mountain tarn, where the water is clearest of clear and the wily Salvelinus lurks. The Fowler Ponds are like this, near the north end of the Traveler, that ubiquitous mountain that seems to move with you down the East Branch. The trout from the Fowler Ponds are unusually pink-fleshed when cooked; and no doubt Dr. Rogers has long considered that environmental subtlety contributing to this.

For some reason, fishing with Dr. Rogers is never very convenient. If trout were jumping all over his Shin Pond dock, it is believed that Dr. Rogers would still hide himself to an out-of-the-way area where

the thrill of more primitive surroundings aids the appetite, if not always the catch, though a bountiful creel is generally the result.

It may be a two- or three-mile climb from the nearest road to these ponds, and there impediment is divested and a one-man life "raft" is inflated and launched. Dr. Rogers sort of rolls into the craft—and out of it—from the shore, since one cannot stand in such a rig. When enough fish are caught for lunch, Piscator unlimbers a kit of homemade nested aluminum mess gear and the trout becomes an emotional as well as gustatory experience.

A particularly interesting project of Dr. Rogers is his joint effort with a few local friends to re-introduce the woodland caribou to the slopes of Mt. Katahdin, where the animals once roamed in reasonable abundance. Dr. Rogers tells of seeing them when he was a boy, and cites the time in his youth when he saw numerous bleached caribou bones on Mt. Katahdin, where a herd presumably was stampeded over the edge of the alpine "tableland"—a prominent feature of the mountain—probably by irresponsible lumbermen, as much as a hundred years ago. In those days an occasional caribou would wander even into Patten village.

The caribou project is making progress. In conjunction with State authorities, Dr. Rogers has been instrumental in arranging for a small shipment of caribou from Newfoundland. Newfoundland in turn seeks to establish the ruffed grouse, and the deal involves so many caribou for so many ruffed grouse chicks. Ostensibly this is a simple exchange until one realizes the difficulty of attempting to hatch the latter in captivity.

However, the State biologist, with Dr. Rogers' encouragement, is enthusiastic and the exchange is slowly underway. Capture of caribou calves, it is reported, is not especially difficult and this phase of the project is accomplished.

This is a rather remarkable undertaking. Over-hunted to extinction in this area years

ago, the new herd will eventually find a home in the highly protected Baxter State Park, where ecologists say a successful balance of natural food and population is quite possible.

The crowning achievement of Dr. Rogers' retirement life is the founding, within the last three or four years, of the Lumberman's Museum; and of this unique effort a more adequate account is needed than can be given here. For some years he has collected many artifacts of logging lore that are authentic of the period and area of which he becomes the Herodotus. These he first mounted on a display panel and exhibited in a vacant store in Patten village. Later, as the collection grew, other displays were added, and what had been only the germ of an idea became a museum in reality. At this point the collection was housed in the back room of the town library, the building where Mrs. Rogers holds forth in the front room as librarian.

As the collection grew, so did its importance, and finally the improvised space became inadequate. Dr. Rogers learned of a vacant log cabin on nearby Mt. Chase, an authentic old structure with dovetailed log corners. Somehow he arranged for its dismantling and removal to a vacant lot in the village, where it was erected as the new home for the Lumberman's Museum; this is now a corporate entity with some promise, occasionally tenuous, of financial support and, more important, of perpetuity.

There is strong suspicion that Dr. Rogers has liberally augmented his begging and borrowing with his own resources. All contributions, both physical and financial, have been welcome. What has resulted is a dream fulfilled for this native son—indeed, a monument to the herculean labor and Yankee ingenuity that went into lumber production 50 to 100 years ago in the State of Maine. It is serious documentation of a historic part of the American scene.

The physical exhibits include every sort of tool found in a logging camp and saw mill, from a pod auger to—no, not the

chain saw, which would never be permitted—but to the "cant dog" or peavey, which is shown by several examples as it evolved from the crude pick pole and swinging hook to the present-day right arm of the logger.

In addition, there are operating-scale dioramas of a saw mill, a saw pit, and cutaway scale logging camps (all of these, down to the finest detail, he built himself); a full-size woods forge with bellows, millwright tools, cooking gear, and topographic maps locating the ancient tote roads and driving waters of the period.

The Museum building is panelled inside with native woods of the region. Externally it is the same log structure that once stood lonely vigil on the slopes of Mt. Chase. Down the road perhaps a half-mile is the arboretum planted by Dr. Rogers in memory of his mother, Mary Rogers. It is well established, with specimens of all Maine trees of economic value, and other specimens, growing well. Of course, this project was not built overnight. It long preceded the Museum: Dr. Rogers made the plantings himself, sometimes transplanting the less common species many miles from the deep woods. The arboretum of itself has substantial educational value.

Visiting the Museum provides nostalgic retrospect for a different age, a different gage of man, and a way of life lost to the newer generations except as Dr. Rogers' writings and the Museum collections mirror it. The modern logger frequently gets home to supper and jostles to work in the morning on a noxious dual-wheeled behemoth over bulldozed scars in the forest that never heal—a far cry from the woodsman of yesteryear who walked into camp in the fall and didn't come out of the woods until the spring drive landed him at the terminal booms down river many miles. Today logs are driven no more. The bull dozer, diesel truck, and chain saw are emblematic of modern logging, still the living industry of that section of the State.

Dr. Rogers is keen to preserve a record of the way it used to be done. He has

given to his village and State a museum, a book-in-process, and an arboretum. These will remain for Patten schoolboys to see, and for those transient outsiders whose curiosity for the region is piqued by something the State of Maine enthusiast is never really able to identify—or conquer—an outstanding collection of important historic antiquities.

Enough has been said now of Lore Rogers to show his former associates what has been done with an abundant life; for this is no man living a life of quiet desperation, but more the role of Chanticleer, as

Thoreau would put it, trying to “wake my neighbors up.”

It is gratifying to know that he has accomplished his goals, certainly in principle, for he would be the first to acknowledge that a Museum is never completed in the definitive sense.

As curator, he welcomes one and all to his new and rustic headquarters. Although Patten is 900 miles from Washington, visitors from the area do get up to see him and are rewarded with an indelible experience. Only infrequently in our daily lives do we come across such a person.

Joint Board on Science Education

Summary Report for 1962

John K. Taylor *

National Bureau of Standards

Introduction

The year 1962 has been most active and successful for the Joint Board on Science Education. Literally hundreds of local scientists have participated in various phases of its program, which has reached thousands of students and teachers in the greater Washington area. The following summary illustrates the scope of the program.

Accomplishments

Secondary School Contacts Committee. An engineer or scientist was appointed to serve as liaison or contact with each of 232 secondary schools in the greater Washington area. A 60-page directory, listing the address of each school and the name and address of the contact person, was printed and distributed to schools and to persons interested in science education. The

directory also includes information on other activities of the Joint Board, including committee personnel, science fair schedules, and a list of laboratories offering field trip opportunities.

The Reporter. This newsletter, now in its fifth year of publication, is issued monthly during the school year. It presents information about events of interest to teachers, announces meetings, publicizes awards and other recognitions, reviews new books, and carries feature articles related to science and mathematics teaching. It is sent free of charge to all local science and mathematics teachers and to others interested in science education. The present circulation is 2900.

Frontiers of Science Lectures. Lectures designed for high school students and teachers, featuring recent advances in science, have been sponsored during the past several years. The current series has been planned for the spring and will be announced soon.

* Chairman of the Academy's Committee on Science Education; vice-chairman of the Joint Board on Science Education and director of science projects; and editor of *The Reporter*.

Research Participation. In cooperation with the Washington Academy of Sciences, the Junior Academy, and the Chemical Society of Washington, the Joint Board sponsored a program designed to introduce high-ability high school students to scientific research. Forty-five students were given the modest stipend of \$10 per week to meet expenses. They were assigned to work in local research laboratories on active scientific investigation. A grant has been received from the National Science Foundation to continue this activity during the coming summer.

Teacher Awards. As a feature of Engineers, Scientists and Architects Day, the Board annually recognizes teachers of the local area. During 1962, 12 teachers were presented Distinguished Teacher Awards, consisting of certificates and inscribed copies of a technical encyclopedia. In addition, 48 others were presented citations for outstanding competence. All were guests of the Joint Board at the ES&A Day luncheon, where the presentations were made. This is a continuing activity.

Project Book. In order to stimulate interest in science projects, the Board in 1960 published a book, "Project Ideas for Young Scientists." This book containing brief suggestions for projects involving scientific investigation, together with references to further information, sold 4000 copies both locally and nationally in the first edition. A major revision and enlargement has been completed, so that the new book contains some 600 ideas in all fields of science. Chapters with projects in engineering and pharmaceutical sciences are new features. It is available at cost to students and teachers, both locally and elsewhere, at \$1.25 per copy, from the Joint Board Office, 1530 P Street, N.W., Washington 5, D.C.

Science Fairs. Posters, entry blanks, and related materials were furnished to five area fairs. Transportation was provided to ten students and six adult sponsors to the National Science Fair in Seattle last May: the Board paid all expenses connected with

the trip of six students and one adult. The cooperation of the Northern Virginia Real Estate Board in financing the costs of representatives from the Virginia schools, and the financial assistance of the Prince Georges Science Fair Association and the Montgomery County Board of Education, are appreciated. As a result of participation in the National Science Fair, one first place, one second place, one third place, five fourth place, and six special awards were received by area contestants.

Committee on Women in Science. In an effort to encourage a larger number of girls in our secondary schools to investigate and weigh the possibilities of engineering, science, or mathematics as a career, a number of leading women scientists and engineers of this area have formed a committee to determine the best possible methods to encourage these students. The Joint Board is giving nominal financial support to this work, and also is offering advisory service to the committee.

NSF Program. Under grants from the National Science Foundation to the Washington Academy of Sciences, a series of special projects is being administered by the Joint Board. These programs are as follows: (1) A visiting lecturer, science project advisor, career day participation, and substitute teacher program through establishment of a visiting scientist roster; (2) conferences on problems related to science and mathematics teaching; (3) support of the publication and distribution of *The Reporter*; and (4) major support of the Research Participation program. The grants for this work total \$21,000.

Further information on these programs may be obtained from the office of the Joint Board at 1530 P St., N.W., Washington 5, D. C.; telephone North 7-3661.

Financial Support

The accomplishments of the Joint Board result from the volunteer efforts of a large number of individuals. Expenditures are maintained at a minimum. Financial support, except for specific projects carried out under National Science Foundation

grants, is derived from contributions of a number of technical societies and industrial or business organizations, who realize that, because of the extensive volunteer services supported, benefits are reflected back to them and to the community, many times the amount contributed.

Financial Statement

Program	Expended. 1961-1962	Budgeted. 1962-1963
Administrative expenses	\$ 40	\$ 200
Secondary school program ..	996	925
Science Fairs	2700	3000
Science teacher awards	526	700
Frontiers of Science	18	150
Finance Committee	90	100
Committee on Women in Science	181	250
Project Ideas for Young Scientists	791	—
Publication, <i>The Reporter</i> ..	2550	2500
Total	\$7892	\$7825

Contributions for the foregoing purposes during the past year amounted to \$5030. Publication of *The Reporter* was financed by a National Science Foundation grant. The budget for 1962-63 has been set at a minimum; the program could be enlarged and its effectiveness increased, if additional funds were available.

General Comments

The excellent spirit of cooperation between scientists and the local schools is an achievement of which the Joint Board can be justly proud. Teachers and administrators in the schools have come to look upon their colleagues in the scientific and engineering community as coworkers, and the high level of science education existing locally is in no small measure the result. The Joint Board has been the inspiration of several similar programs being formed or already started in several parts of the country. Accordingly, assistance given this program, both in service and in financial contributions, should not be considered as an act of charity but rather as an investment in the future security of our nation.

Contributors 1961-62

Technical Societies

- Acoustical Society of America, Washington Section
- American Institute of Electrical Engineers, Washington Section
- American Institute of Industrial Engineers, Washington Chapter
- American Institute of Mining, Metallurgical, and Petroleum Engineers, Washington Section
- American Meteorological Society, District of Columbia Branch
- American Society of Agricultural Engineers, Washington, D. C., Section
- American Society for Metals, Washington Chapter
- American Society for Microbiology, Washington Branch
- American Society of Safety Engineers, Washington Safety Society Chapter
- Anthropological Society of Washington
- Association of Senior Engineers of the Bureau of Ships
- Chemical Engineers Club of Washington
- Chemical Society of Washington
- D. C. Council of Engineering and Architectural Societies
- D. C. Society of Professional Engineers
- Geological Society of Washington
- The Helminthological Society of Washington
- Institute of Aerospace Sciences, Washington Section
- Institute of Radio Engineers, Washington Section
- Institute of Traffic Engineers, Washington Chapter
- Medical Society of the District of Columbia
- Philosophical Society of Washington
- Sigma Delta Epsilon, Omicron Chapter
- Society of American Foresters, Washington Section
- Society of Experimental Biology and Medicine
- Society of Women Engineers, Washington Chapter
- Washington Academy of Sciences
- Washington Junior Academy of Sciences
- Washington Society of Engineers
- American Welding Society, Washington Chapter

Industrial and Business Organizations

- ACF Industries
- Allis-Chalmers Manufacturing Company
- American Cyanamid Company
- ARINC Research Corporation
- Analytic Services Incorporated
- Asphalt Institute
- Atlantic Perlite Company
- Atlantic Research Corporation
- Chesapeake and Potomac Telephone Company
- Electronic Wholesalers, Inc.
- Fisher Scientific Company

General Electric Company
 Harris Research Laboratories, Inc.
 Hazelton Laboratories, Inc.
 Hydronautics, Inc.
 International Business Machines Corporation
 Johns-Hopkins Applied Physics Laboratory
 Litton Systems, Inc., Maryland Division
 Minneapolis-Honeywell Regulator Company
 Operations Research, Inc.
 Photogrammetry, Inc.
 Potomac Electric Power Company
 Scope, Inc.
 Stauffer Chemical Company
 Technical Sales Club
 Vitro Laboratories, Silver Spring Laboratory
 Washington Gas Light Company
 Westinghouse Electric Corporation

The Joint Board on Science Education acknowledges with thanks the support of the foregoing contributors during the past year. They, and others interested in encouraging science talent and in strengthening the science programs in our local schools, are invited to contribute to the 1962-1963 budget. Checks should be made payable to the Joint Board on Science Education, and mailed to Churchill Eisenhart, treasurer, Room 402 South Building, National Bureau of Standards, Washington 25, D. C.

THE BROWNSTONE TOWER



What scientific organization holds the largest meetings in the United States in terms of the numbers of papers presented? Many might guess the American Chemical Society, that giant of scientific societies, with a membership of about 100,000, exceeding that of the American Association for the Advancement of Science. Others might name the American Medical Association, with a membership approaching 200,000. I should think that no one would mention the National Geographic Society—everybody's society; with a membership of more than 2.5 million, it is too large to hold general meetings.

None of the foregoing guesses is right; the record is held by an organization whose members totaled only 7,451 as of last October. I refer to the Federation of American Societies for Experimental Biology. Founded in 1912, the Federation, as it is usually called, now consists of six member societies that are oriented toward biological research underlying medicine—in short, the physiologists, the biochemists, the pharmacologists, the pathologists, the nutritionists, and the immunologists.

At its last annual meeting in the spring of 1962, the number of registrants—11,800—exceeded the total membership of the Federation; and the number of papers presented—2,990—greatly exceeded the largest number ever presented at a meeting of the American Chemical Society, i.e., 1,761 in the fall of 1960. However, ACS holds two general meetings each year, whereas the Federation holds only one. Nevertheless, the biggest scientific meeting of each year is staged by the Federation, which consequently deserves to be better known than it is in this community where, like ACS, it is headquartered.

Physically, the Federation is situated on the west side of Wisconsin Avenue, on a wooded knoll not far north of the National Institutes of Health. Its principal building, which had been a private residence until the property was purchased for the Federation in 1954, cannot be seen from the highway. It was named Beaumont after William Beaumont, whose work on the gastric juices and digestion, published in 1833, is a classic. Turning into the grounds from the highway, one drives up a winding, beautifully landscaped road until the long, two-story, 20-room fieldstone house comes into view. To the right of this house and at the exposed edge of the knoll now stands a new five-story brick office building, of Georgian design to harmonize with the old residence. This building was completed in 1962, and was dedicated on October 12. It houses the expanding activities of the Federation. Soon a wing will be required for projected research services.

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So much for the impressive plant of the Federation. Even more important to its success is the Federation's executive officer, Milton O. Lee, who has been guiding its development since 1947, when its office was located in three small rooms in the main building of the National Academy of Sciences-National Research Council. At that time Dr. Lee was also editor of the publications of the American Physiological Society, one of the member societies of the Federation, and of Federation Proceedings—responsibilities that he still holds. This explains his interest and effectiveness in biological communications, the term now being used to cover the recording, transmission, storage, and retrieval of information, including publication, abstracting, indexing, and documentation. Beyond his current publication of primary research and of indexes and abstracts of papers to be presented at Federation meetings (a monumental job of rapid dissemination of information), Dr. Lee is about to embark on special services connected with communications: (1) a publication service center, which will reduce costs of publication of participating journals; (2) publication of conference and symposia proceedings; (3) an information processing center involving the use of an electronic computer; (4) tabulation and analysis of Ph.D. dissertations in the basic medical sciences; (5) a study of oral communications at scientific meetings.

Beaumont is not only the headquarters of the Federation but also of three of its member societies, whose executive secretaries have their offices in Beaumont House. Also in Beaumont House are the business and personnel offices of the Federation, and the Institute for the Advancement of Medical Communications. In the new office building are the Placement Service, editorial offices, and certain ancillary activities such as the National Register of Scientific and Technical Personnel and the Biological Handbook Offices.

The dedication of the new office building was a brilliant occasion, attended not only by leading biologists but by leaders in the

physical sciences also. The number was limited to about 50 by the small seating capacity of the conference room, in which luncheon was served by a caterer. As a memento of the occasion, each person found at his plate an inscribed copy of a hard-covered facsimile of "Experiments and Observations on the Gastric Juice and the Physiology of Digestion" by William Beaumont, M.D. The principal speaker was Detlev W. Bronk, former president of the National Academy of Sciences and himself a famous physiologist. Thus the Federation was launched on a new and larger phase of its distinguished career of service to the biomedical sciences—a credit to biology, to this scientific community, and to science in general.

—Frank L. Campbell

Merriam Offers Help To Eclipse Viewers

Carroll F. Merriam of Prospect Harbor, Me., a nonresident Academy member who is serving on the technical advisory committee of the Maine Department of Economic Development, has called attention to the total solar eclipse that will occur on Saturday, July 20, 1963, along a strip extending from Hokkaido to Alaska, and across Canada and the northern part of the United States. Dr. Merriam writes that he lives in the path of totality of the eclipse, and that he "would be glad to be of assistance to other (Academy) members or scientific organizations desiring information regarding preparations for observing this eclipse." Those interested may address Dr. Merriam at Prospect Harbor.

(Prospect Harbor is 9 miles EbyN of Bar Harbor, at lat. 44° 24.6'N, long. 68° 01.6'W. If we read our Ephemeris correctly, the town should be blacked out at 5:45 p.m. EDT, for 59 seconds. If anyone is going up, we'd like to consider signing on as photographer, or timekeeper, or roving Journal reporter.—Ed.)



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.

GEOLOGICAL SURVEY

R. L. Nace spent three weeks in November in Paris, in the capacity of scientific advisor to the United States delegation to the General Conference of UNESCO. During that period he also represented the United States on UNESCO's Committee of Experts on Scientific Hydrology, which prepared a report for the General Conference.

T. P. Thayer returned recently from a trip made to the Near East to study chromite deposits and related rocks. Visits to the principal producing districts in Iran, Pakistan, and Turkey were sponsored by CENTO, and the Troodos district in Cyprus was visited enroute. Dr. Thayer also presented a paper at the Fifth Congress of Yugoslav Geologists in Belgrade.

HARRIS RESEARCH LABORATORIES

Alfred E. Brown was a member of a panel that discussed "Intellectual Resources of the Metropolitan Washington Area" at a special meeting of the D. C. Chapter of the Society of the Sigma Xi, on December 3.

Anthony M. Schwartz recently addressed the chemistry clubs of Howard University and the University of Maryland, on "Professional Relations of the Chemist." Dr. Schwartz is chairman of the Professional Relations Committee of the Washington Section, American Chemical Society.

NATIONAL BUREAU OF STANDARDS

Herbert F. Schiefer, consultant on textiles and chairman of ASTM Committee D-13 on Textile Materials, headed the ASTM delegates attending the Conference

on Pan American Standards, held November 10-15 in Lima Peru, to formally discuss and initiate the adoption of pan-American standards for textiles.

James L. Thomas, chief of the Resistance and Reactance Section, retired on October 19 after 36 years of service; he will act as a consultant on measurements in private industry. Dr. Thomas is internationally known for his development of a special type of electrical resistance standard, the "Thomas Resistor," which is used by most standards laboratories. He also helped carry out one of the most complete and accurate measurements of electrical resistance in terms of the units of length and time.

John B. Wachtman, Jr., has been appointed chief of the Physical Properties Section, which studies the physical properties of inorganic, non-metallic crystals.

Bureau specialists took an active role in the 17th Annual Instrument-Automation Conference and Exhibit of the Instrument Society of America, held in the New York Coliseum. **Arnold Wexler**, chief of the Mechanical Instruments Section, was named an ISA fellow. Mr. Wexler, who developed a super-accurate gravimetric standard hygrometer, was honored for "distinguished contributions in the field of standards for humidity measurements."

Recent talks by NBS Washington personnel:

H. C. Allen, Jr.: "EPR Spectrum of Some Cu^{+2} Compounds"—Chemistry Colloquium, University of Virginia, Charlottesville.

R. G. Bates: "Reference Standards in Analytical Chemistry"—Analytical Group, Philadelphia Section, American Chemical Society.

G. M. Brauer: "Possible Resins for Use in Dentistry"—Dental School of Northwestern University.

M. Greenspan: "Velocity of Sound in Water"—Acoustical Society of America, Seattle.

J. D. Hoffman: "Part I—Dielectric Properties of Polychlorotrifluoroethylene" and "Part II—Spherulithic Growth with Chain Folds in Polychlorotrifluoroethylene"—University of Massachusetts, Amherst.

J. L. Jackson: "Properties of the Effective Diffusion Constant"—American Physical Society, Cleveland.

J. K. Taylor: "Instrumentation and the Analytical Chemist"—Wilmington Section, Instrument Society of America, Wilmington, Del.

L. S. Taylor: "Radiation and the World We Live In"—Honor Lecture, Radiological Society of North America. "An American Community Looks at Civil Defense"—American Medical Association, Symposium on Disaster Medical Care, Chicago.

R. S. Tipson: "Nomenclature of Sugar Conformers"—Rockefeller Institute, Organic Chemistry Discussion Group, New York City.

L. A. Wall: "Synthesis of New Fluorocarbon Polymers and Their Decomposition"—Philadelphia College of Pharmacy and Science, Philadelphia Section of the American Chemical Society. "Polymerization at High Pressures, Initiated With Gamma Rays"—Battelle Memorial Institute, Columbus.

W. J. Youden: "The Sample, the Procedure, and the Laboratory"—American Chemical Society, Southeastern Pennsylvania Section, Philadelphia.

L. A. Wood: "The National Bureau of Standards and Its Work on Rubber"—Chicago Rubber Group.

NATIONAL INSTITUTES OF HEALTH

Carl R. Brewer, chief of the Research Grants Branch, Division of General Medical Sciences, has been named an advisor to the National Research Council. Dr. Brewer succeeds **Kenneth M. Endicott,** director of the National Cancer Institute, who had held the position for the past three years.

Aaron S. Posner of the Laboratory of Histology and Pathology, National Institute of Dental Research, was invited to be a

Claude Bernard guest professor at the Institute of Experimental Medicine and Surgery, University of Montreal, on November 14.

A new species of malaria parasite has been named **Plasmodium Coatneyi** in honor of **G. Robert Coatney,** chief of the Laboratory of Parasite Chemotherapy, National Institute of Allergy and Infectious Diseases. Dr. Coatney is a past president of the American Society of Tropical Medicine and Hygiene.

Paul W. Bowman has been appointed a research grants coordinator in the Research Grants Branch, Division of General Medical Sciences. Dr. Bowman had been a member of the George Washington University faculty for 38 years, and was head of the Biology Department.

Kenneth M. Endicott, director of the National Cancer Institute, has been elected to the Board of Directors of the American Cancer Society.

Chester W. Emmons has been elected the first, and at present the only, honorary member of the International Society for Human and Animal Mycology. Dr. Emmons is chief of the Medical Mycology Section of the Laboratory of Infectious Diseases, National Institute of Allergy and Infectious Diseases.

SMITHSONIAN INSTITUTION

The following scientists recently joined the staff of the Institution's Museum of Natural History.

Richard H. Eyde, who recently received his doctorate from Harvard University, as associate curator, Division of Woods.

Francis M. Hueber, formerly of the Geological Survey of Canada, as associate curator, Division of Invertebrate Paleontology and Paleobotany.

Harold E. Robinson, recently assistant professor of biology at Wofford College, as associate curator, Division of Cryptogams.

Victor G. Springer, formerly of the Florida State Board of Conservation Ma-

rine Laboratory, as associate curator, Division of Fishes.

USDA, BELTSVILLE

Stanley A. Hall gave a talk on "Insect Attractants and Chemosterilants" at the annual convention of the Association of American Pesticide Control Officials, at Cincinnati on October 10. On November 19 he gave another talk, entitled "Pesticides in Agricultural Progress," at the Texas Insect and Plant Disease Control Conference at Texas A & M College, College Station.

R. L. Wain of the Agricultural Research Council, Wye College, England, visited a number of scientists at Plant Industry Station during the week of November 19. Dr. Wain is conducting outstanding research in the field of plant-growth-regulating substances, herbicides, and fungicides. While at Plant Industry Station, he delivered an inspiring lecture before a large, enthusiastic group of local scientists.

At the Fifth International Mushroom Congress, held in Philadelphia in November, a long-standing member of the Academy, **E. B. Lambert** of the Crops Research Division, ARS, was presented a cash award of \$5,500. The award was given by the Mushroom Growers of America in recognition of his research contributions to their industry. Dr. Lambert was president of the Congress, which was attended by mushroom growers and research workers in the field of mushroom science from 18 countries.

N. R. Ellis received the Honorary Fellow Award of American Society of Animal Science at the annual meeting in Chicago on November 23-24.

Edward F. Knipling received the Distinguished Alumni Award from Texas Agricultural and Mechanical College on November 16. Dr. Knipling graduated from Texas A&M in 1930, and has been an entomologist in USDA since 1931.

USDA, WASHINGTON

During the period November 12-17, **Justus C. Ward** served as a representative

from the United States at a Conference on Pesticides in Agriculture, sponsored by FAO in Rome. On November 22 and 23, Dr. Ward visited the headquarters of the Committee on Insecticides of WHO in Geneva, and as an invited observer attended meetings of an Expert Committee then in session.

Harold H. Shepard attended the meetings of the Entomological Society of America held in Phoenix, Ariz., in December.

DEATHS

Sara E. Branham died suddenly on November 16, at the age of 74; she was an internationally known bacteriologist. At the time of her retirement in 1958, she was chief of the Section on Bacterial Toxins, Division of Biologics Standards, National Institutes of Health. Dr. Branham was a native of Oxford, Ga.; she received A.B. degrees from Wesleyan College (Macon, Ga.), and the University of Colorado, and the M.D. and Ph.D. degrees from the University of Chicago. The University of Colorado awarded her an honorary Doctor of Science degree in 1937.

CALENDAR OF EVENTS

January 14—American Society for Metals

S. L. Gertsman, Canadian Department of Mines and Technical Surveys, "Non-nuclear Uses of Uranium in Metallurgy."

3:00 p.m., AAUW Building, 2401 Virginia Ave., N.W.

January 15—Anthropological Society of Washington

Robert Lystad, Johns Hopkins University, "Fieldwork in Ghana."

3:15 p.m., Rm. 43, National Museum, 10th & Constitution Ave., N.W.

January 15—American Institute of Electrical Engineers

Donald E. Garr, director of engineering, Raytheon Company, "Lasers" (slides and demonstrations).

Dinner at 6:00 p.m., O'Donnell's Restaurant, 1221 E St., N.W.; meeting at 3:00

p.m., PEPCO Auditorium, 10th & E Sts., N.W.

January 16—Washington Society of Engineers

N. W. Eft, research engineer, Babcock & Willcox, "Coal Slurry—Its Transportation and Combustion."

8:00 p.m., Powell Auditorium, Cosmos Club.

January 16—American Meteorological Society

Program to be announced.

8:00 p.m., National Academy of Sciences.

January 16—American Society for Quality Control

Joseph A. Gwyer, Library of Congress, "Quality Control and Reliability in the USSR."

8:00 p.m., ballroom of Roger Smith Hotel, 18th & Pennsylvania Ave., N.W.

January 16—Institute of Environmental Sciences

David Orbock and Martin Marietta, "Simulation of Space Environment."

8:00 p.m., Holiday Inn of Baltimore, Lock Raven Blvd. & Joppa Rd., Towson, Md.

January 17—Society of American Foresters

Michael Frome, "Public Image of the Forestry Profession." (Mr. Frome is author of the book, "Whose Woods These Are," concerned with wild land areas.)

Dinner meeting beginning at 6:30 p.m., YWCA, 17th & K Sts., N.W. (Wives of members are particularly invited to attend.)

January 21—Society of American Military Engineers

Program to be announced.

Noon, Barker Hall, YWCA, 17th & K Sts., N.W.

January 22—American Society for Microbiology

Program to be announced.

3:00 p.m., Sternberg Auditorium, Walter Reed.

January 23—Geological Society of Washington

Program to be announced.

3:00 p.m., Powell Auditorium, Cosmos Club.

January 24—American Society of Mechanical Engineers

Program to be announced.

3:00 p.m., PEPCO Auditorium, 10th & E Sts., N.W.

January 27—February 1—American Institute of Electrical Engineers

General meeting.

Hotels Statler-Hilton and New Yorker, New York City.

January 28—D. C. Society of Professional Engineers

Program to be announced.

3:00 p.m., National Housing Center, 1625 L St., N.W.

NEW MEMBERS ELECTED

The following persons were elected to membership in the Academy at the Board of Managers meeting of December 6:

Warren L. Butler, biophysicist, Agricultural Marketing Service, USDA (Beltsville), "in recognition of his contributions to a better understanding of the biophysical phenomena in plants, and in particular his role in detecting and quantitatively assaying phytochrome." (Sponsors: Peter H. Heinz, Jacob M. Lutz, Robert E. Hardenburg.)

Charles C. Craft, plant physiologist, USDA (Beltsville), "in recognition of his contributions in the field of post-harvest physiology of fruits and vegetables, and in particular the effects of storage on biochemical changes, composition, and volatile emanations of tomatoes, peaches, and potatoes." (Sponsors: Peter H. Heinz, Jacob M. Lutz, Robert E. Hardenburg.)

Donald R. Egolf, cytogeneticist, Na-

tional Arboretum, "in recognition of his contributions to our knowledge of the cytogenetics and cytotaxonomy of cultivated woody plants, especially of *Viburnum*, leading to a better understanding of the principles of developing improved economic plants." (Sponsors: Egbert H. Walker, H. A. Borthwick, S. L. Emsweller.)

Robert J. Fallon, assistant professor, Institute for Molecular Physics, University of Maryland, "in recognition of his contributions to chemical physics, and in particular his researches on molecular interactions." (Sponsors: Joseph T. Vanderslice, Homer Schamp, Jr., Edward A. Mason.)

Louis Monchick, chemist, Applied Physics Laboratory of Johns Hopkins University, "in recognition of his contributions to chemical physics, and in particular his researches on gas kinetics and transport phenomena." (Sponsors: Edward A. Mason, Joseph T. Vanderslice, Homer Schamp, Jr.)

Stanley Weissman, assistant professor, Institute for Molecular Physics, University of Maryland, "in recognition of his contributions to molecular physics, and in particular his research on transport properties of gases." (Sponsors: Joseph T. Vanderslice, Homer Schamp, Jr., Edward A. Mason.)

Arthur A. Westenberg, supervisor, research in high temperature chemistry and physics, Applied Physics Laboratory of Johns Hopkins University, "in recognition of his contributions to the measurement of transport properties of gases at high temperatures and of the fundamental properties of laminar and turbulent flames." (Sponsors: Edward A. Mason, Homer W. Schamp, Jr., Joseph T. Vanderslice.)

JOINT BOARD ON SCIENCE EDUCATION

Chemistry Teaching Conference

The Joint Board's Fourth Annual Conference on the Teaching of Chemistry was a most successful affair. One hundred and

five persons attended the meeting, held in Marvel Hall of the American Chemical Society Building on Saturday, December 8.

The morning session featured a lecture and discussion period with J. Arthur Campbell of Harvey Mudd College, Claremont, Calif., as speaker and discussion leader. Professor Campbell, who is executive director of the Chemical Material Study (CHEM Study) made a plea for more meaningful student laboratory work in which the results are unknown and unpredictable by the student, and perhaps even to science. He illustrated his point by a demonstration in which a fluid contained in a bottle was shaken, whereupon a blue color was generated only to revert to a colorless state on standing. Those present were asked to suggest reasons for the observed behavior, that could be tested experimentally for their validity. From the eagerness shown by each spectator to examine the bottle and to test a personal theory, it was evident that Dr. Campbell had not only made a point about exciting experiments, but also had proved himself to be a master teacher as well.

Dr. Campbell discussed the use of films in teaching chemistry, and showed a new film on the periodic table. The discussion that followed emphasized that inaccuracies in a film can be used to teaching advantage; for example, the recent discovery of xenon tetrafluoride requires modification of statements made in the film about the inertness of the noble gases.

The afternoon session consisted of two simultaneous discussion periods concerned with CHEM-Study chemistry and with programmed instruction in chemistry. The first was led by Dr. Campbell, while the second was led by Jay A. Young, head of the Chemistry Department at King's College (Wilkes-Barre, Pa.), a leading authority on programmed instruction. The groups interchanged during the last half of the session, so that all present had the opportunity to participate in smaller group discussions of both subjects.

Engineering Education Conference

The Second Annual Conference on Engineering Education, arranged by the Joint Board in the NSF-sponsored program series, will be held at Catholic University on Saturday, January 12. The D.C. Council of Engineering and Architectural Societies, co-sponsor of the conference, has planned an outstanding program.

The morning session will open with two talks on the manpower situation for engineers, to be presented by Robert W. Cain, program director for manpower studies, National Science Foundation, and by Newman Hall of the Commission on Engineering Education. These will be followed by a presentation of "The World of Engineering" by the following: in Industry—George R. Seidel, E. I. duPont de Nemours Company; in Government—Charles Bernier, chief scientist, ASTIA; in Architecture—Francis D. Lethbridge, architect, AIA.

The luncheon will be followed by a talk on the Junior Engineering Technical Society Program, by Richard T. Fallon, national director of this Program.

The afternoon session will be opened with a panel discussion on "How to Encourage High School Students to Enter Engineering." Panelists will include Harold Foecke, HEW; Walter C. Connolly of the School of Engineering, University of Virginia; and Stewart Wood, president of the Washington Junior Academy of Sciences. Ample time has been provided for all present to participate in the discussion.

The expected 100 participants will include high school guidance counselors, science teachers, and academic and professional engineers.

BOARD OF MANAGERS MEETING NOTES

November Meeting

The Board of Managers held its 550th meeting on November 7 at the National Academy of Sciences, with President Van Evera presiding.

The minutes of the 549th meeting were approved as previously circulated.

Announcements. Dr. Van Evera announced the appointment of Lawrence A. Wood as chairman of a Bylaws Committee, to work with the Policy and Planning Committee in the current proposed revision of the Bylaws.

Membership. Chairman Mary L. Robbins announced that the Committee had added to its organization a new panel on behavioral sciences, to consider applications in that area; John C. Ewers of the Smithsonian Institution is chairman of the panel.

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

Awards. Dr. Van Evera reported that John S. Toll, general chairman of the committee, was receptive to nominations for the Academy's annual awards. Other members of the committee are Don Marlowe, engineering sciences; Ugo Fano, physical sciences; Robert Berliner, biological sciences; F. Joachim Weyl, mathematics; and Leo Schubert, teaching of science.

Grants-in-Aid. On motion of Chairman A. T. McPherson, the Board agreed that AAAS be asked to issue grant-in-aid checks to the following: Clark Tibbetts of George C. Marshall High School, \$54, to purchase radioactive materials for research; James Steakley of the same school, \$31, to purchase and ship the working material and equipment for housing animals, and other supplies; Daniel Peacock of the National Museum, \$100, to make ten field trips for the collection of special species of field mice.

Policy and Planning. Chairman Wayne Hall discussed the pros and cons of a "calendar" vs an "academic" year basis for conducting the Academy's activities, and proposed that the Academy henceforth conduct its activities on an academic year basis beginning July 1 each year. The ensuing discussion was lively, but revealed no predominant sentiment for or against the proposal. The Board accordingly tabled the motion.

Dr. Hall also discussed the need for

clarification or revision of the Bylaws with respect to elective officers of the Academy. The language of the currently pending Bylaws revisions provides that all eight of the Academy's officers (president, president-elect, secretary, treasurer, editor, managing editor, archivist, and custodian of publications) shall be elected. In response to a suggestion from Editor Detwiler, the committee expects to make it clear that the last four of these offices are appointive. It also expects to consider a corollary suggestion, that some of the appointive offices are no longer needed.

Science Education. Chairman John K. Taylor reported that the National Science Foundation had been requested to support the following three one-year projects, proposed for initiation July 1, 1963: \$10,630 for continuation of the conferences on science teaching; \$6,990 for continuation of the visiting scientists and engineers lecture program; \$900 to initiate a college science conference in the Washington area.

Dr. Taylor reported that the most recent science education conference, concerned with physics, had been held on November 3; about 40 persons attended. Projected conferences include one on general science for the Northern Virginia area, at Hammond High School on November 17; on teaching of chemistry at the American Chemical Society headquarters on December 8; and on engineering at Catholic University on January 12.

Election of Members. Following the Second Reading of their names by Dr. Robbins, five nominees were elected to membership in the Academy, as follows: Robert R. Bennett, Hyman P. Kaufman, Ruth M. Leverton, Harvey C. Moore, and Gustave Shapiro.

Nomination of Officers. Ralph D. Myers, senior affiliated society delegate acting as chairman of the Nominating Committee, presented a slate of candidates for office in 1963; and additional nominations were made by petition of members of the Board. The task of selecting a slate of candidates had been complicated by the resignation,

several months ago, of President-elect Heinz Specht.

The slate of candidates, to be voted on in December by mail ballot of the membership, is as follows:

President: B. D. Van Evera. *President-elect:* Francois N. Frenkiel and Marion W. Parker. *Secretary:* George W. Irving, Jr. *Treasurer:* Malcolm C. Henderson. *Managers* (two to be selected): Mary Louise Robbins, John K. Taylor, Allen Alexander, and Harold T. Cook.

Treasurer. Treasurer Henderson reported current balances as follows: Academy, \$7,700; Junior Academy, \$2,273; Joint Board, \$10,000. Dr. Henderson also reported that the surplus publications of the Academy, amounting to about 15 tons, had been shipped to the Johnson Reprint Company in New York for sorting, cataloging, and pricing. On receipt of this material, the firm had requested permission to discard some of it that was in oversupply and short demand. The Board authorized Dr. Henderson to take appropriate steps in this connection.

The Board approved a 10-percent salary increase for the Academy's office assistant.

Editor. Editor Detwiler reported that the November issue of the Journal had gone to press; also, that the list of delegates to the Academy, appearing on the inside rear cover of the Journal, had been brought up to date.

New Business. The Board approved a motion by Frank L. Campbell, that the president appoint a special committee to consider how the Academy could assist in preparing for and conducting two international congresses—one on psychology and one on zoology—that will be held in Washington in August 1963.

December Meeting

The Board of Managers held its 551st meeting on December 6 at the National Academy of Sciences, with President Van Evera presiding.

The minutes of the 550th meeting were approved as previously circulated, with minor corrections.

Membership. Chairman Mary L. Robbins presented the name of one nominee for membership, for First Reading.

Awards for Scientific Achievement. It was agreed that the annual achievement awards would be presented this year at the February meeting, rather than at the January meeting; the award presentations would take the place of the customary address by the retiring president.

Meetings. Dr. Van Evera announced that the next regular meeting would be held on December 20 at the Cosmos Club, and that John D. Hoffman of NBS would speak on "The Crystallization of Linear Polymers with Chain Folding." He reported that he had not yet been able to appoint a new chairman for the Meetings Committee.

Grants-in-Aid. Chairman A. T. McPherson presented an application from Clayton Curtis, Jr. (age 15), for aid in building a transistor diode electronic computer as a prelude to a career in electronics, and specifically in computer technology. The total materials bill was estimated at \$876, of which the Academy was asked to pay \$200. The project had the endorsement of knowledgeable persons at NBS and IBM. The Board approved the application.

Encouragement of Science Talent. Chairman Abner Brenner announced that he expected to retire from this Committee, after three years of service. Dr. Van Evera took under advisement the appointment of his successor.

Election of Members. Following the Second Reading of their names by Dr. Robbins, seven nominees were elected to membership in the Academy, as follows: Warren L. Butler, Charles C. Craft, Donald R. Egolf, Robert J. Fallon, Louis Monchick, Stanley Weissman, and Arthur A. Westenberg.

Treasurer. Dr. Henderson reported cash balances as follows: Academy, \$5,344; Junior Academy, \$2,732; Joint Board, \$12,722.

Dr. Henderson announced that the Academy's books for 1962 would be closed on December 21. He expected that the Acad-

emy would have a slight reduction in its cash balance, as compared with 1961.

Editor. Mr. Detwiler reported that the December issue of the Journal had gone to press.

Announcements. Dr. Frenkiel announced that a union was being consummated between the Institute of the Aerospace Sciences and the American Rocket Society. The new organization would be called the American Institute of Aero- and Astronautics.

New Business. Mr. Brombacher raised the question of a change in the business year of the Academy. This matter had been tabled at the November Board meeting, at least as a change applicable to Academy operations as a whole; but on further discussion it was moved and seconded that the term of office of the Meetings Committee and the Membership Committee be put on an academic year basis, namely, from July 1 to June 30. The motion was passed.

Also discussed was the question of whether the Board should meet on a regular night of each month, or on a rotating schedule as in 1962. A decision was postponed until the next Board meeting, which was set for January 8.

SCIENCE AND DEVELOPMENT

George Washington University has received a research grant of \$24,725 from the National Institute of Allergy and Infectious Diseases, which will be used for a study of inhibition of growth of microorganisms. H. George Mandel, of the Department of Pharmacology, will direct the project.

Howard University has received a \$40,000 grant from the National Science Foundation to increase the capacity of its IBM Computing Center. The computer is used to solve problems in bookkeeping, bridge and road design, physics, chemistry, and statistical analysis. The grant will make it possible to increase the capacity of the digital computer system from 20,000 to 60,000 numbers.

Department of Agricultural scientists have isolated a natural attractant from female American cockroaches.

This achievement may lead to development of new, more effective methods of controlling these household pests. Chemists are now trying to identify the substance as the first step toward preparation of an inexpensive synthetic attractant; it is not practicable to use the natural attractant as a control tool, since thousands of female cockroaches are required to produce very small amounts. An inexpensive synthetic attractant could be mixed with insecticides or combined with a chemosterilant. Also, it could be used in detecting a cockroach infestation in the early stages.

A model of the SM-1 military nuclear power plant has been transferred to the Division of Manufactures and Heavy Industries of the National Museum. It will be displayed in the hall of nuclear energy at the Smithsonian's new Museum of History and Technology. The SM-1 is the first of its type and size to be built in the United States; it began operation at Fort Belvoir, Va., on April 15, 1957. A field plant based on SM-1 design is currently furnishing heat and electricity

at Fort Greely, Alaska. Plants in Greenland, Wyoming, and Antarctica were prepackaged by their manufacturers in air-transportable modules for rapid installation at remote sites. Crews trained by the Army Nuclear Power Program can erect these portable plants in less than 90 days.

According to a news release by the Smithsonian Institution, shortage of available fresh water threatens to become crucial in the United States—as well as the rest of the world—within the next two decades.

The maximum dependable supply of fresh water for this nation is about 515 billion gallons a day. Water use has increased from 40 billion gallons daily in 1900 to 323 billion gallons at present; it will rise to at least 597 billion gallons by 1980. The most promising solution would be distilling water from the oceans. The Federal Government is spending \$1 million to \$3 million a year to subsidize research on conversion of ocean or bay water. Costs of conversion are now \$1.74 to \$4.00 per thousand gallons, as compared to American municipal water rates of 25 to 40 cents per thousand gallons.



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Biological Society of Washington	JOHN A. PARADISO
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Entomological Society of Washington	FRANK L. CAMPBELL
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Society of American Military Engineers	Delegate not appointed
Institute of Radio Engineers	ROBERT D. HUNTOON
American Society of Civil Engineers	THORNDIKE SAVILLE, JR.
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American Society for Metals	HUGH L. LOGAN
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*Delegates continue in office until new selections are made by the respective affiliated societies.

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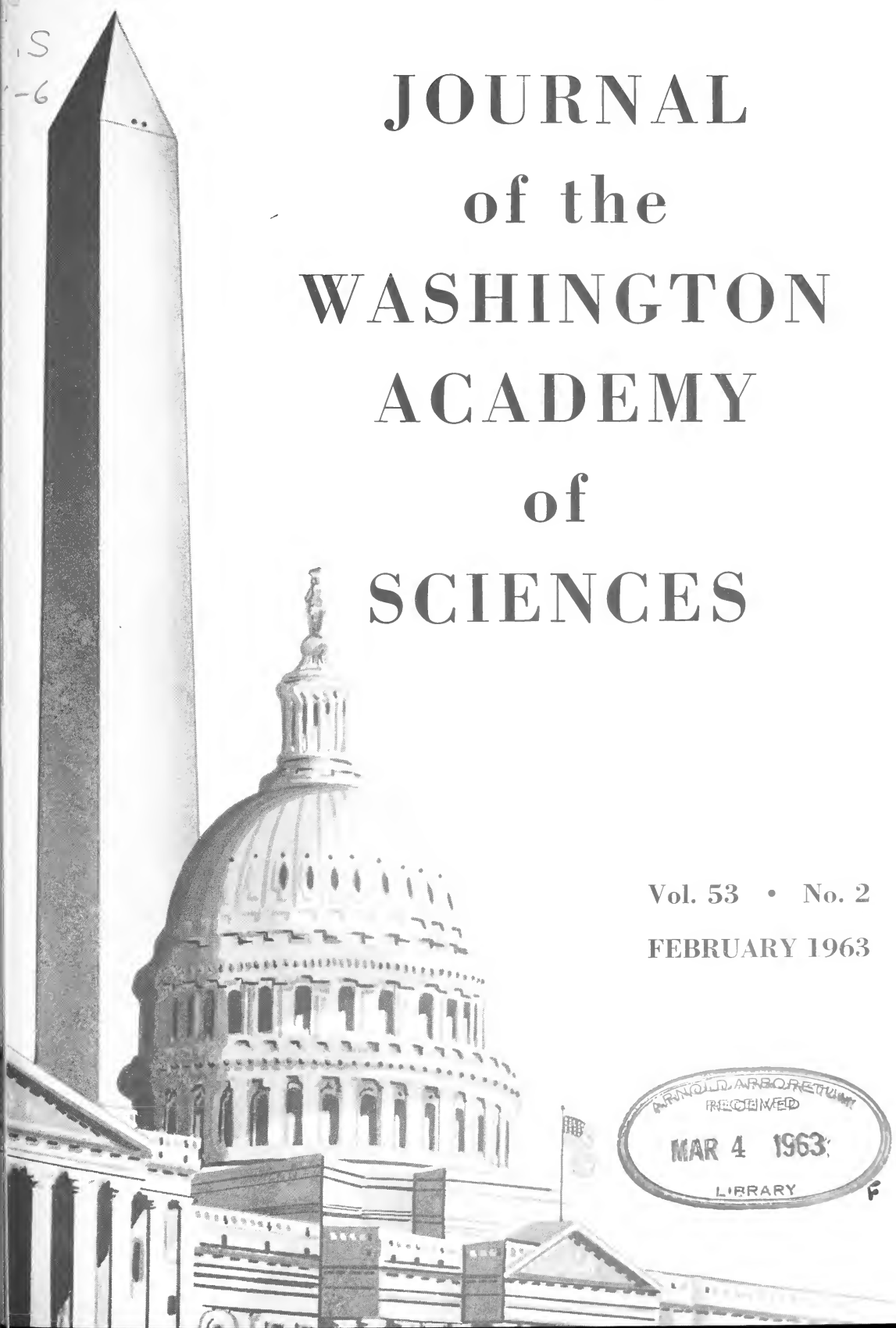
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This Journal, the official organ of the Washington Academy of Sciences, publishes historical articles, critical reviews, and scholarly scientific articles; notices of meetings and abstract proceedings of meetings of the Academy and its affiliated societies;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

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Five Scientists to Receive Academy's Annual Awards

Awards for outstanding achievement in scientific research will be conferred upon four young scientists at the Washington Academy's 65th Annual Dinner Meeting, to be held on February 21 at the Cosmos Club. At the same meeting, a stimulating teacher of science also will receive an award.

The young investigators to be honored are Marshall Nirenberg of the National Institutes of Health, in the biological sciences; Edward A. Mason, of the University of Maryland, in the physical sciences; Lindell E. Steele, of the Naval Research Laboratory, in the engineering sciences; and Bruce L. Reinhart, of the University of Maryland, in mathematics. The award on the teaching of science will go to Rev. Francis J. Heyden, S. J., of Georgetown University.

It has been customary for these annual awards to be presented by the retiring president at the January meeting of the Academy. Because current President Van Evera was elected for a second year and is not retiring in 1963, he has chosen to present the awards at the February meeting. He will be assisted by John S. Toll, head of the Department of Physics and Astronomy at the University of Maryland and chairman of the Academy's Committee on Awards for Scientific Achievement. The awards consist of scrolls engraved with a citation. If not already a fellow of the Academy, the award recipient will be invited to accept fellowship, 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 physical, biological, and engineer-

ing sciences. An award for outstanding teaching was added in 1955 and another for mathematics was launched in 1959. All previous award winners are listed elsewhere in this story.

Except in science teaching, where no age ceiling has been set, candidates for awards must be under 40. From among solicited nominations each recipient of an award is selected by an appropriate panel of specialists under the general chairmanship of Dr. Toll. The panel chairmen for the present awards are: Robert Berliner (biological sciences); Ugo Fano (physical sciences); Donald E. Marlowe (engineering sciences); F. J. Weyl (mathematics); and Leo Schubert (teaching of science).

Biological Sciences

Winner of the award in the biological sciences, Marshall Nirenberg is a staff member of the Section on Metabolic Enzymes in the Laboratory of Biochemistry and Metabolism, National Institute of Arthritis and Metabolic Diseases. 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. Then he switched to biochemistry and took his Ph.D. at the University of Michigan in 1957. Since then he has worked at NIH, first on postdoctoral fellowships, then as a member of the staff. Dr. Nirenberg is cited "for contributions toward the first direct experimental verification of the chemical basis of the genetic code." He has already been honored in Washington for this work by the National Academy of Sciences, which at its annual meeting in the spring of 1962 conferred upon him its first award in

Award Winners at Annual Academy Meeting



M. NIRENBERG



E. A. MASON



L. E. STEELE



B. L. REINHART



F. J. HEYDEN, S.J.

molecular biology. Additional information about Dr. Nirenberg and his work may be found in *The Brownstone Tower* of this *Journal* for March 1962.

Physical Sciences

Edward A. Mason became full professor in the Institute of Molecular Physics, University of Maryland, in 1950 when he was 34. His progression to his present eminence began at Virginia Polytechnic Institute, and continued at Massachusetts Institute of Technology to his Ph.D. in 1950 in physical chemistry. He remained at MIT for two years, held a fellowship at the University of Wisconsin for one year, and then became assistant professor of chemistry at Pennsylvania State University in 1953. In 1955 he moved to his present institute as associate professor.

Dr. Mason is cited "for his many outstanding contributions to the molecular theory of gas properties." On being ques-

tioned about the significance of the citation, Dr. Mason pointed out that it had to do with both experimental and theoretical studies on forces between molecules and their interactions in gases; in other words, he is concerned with the kinetic theory of gases. Working with associates, he has support for his research program from three different agencies.

Engineering Sciences

Like Dr. Nirenberg, the recipient of the award in engineering sciences, Lindell E. Steele, is not to be found in *American Men of Science*, not because he could not qualify, but because he has been overlooked. Now 34, he took his bachelor's degree in chemistry at George Washington University. He is head of the Radiations Operations Section, Metallurgy Division, at the Naval Research Laboratory, and has been cited "for contributions to the field of radiation effects to reactor pressure

vessel materials." This means that he has been studying principally the effects of neutron irradiation on materials used for the construction of reactors, especially advanced structural steel.

Mr. Steele is an unusual person, not only because of his significant research, but because he has had the forethought to educate himself more broadly than is the custom among scientists. He won a master's degree in economics from American University, obtained by persistent effort at night. He holds membership in a national social science honorary society. He will probably continue to learn for the rest of his life, but no longer in a formal manner; now he must pay attention to his specialty, and to his four young daughters.

Mathematics

Bruce L. Reinhart is associate professor of mathematics at the University of Maryland. He took his bachelor's degree at Lehigh, and his M.A. and Ph.D. at Princeton; he is now only 32. After taking his Ph.D. he taught at Princeton, the University of Chicago, and the University of Michigan, coming to the University of Maryland in 1959. In addition to his academic post, he is a mathematician for the Research Institute for Advanced Study at Baltimore, an organization for pure research supported by the Martin Com-

pany. During the academic year 1961-1962 he held a NATO fellowship at the University of Strasbourg. Dr. Reinhart is cited "for his contributions to the topology of differentiable manifolds."

Teaching of Science

Probably no one in the Washington area concerned in any way with science is unacquainted with Rev. Francis J. Heyden, S. J., director of the Observatory of Georgetown University. He took his Ph.D. in astronomy at Harvard in 1944, and has been on the staff of Georgetown University ever since. According to American Men of Science, his research has been concerned with geodetic determinations from observations of satellites, solar eclipses, and high altitude flares; and spectra of the atmospheres of the sun and planets.

Father Heyden's citation is a graceful compliment to his inspiring life: "By combining teaching and research, he leads others to join his adventures in science." His helpfulness is not limited to his own students, but extends to the whole scientific community, especially to secondary school students who are beginning to take an interest in science. For them, Father Heyden will make available if he can the currently excellent facilities of his University for scientific meetings and social events.

Past Winners of Scientific Achievement Awards Washington Academy of Sciences *

Biological Sciences

1939	Herbert Friedmann, SI	1952	Ernest A. Lachner, USNM
1940	No award given	1953	Bernard L. Horecker, NIH
1941	G. Arthur Cooper, USNM	1954	Leon Jacobs, NIH
1942	Robert S. Campbell	1955	Clifford Evans, SI
1943	Jason R. Swallen, USDA		Betty J. Meggers, SI
1944	Norman H. Topping, NIH		Robert Traub, WRAIR
1945	Henry K. Townes, USDA	1956	Earl Reese Stadtman, NIH
1946	Waldo R. Wedel, USNM	1957	Maurice R. Hilleman, WRAMC
1947	No award given	1958	Ellis T. Bolton, CIW
1948	Robert J. Huebner, NIH		H. George Mandel, GWU
1949	Edward C. Hamp, NIH	1959	Dwight W. Taylor, USGS
1950	David H. Dunkle, USNM	1960	Louis S. Baron, WRAIR
1951	Edward W. Baker, USNM	1961	Robert W. Krauss, UM

* The institutions listed are those to which these scientists were attached at the time they received their awards. See below for key to initials.

Physical Sciences

1939	Wilmot H. Bradley, USGS	1953	John R. Pellam, NBS
1940	Ferdinand G. Brickwedde, NBS	1954	Samuel N. Foner, APL, JH
1941	Sterling B. Hendricks, USDA	1955	Terrell Leslie Hill, NMRI
1942	Milton Harris, NBS	1956	Elias Burstein, NRL
1943	Lawrence A. Wood, NBS	1957	Ernest Ambler, NBS
1944	George A. Gamow, GWU		Raymond Hayward, NBS
1945	Robert Simha, NBS		Dale Hoppes, NBS
1946	G. W. Irving, Jr., USDA		Ralph P. Hudson, NBS
1947	Robert D. Huntoon, NBS	1958	Lewis M. Branscomb, NBS
1948	J. A. Van Allen, CIW		Meyer Rubin, USGS
1949	John A. Hipple, NBS	1959	Alan C. Kolb, NRL
1950	Philip H. Abelson, CIW	1960	Richard A. Ferrell, UM
1951	Milton S. Schechter, USDA	1961	John Hoffman, NBS
1952	Harold Lyons, NBS		

Engineering Sciences

1939	Paul A. Smith, USCGS	1951	Max A. Kohler, USWB
1940	Harry Diamond, NBS	1952	William R. Campbell, NBS
1941	Theodore R. Gilliland, NBS	1953	Robert L. Henry, APL, JH
1942	Walter Ramberg, NBS	1954	W. S. Pellini, ONR
1943	Lloyd V. Berkner, BA, USN	1955	Arthur E. Bonney, APL, JH
1944	Galen B. Schubauer, NBS	1956	M. L. Greenough, NBS
1945	Kenneth L. Sherman, CIW	1957	Joseph Weber, UM
1946	Martin A. Mason, NBS	1958	San-fu Shen, UM
1947	Harry W. Wells, CIW	1959	Harvey R. Chaplin, Jr., DTMB
1948	Maxwell K. Goldstein, NRL	1960	Ronald E. Bowles, DOFL
1949	Richard K. Cook, NBS	1961	Rodney E. Grantham, NOL
1950	Samuel Levy, NBS		

Mathematics

1959	Geoffrey S. S. Ludford, UM	1961	Lawrence E. Payne, UM
1960	Philip J. Davis, NBS		

Key to the Institutions and Number of Award Winners from Each

3	APL-JH	Applied Physics Laboratory, Johns Hopkins	1	ONR	Office of Naval Research
1	BA-USN	Bureau of Aeronautics, U.S. Navy	3	SI	Smithsonian Institution
5	CIW	Carnegie Institution of Washington	6	UM	University of Maryland
1	DOFL	Diamond Ordnance Fuze Laboratory	1	USCGS	U.S. Coast and Geodetic Survey
1	DTMB	David Taylor Model Basin	5	USDA	U.S. Department of Agriculture
2	GWU	George Washington University	3	USGS	U.S. Geological Survey
24	NBS	National Bureau of Standards	5	USNM	U.S. National Museum
6	NIH	National Institutes of Health	1	USWB	U.S. Weather Bureau
1	NMRI	Naval Medical Research Institute	2	WRAIR	Walter Reed Army Institute of Research
1	NOL	Naval Ordnance Laboratory	1	WRAMC	Walter Reed Army Medical Center
3	NRL	Naval Research Laboratory			
			76		awards for research, 1939-1961

Teaching of Science

1955	Helen N. Cooper, Montgomery County Public Schools	1959	Betty Schaaf, Deal Junior High School
1956	Phoebe H. Knipling, Arlington County Public Schools		Helen Garstens, University of Maryland
1957	Dale E. Gerster, Bladensburg High School	1960	Karl F. Herzfeld, Catholic University
1958	Carol V. McCammon, Coolidge High School		Pauline Diamond, Sherwood High School
		1961	Ralph D. Myers, University of Maryland
			Charles R. Naeser, George Washington University

Teaching of Science Special Awards

1951	Howard B. Owens, D. C. Public Schools
1952	Keith C. Johnson, D. C. Public Schools

Lasers

Thomas R. Lawrence *

National Bureau of Standards

I. Introduction

A laser is a new type of light source in which a large number of radiating atoms are coordinated to produce a very intense light beam that is nearly monochromatic, well collimated, and extremely coherent. A light beam with these properties has many potential applications; hence, lasers have been the subject of widespread and intensive research. Many varieties of lasers have been developed in the few years since the proposal for such a device by A. L. Schawlow and C. H. Townes (1) in 1958. Some specific types of lasers will be discussed after an introduction to lasers in general.

The term "laser" is derived from the first letters of the words in the phrase "Light Amplification by Stimulated Emission of Radiation." However, "laser" usually refers to a device that is not merely a light amplifier but also an oscillator, which is an amplifier with positive feedback through a resonant circuit. The operation of a laser is analogous to a radio frequency oscillator; however, this analogy will not be emphasized, since the techniques for obtaining gain and resonant feedback at optical frequencies are so different from those at radio frequencies.

It should be mentioned that other names besides "laser" have appeared in the rapidly expanding literature on this sub-

ject. "Optical maser" is often used, since it is the term favored by the inventors and by the scientists at the Bell Telephone Laboratories: but "optical oscillator," "optical resonator," and "iraser" (for those radiating infrared) also have been used. It remains to be seen which name will eventually gain acceptance. (Some scientists in the field talk informally about "lasers" and write papers about "optical masers.") Since the choice still seems to be open, this article will be about lasers.

II. Atomic Processes and Coherent Light Amplification

The operation of a laser depends on the utilization and, to some extent, manipulation of the naturally occurring transitions between the energy levels of a quantized system, such as an atom. There are three distinct but theoretically related types of radiative transitions between two of the energy levels of a quantized system. First, there is the process of spontaneous emission. An atom in an energy level E_2 may spontaneously drop to a lower energy level E_1 , and emit a photon whose wavelength is $\lambda_{12} = hc/(E_2 - E_1)$ (h is Planck's constant and c is the velocity of light). Spontaneous emission is a random process that occurs at a rate which is proportional to the population of the atoms in the upper energy level. Because it is a random process, there is no correlation in the phase or direction of the photons emitted spontaneously.

The second process is the absorption of radiation. An atom in the lower energy level, E_1 , may absorb a photon whose wavelength is λ_{12} and jump to the higher energy level E_2 . The rate for this process is pro-

* Dr. Lawrence, a native of Dunkirk, N. Y., is a graduate of Antioch College (B.S., 1954) and Harvard University (A.M., 1956, Ph.D. in physics, 1961). He joined the NBS staff in October 1961, and has been working on lasers, with emphasis on development of a helium-neon laser as a light source for interferometric measurement of long path lengths.

portional to the number of atoms in the lower energy level and the intensity of the radiation whose wavelength is λ_{12} .

The third process, stimulated emission, is the basis of the laser. Radiation of wavelength λ_{12} may interact with an atom in the higher energy level E_2 , and induce the atom to make a transition to the lower energy level, E_1 , emitting a photon whose wavelength is identical with the wavelength of the incident radiation. Stimulated emission is not a random process; the stimulated photon is emitted in phase with the incident radiation. Thus, stimulated emission offers a means by which a number of radiating atoms may be coordinated with an incident light wave to produce amplification of the light wave. However, amplification by stimulated emission must compete with attenuation by absorption. The rate of stimulated emission is proportional to the number of atoms in the higher energy level and the intensity of the radiation whose wavelength is λ_{12} . In a medium which contains N_1 atoms in the lower energy level and N_2 atoms in the higher energy level, absorption will predominate if N_1 is greater than N_2 ; stimulated emission will predominate if N_2 is greater than N_1 . Usually, it is expected that the population of the energy levels will be distributed according to the Maxwell Boltzmann equation.

$$N_2/N_1 = e^{-(E_2 - E_1) / kT}$$

(k is the Boltzmann constant and T is the absolute temperature). In this case, N_1 will be greater than N_2 and absorption will predominate. However, there are cases in which N_2 is greater than N_1 and stimulated emission predominates. The condition in which the population in an upper energy level is greater than the population in a lower energy level is called a population inversion.

In order to establish and maintain a population inversion, there must be a method of exciting atoms selectively to the upper energy level, E_2 , and an efficient

means of removing atoms from the lower energy level E_1 . Here, transition processes other than stimulated emission become important. In addition to the radiative transitions considered previously there are several types of radiationless transitions. In a gas, an atom may make a radiationless transition when it makes an inelastic collision with an electron, a molecule, or another atom. In a solid, the energy difference involved in the radiationless transition may be transferred to lattice vibrations, thus heating the solid. The method for selectively exciting atoms to the energy level E_2 involves either an inelastic collision process or absorption of radiation (optical pumping). The removal of atoms from the energy level E_1 is usually by spontaneous transitions from E_1 to lower energy levels.

The existence of methods for selectively populating E_2 and depopulating E_1 does not guarantee a population inversion between the two energy levels. Atoms in the energy level E_2 may make spontaneous transitions to E_1 and other energy levels, which tend to reduce the population of the energy level E_2 .

Thus, in order to attain a population inversion, the rate at which atoms are excited to E_2 must be great enough to force the population of E_2 at equilibrium to be greater than the population of E_1 , at equilibrium. The probability for spontaneous emission tends to increase rapidly with decreasing wavelength of the emitted radiation; hence, the rate of pumping atoms into the level E_2 that is required for population inversion is also increased. For this reason, most of the lasers that have been produced so far have radiated in the infrared portion of the spectrum.

Consider a light wave whose wavelength is λ_{12} traveling through an active medium (a volume of matter in which a population inversion exists between energy levels E_1 and E_2). The important property of stimulated emission is that a large number of photons are coupled in phase and frequency to the incident wave that stimulated their

emission. The coordinated radiating atoms in this case are much the same as an array of radio antennas that produces a directional radio wave; they produce a light wave with the same directional properties as the incident wave. The amplitude of the stimulated wave then adds to the amplitude of the incident wave, since both waves have the same frequency, phase, and direction of propagation. In other words, the incident light wave is coherently amplified in the active medium.

Of course, the active medium could be used directly as a simple light amplifier or image intensifier; however, such application is subject to a number of limitations. First, the wavelength of the light to be amplified must be one for which a light amplifier can be produced. A light amplifier of this type will respond only to light in one or more narrow wavelength bands, about the same as the line width of a spectral line. Second, the amplification per centimeter of amplifier length is quite small in most cases and the amplifier would need to be quite long. Third, the most serious difficulty is that spontaneous transitions from E_2 to E_1 occur rapidly in the optical region. The spontaneous emission corresponds to amplifier noise: the amplified image is superimposed on a background of light due to spontaneous emission, whose intensity may be much greater than the intensity of the image.

III. Oscillators Using Coherent Light Amplifiers

The most important use of stimulated optical emission is to obtain coherent amplification in an optical frequency oscillator, i.e., a laser in the usual sense. The construction of a laser is not difficult in principle, but the details often require considerable care. To make a laser, one simply places mirrors at both ends of a cylindrical volume of light-amplifying medium. The mirrors must be of high quality; they should be highly reflecting, but at least one of them must be slightly

transmitting so that light may be extracted from the laser. If flat mirrors are used, they must be made extremely flat (no variations from a true plane surface of more than 5×10^{-7} cm^{*}) and they must be aligned parallel. (The angle of inclination between the two surfaces should be less than five seconds of arc.^{*})

The laser oscillation is triggered by spontaneous emission of photons with precisely the right wavelength and direction of propagation. The light wave travels through the active medium and is coherently amplified by stimulated emission. When the light strikes the mirror, some energy is transmitted through the mirror and some is absorbed or scattered by the reflecting layer, but most of the light is reflected back (or fed back) through the amplifying medium to the other mirror. If the amplification is greater than the total losses in a round trip, then the intensity will continue to increase as the light wave is reflected back and forth through the amplifying medium. As the intensity of the wave grows, stimulated transitions become an important means of removing atoms from the upper energy level and populating the lower energy level. Thus, the equilibrium populations of the energy levels shift so as to reduce the amount of the population inversion. Eventually, the population inversion is reduced to an amount where the gain just balances the loss: in other words, the amplifier saturates.

The intensity at which saturation occurs varies from laser to laser, but usually it is a very high intensity, of orders of magnitude larger than the intensity due to spontaneous emission.

Amplification by stimulated emission may occur in a wavelength interval corresponding to the width of the spectral

^{*}These are requirements quoted for the first He-Ne gaseous laser (2), in which the amplification per unit length is relatively low. The requirements are not so stringent for a laser with high amplification.

line. However, it is characteristic of oscillators that the amplitude of oscillation is of significant size only in a very small range about the resonant frequency. In the case of the laser, the precise wavelength (or wavelengths) at which oscillation occurs depends on the spacing between the reflectors. The system of two parallel, partially reflecting, flat surfaces has long been used in precision spectroscopy: it is called a Fabry-Perot interferometer. In the laser oscillator, the Fabry-Perot interferometer is equivalent to an optical resonator. The resonant frequencies are those for which the superimposed segments of the multiply-reflected wave are all in phase. The most important resonances are at the wavelengths for which the Fabry-Perot condition for a plane wave perpendicular to the reflecting surfaces is satisfied: $2L = N\lambda$ (λ is the wavelength, L is the spacing between the reflectors, and N is an integer).

Usually, N is a very large number, so the Fabry-Perot resonances are closely spaced. The difference in frequency between two successive Fabry-Perot resonances is $\Delta\nu_r = c/2L$ (c is the velocity of light and L is the distance between reflectors). In order to obtain sufficient amplification, a lower limit must be placed on the value of L , which, in turn, sets an upper limit on $\Delta\nu_r$. It often happens that $\Delta\nu_r$ must be smaller than the amplifier bandwidth; in this case, the spectrum of the laser is composed of several very sharp spikes. This radiation is not truly monochromatic; but since the width of each spike is small compared to the separation, it is presumed possible to isolate one of the spikes with a suitable filter. In several cases, laser operation at a single frequency (monochromatic radiation) has been obtained.

A light wave that propagates in a direction other than perpendicular to the reflecting surfaces will be deflected out of the laser after a few reflections. Since a wave must travel back and forth through the amplifying medium many times to be

amplified to a high intensity, the oblique radiation makes little contribution to the output of the laser. The radiation from the laser is almost entirely in the direction perpendicular to the reflecting surfaces. Therefore, the laser beam is collimated; this means that the laser beam is composed of parallel rays and does not spread. (Here the laser has been assumed to have plane reflectors. If the laser has concave reflectors, the radiation diverges as the radiation from a point source and can be collimated with an appropriate lens.)

The degree to which light is coherent is a measure of the wave quality of the light beam. Spatial coherence may be demonstrated by the observation of interference fringes when one portion of a wavefront is superimposed on another, such as with a multiple slit. The light from a laser has been shown to be spatially coherent by the observation of fringes when a double slit was placed directly in front of the laser. Also, interference has been produced in superimposing the light from one end of a laser on the light from the other end. Coherence in time may be demonstrated by the observation of interference when one segment of the wave is superimposed on another, such as in a Michelson interferometer or a Fabry-Perot interferometer. This type of coherence is directly related to the monochromatic quality of the radiation.

The coherence of laser radiation has been demonstrated also in the following way. The radiation from a laser that is oscillating at two adjacent Fabry-Perot resonance frequencies is detected by a phototube. The current from the phototube is frequency-analyzed and is found to be modulated at the radio frequency that is equal to the difference (beat note) of the two optical frequencies. Javan (3) extended this technique to demonstrate that it is also possible to obtain a radiofrequency beat note by mixing the outputs of two separate and independently oscillating lasers. In addition to determining the frequency difference of the two lasers to

high precision, the beat note provides a convenient means to obtain information about the line width and frequency stability of laser oscillations. Also, many proposed applications of the laser are based on the coherence that is demonstrated by the observation of this beat note.

IV. Solid State Lasers

Perhaps the best known laser is the ruby laser, which was the first to be operated successfully (4). Ruby is crystalline aluminum oxide with an impurity of trivalent chromium ions; this impurity gives ruby its red color and is the active element in the laser. Population inversion in the ruby is attained by optical pumping; the ground state Cr^{+++} ions absorb radiation in the green and near-ultraviolet portions of the spectrum and are excited to several broad bands of closely spaced energy levels. These excited Cr^{+++} ions promptly decay by non-radiative transitions to a narrow energy band.

If the pumping light is sufficiently intense, the Cr^{+++} ions accumulate in this energy level to produce a population inversion. In this particular case, the stimulated transition is to the ground state; hence more than half the Cr^{+++} ions must be pumped out of the ground state to produce a population inversion. Therefore the threshold intensity of the pumping radiation is very high; so the ruby laser is usually operated in a pulsed fashion.

The assembled laser is usually a ruby rod 5 to 10 cm long and 0.2 to 0.5 cm in diameter, placed along the axis of a helical xenon flash tube. The ends of the ruby rod are ground flat and parallel, and the reflecting coatings are usually applied directly to the ruby. The xenon tube is flashed by discharging a bank of condensers through it. If the peak intensity of the flash exceeds a critical value (threshold intensity), the ruby rod emits a brief but very intense burst of red light; it "lases."

The pulsed ruby laser is particularly suited to high power applications; the properties of coherence, directionality, and

line width of the ruby laser, while much better than conventional light sources, do not match those of some of the other lasers to be discussed later.

The high power of the ruby laser has been further increased by modifying the design. In this modification, one end of the ruby rod is made non-reflecting, and a mechanical or electro-optic shutter is placed between the end of the rod and an external reflector. The shutter is synchronized with the xenon flash lamp so that it opens near the end of the pulse of pumping light; thus the start of laser oscillation can be delayed until nearly all the Cr^{+++} ions are excited to the upper level of the laser transition. When the shutter is opened, the intensity of the stimulated emission increases very rapidly, and the energy stored by the excited Cr^{+++} ions is released in a very short time to produce a laser pulse of very brief duration and very high power. (The duration is about a microsecond and the power is about a megawatt.)

Of course, the laser does not create energy; in fact, the energy in the laser pulse is often less than one percent of the energy used by the xenon flash lamp. The efficiency of the energy conversion depends on the geometry of the laser, the quality of the ruby, and other variable factors. However inefficiently, the laser converts energy from one available form to another which may be more useful. For instance, if a short focal length lens is placed in the path of the laser beam, the light can be focussed to a spot of very small dimension, since the light beam of the laser is nearly parallel. One then obtains an enormous power density which burns holes through razor blades, etc. There are more practical uses for the focussed laser beam, such as drilling holes in diamonds and making spot welds in otherwise inaccessible or inconvenient places.

Many other solid state lasers have been developed since the ruby; most of these are divalent or trivalent rare-earth ions dilutely dispersed in crystal lattices such

as CaWO_4 , CaF_2 , or SrMoO_4 . Population inversion in these rare earth lasers is obtained by optical pumping to a broad energy band followed by rapid decay to a sharp energy band, just as in the ruby laser. However, in most of the rare earth lasers, the lower energy level of the laser transition is enough above the ground state that it can be depopulated by cooling the crystal. Thus, population inversion can be obtained with lower intensities of pumping radiation, and it should be possible to operate these lasers continuously. Continuous operation has already been achieved for some of them.

V. Gas Lasers

The lasers that employ gaseous media for coherent amplification differ from the solid state lasers in several respects. All gaseous lasers are operated continuously, but have much lower power outputs (characteristically, about a milliwatt). The gas lasers usually have low gain per unit length and must be about a meter long to obtain sufficient amplification. While the gas lasers are inferior to the solid state lasers in regard to power output, they are superior in regard to coherence, collimation, and monochromaticity.

In gas lasers, the population inversion is generally achieved by means other than optical pumping. The only gaseous laser which is optically pumped is the cesium vapor laser. The line width of the intense 3888 \AA line in the emission spectrum of helium overlaps the wavelength of one of the lines in the absorption spectrum of cesium vapor. Therefore, cesium atoms may be excited to a specific energy level by optical pumping using a helium discharge tube as the light source. Population inversions between the energy levels of several transitions are expected, and laser oscillation has been observed for one of these transitions, which has a wavelength of about 7.18 microns (5).

Population inversions in the other gas lasers are achieved by various processes involving inelastic collisions. In the helium-

neon laser, neon atoms are selectively excited to certain energy levels by transfer of energy from helium metastable atoms to neon atoms in the ground state. The probability of energy transfer is significant only if the neon atom is excited to an energy level that is very close to the energy of the helium metastable atom. The energy level diagram (Figure 1) shows that the $2s$ (Paschen notation) energy levels of neon are very close to the 2^3S (metastable) energy level of helium. The $2p$ energy levels of neon, on the other hand, are considerably lower than the energy level of the helium metastable atom. Therefore, the energy transfer process selectively excites neon atoms to the $2s$ energy levels, and population inversion may be expected for any of the 30 allowed $2s - 2p$ transitions. Thus far, laser oscillations have been observed for 11 of these transitions (6,7); the highest intensity has been obtained for the $2s_2 - 2p_4$ transition, whose wavelength is 11523 \AA .

Although it is not shown in Figure 1, there is another helium metastable energy level and it is very close to the group of $3s$ energy levels of neon. Thus far, laser oscillations have been observed for two transitions whose upper energy level is in this group, $3s_2 - 2p_4$ ($\lambda = 6328 \text{ \AA}$) and $3s_2 - 3p_4$ ($\lambda = 3.3913 \text{ microns}$).

Laser oscillation has been observed for the $2s_2 - 2p_4$ transition in a discharge of pure neon. The intensity of this laser radiation was considerably less than in the helium-neon laser, but the observation of laser oscillation in the pure neon discharge indicated another method of producing population inversion, which may be applicable to discharges in other gases. In a gas discharge, atoms are excited from the ground state to higher energy levels by inelastic collisions with electrons of sufficient energy. This process of excitation is somewhat selective; most of the atoms are excited to energy levels from which radiative transitions to the ground state are allowed. Also, since this excitation process is ultimately responsible for

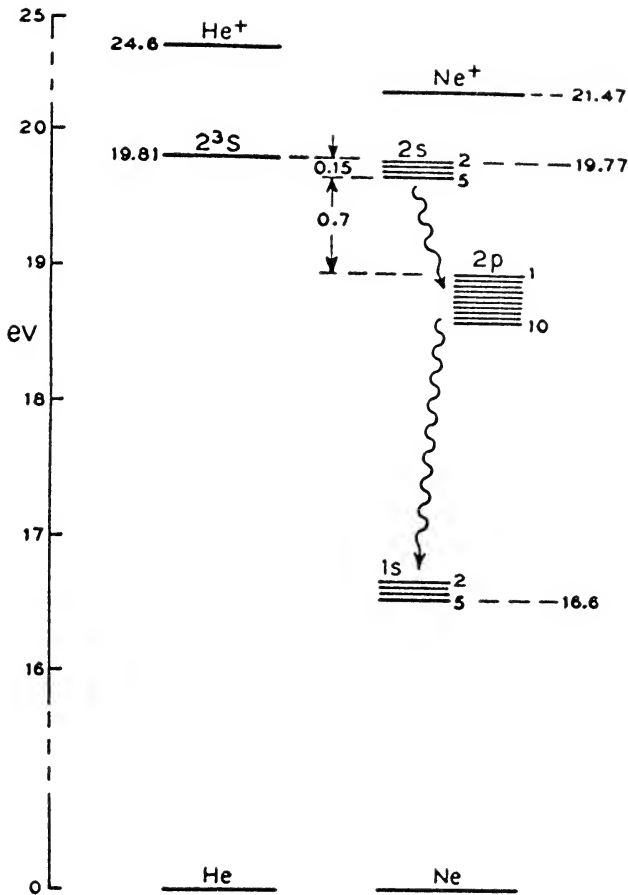


Figure 1.—Energy level diagram of He and Ne atoms. (From *J. Opt. Soc. Am.* 52, 32 (1962).)

sustaining the discharge, it may have sufficient influence on the equilibrium in the discharge to produce population inversions.

The rules that determine whether a given transition is allowed (selection rules) apply to changes in parity and angular momentum. The selection rule that is most relevant to the population inversion in the neon discharge restricts transitions according to changes in l , the orbital angular momentum quantum number of the excited electron. In the energy level diagram of neon (Figure 1), the letters (s and p) classify the atomic energy levels according to the value of l ; s, p, d, and f correspond to l equal to 0, 1, 2, and 3.

According to the selection rule, only transitions in which l changes by plus or minus one are allowed. Therefore, since the valence electrons of neon are in a p ($l = 1$) shell, transitions between the ground state and excited states are allowed only for s ($l = 0$) and d ($l = 2$) excited states.

There are a number of processes which compete with the selective excitation to s and d states by electron impact and tend to prevent population inversion. However, the most obvious of these competing processes, spontaneous transition directly back to the ground state, has little effect on the equilibrium, since the spontaneous

emission is readily absorbed by the atoms in the ground state which are present in great abundance. The most important processes involved in the equilibrium of the $2s_2$ population are selective excitation by electron impact and spontaneous transitions to the $2p$ levels. The most important processes in the equilibrium of the $2p_4$ population are spontaneous transitions to the $1s$ levels, spontaneous transitions from higher levels, and inelastic collisions of electrons with atoms in the $1s$ levels. (Since $1s$ are the lowest excited states and the spontaneous emission due to spontaneous transitions to the ground state is too readily absorbed, the $1s$ levels are effectively metastable and hence relatively highly populated.) The operation of the pure neon laser first demonstrated that population inversion can be produced by electron impact excitation. The possible wide applicability of this method has been demonstrated by obtaining laser oscillations for 22 xenon transitions, eight krypton transitions, four argon transitions, and two other neon transitions (8). In the helium-neon laser, excitation of neon atoms by energy transfer from metastable helium atoms provides an additional means of selectively exciting the neon atoms to the $2s$ and $3s$ levels without directly affecting the $2p$ populations, thus increasing the $2s_2 - 2p_4$ population inversion and producing the other $2s - 2p$, $3s - 2p$, $3s - 3p$ population inversions.

Still another method of producing population inversion is that of the neon-oxygen laser—dissociative excitation transfer. This method is similar to that of the He — Ne laser, but in this case the coincidence of the energy levels does not need to be so close. A neon metastable atom collides inelastically with a diatomic oxygen molecule; the resulting excited oxygen molecule is unstable and immediately dissociates into an excited oxygen atom and an oxygen atom in the ground state. This laser produces oscillation at a wavelength of 8446 \AA (8,9).

VI. Research and Applications

Much of the past and current laser research has been directed toward developing new laser materials and improving existing lasers. An interesting exception has been the generation of optical harmonics, which had been proposed earlier, but was not observed in the pre-laser era because the intensity of light from existing sources was inadequate. However, when the light from a high-power laser (such as the ruby laser) passes through certain asymmetric types of crystals, the light emerging from the crystal contains some light whose wavelength is half the wavelength of the incident radiation (second harmonic) (10). More recently, production of the third harmonic also has been observed.

Much of the motivation for the development of lasers is the potential use of lasers in communications. The light waves produced by lasers have several advantages over radio waves as carriers in certain kinds of communication. For long distance communication (interplanetary, etc.), the advantage of the laser beam is that it is highly directional; hence, information could be sent over very long distances with relatively low-power transmitters. The angular divergence of the beam from a helium-neon laser has been measured to be about 32 seconds, or 1.5×10^{-4} radians, which could be further reduced by sending the beam backwards through a telescope. Another advantage is that the high frequency (up to 5×10^{14} cycles/sec) of the laser radiation greatly increases the information-carrying capacity. It has been stated that a laser beam with a modulation bandwidth of 100,000 megacycles could carry as much information as all the radio-communication channels now in existence (11). One of the problems to be solved is to find means for producing and detecting modulation at such high frequencies.

At the National Bureau of Standards, the gas laser is being considered for use as a standard light source for interferometric measurement of distance. (The procedure

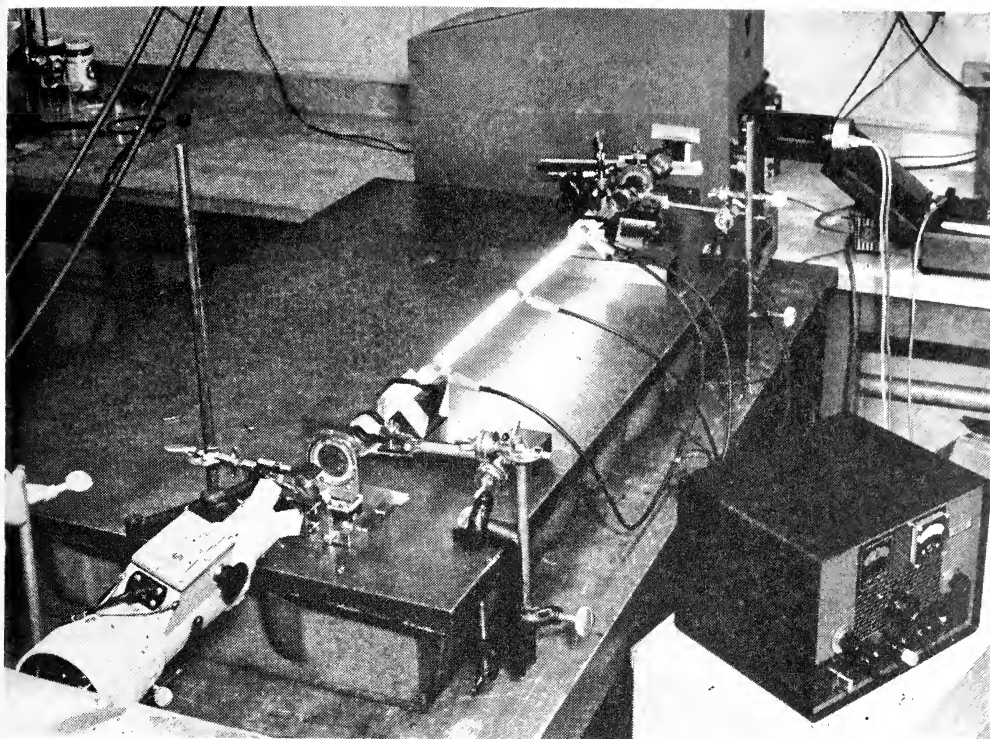


Figure 2.—A helium-neon gas laser set up at NBS.

for interferometric distance measurement is to count the number of times the intensity at the center of the interference pattern in a Michelson interferometer passes through a maximum as one of the mirrors is moved from one position to another. The distance moved by the mirror is one-half the number of maxima counted times the wavelength of the light producing the interference.) Using conventional light sources, it is difficult to observe fringes when the difference in path length for the two parts of the divided beam is greater than 50 cm; with the intensity, coherence, and monochromaticity of the laser radiation, it is possible (in principle, at least) to obtain interference with path length differences of many kilometers. Another advantage of the laser as a light source for interferometry is that most of the area of the circular fringe pattern will be occupied by the central maximum, since the

beam is so highly directional, which simplifies the use of automatic "fringe counters."

At NBS, interference has been obtained in a Michelson interferometer with a path length difference of 100 meters, using the He—Ne gas laser of Figure 2 (after modifications) as the light source. This He—Ne laser is similar to the one described by Rigrod et al. (12). It is a confocal reflector type, with the radius of curvature of the reflectors and spacing between them equal to one meter. The reflectors are multilayer dielectric films with peak reflectance (about 99 per cent) at 11523 Å. The windows at the ends of the discharge tube are sealed on at Brewster's angle, so light with the proper polarization is transmitted through the windows without reflection losses. The discharge tube contains 1 mm Hg of helium and 1/10 mm Hg of neon, and is excited by power from a

radio transmitter applied to external electrodes.

The purpose of the iris diaphragms, which are located between the reflectors and the ends of the discharge tube, is to obtain monochromatic operation of the laser. The apertures are reduced until the diffraction losses become large enough to limit oscillation to the Fabry-Perot resonance frequency nearest the peak of the spectral line. The laser is mounted on a large, heavy surface plate to reduce fluctuations of the reflector spacing due to vibration and temperature fluctuations.

One of the problems to be solved, if lasers are to realize the full potential of their monochromatic quality, is that of stability and adjustment to a precise wavelength. Javan has reported that the line width of the radiation from a He—Ne laser, whose frequency is about 2.6×10^{14} cycles/sec, is less than 2 cycles/sec (3). To obtain stability comparable to this line width, the length of a meter-long laser would have to be held constant to within 10^{-12} cm. (For comparison, the size of an atom is about 10^{-8} cm.) To obtain this stability, the temperature of a fused quartz spacer would have to be held constant within 2×10^{-8} degrees centigrade. Fortunately, such high precision and stability are not required for most of the proposed applications of lasers. Currently available techniques (8) make it feasible to control the frequency of oscillation to about one part in 10^9 , which is sufficient for most applications.

There are many potential applications for lasers in research and technology; no attempt will be made to describe, or even mention, all the proposed applications. A partial list of the kinds of applications in which lasers might be useful includes optical pumping, Raman spectra, photolysis,

interferometry, high-speed photography, and seismology. Perhaps the best indication of the scope of laser applicability is the number of companies that have entered (or have their eye on) the laser market (13).

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National Science Foundation Fellowships for Scientific Study Abroad

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"Perhaps more than any other national activity, scientific research and development depends upon close relationships with other countries." Thus wrote Vannevar Bush in his 1945 report to the President on a program for postwar scientific research.

To achieve maximum effectiveness in the training of scientific manpower, the United States must provide opportunities for limited numbers of developing scientists to study in countries foreign to their own. Private foundations have played a major role in this area in the past. To their assistance, which should continue, has been added in recent years fellowship support by such Federal agencies as the Department of State, National Institutes of Health, and the National Science Foundation (NSF). My purpose is to focus attention on the role of NSF in this field.

NSF Fellowship Programs

The National Science Foundation Act of 1950, as amended, states, "The Foundation is authorized to award . . . fellowships for scientific study or scientific work in the mathematical, physical, medical, biological, engineering, and other sciences at appropriate nonprofit American or nonprofit foreign institutions selected by the recipient of such aid, for stated periods of time." This authorization was limited to U.S. citizens and nationals. In 1959 the Act was amended to provide fellowships also to

foreign nationals for scientific study or work in the United States.

Eight fellowship programs are now supported by NSF, as follows:

1. *Graduate fellowships* for the training of American graduate students at home or abroad.

2. *Cooperative graduate fellowships* for the training of American graduate students at home and abroad under certain conditions.

3. *Summer fellowships* for training American graduate teaching assistants at home.

4. *Postdoctoral fellowships* for advanced training of American research scientists at home or abroad.

5. *Senior postdoctoral fellowships* for additional advanced training of American research scientists at home or abroad.

6. *Science faculty fellowships* for refresher or additional training at home or abroad of American college teachers of science, mathematics, and engineering.

7. *Summer fellowships* for additional training at home of American secondary school teachers of science and mathematics.

8. *Senior foreign scientist fellowships* to enable outstanding foreign scientists to study or work in U.S. institutions.

The number of applicants for fellowships in the foregoing programs, and the number of awards offered from the beginning through June 1962, are given in Table 1.

The programs are listed in order of establishment.

Table 1.—Number of Applicants and Awards Offered Through Fiscal Year 1962 in NSF Fellowship Programs Since Fiscal Year of Inauguration

Fellowship program	Beginning fiscal year	Applicants to date	Awards offered to date
Graduate	1952	41,173	10,758
Postdoctoral (regular)	1952	6,186	1,459
Senior postdoctoral	1956	1,767	524
Science faculty	1957	4,506	1,513
Cooperative graduate	1959	13,322	4,540
Teaching assistants	1959	5,806	2,653
Secondary school teachers	1959	7,234	1,752
Senior foreign scientist	1963	—	—
Totals		79,994	23,199

The financial support of NSF fellowship programs has risen from \$1.45 million in 1952 to nearly \$17 million in 1962. It is anticipated that approximately \$21.5 million will be spent in fiscal year 1963 for support of approximately 4,500 individuals under the foregoing fellowship programs.

NSF Fellowships Permitting Study Abroad

Graduate Fellowships. About three of every four NSF fellowships awarded since 1952 have gone to graduate students to enable them to complete their studies in science, mathematics, and engineering with the greatest possible effectiveness and dispatch. The Foundation has emphasized these graduate level programs to provide means for developing the numbers and kinds of well-trained scientists required by the nation's industries and research laboratories, Government laboratories, and institutions of higher education. Over the years, the level of support has been between one and two per cent of the number of graduate students in the natural sciences, mathematics, and engineering. The distribution of applicants and awards by major fields of study is given in Table 2.

Table 2.—Distribution by Major Fields of Study of Applicants and Awards Offered in the Graduate and Cooperative Graduate Fellowship Programs—Fiscal Years 1952 Through 1962

Major field of study	Applicants	Awards offered	
		Number	Percent
Chemistry	10,585	2,885	27
Physics	10,136	3,286	33
Life sciences	13,567	3,424	25
Mathematics	6,632	2,054	31
Engineering	9,145	2,675	29
Other fields	4,430	964	22

Because awards are made on the basis of ability, and particular fields of study are not shown preference, the number of awards made in each field is related to the number of applicants, about one in four being successful in all fields.

In fiscal year 1962, 10,079 individuals applied in the two graduate-level programs and 2,961 awards were made. Of the total applicants and awards, 5,961 and 1,761, respectively, were in the graduate program and 4,118 and 1,200 in the cooperative graduate program.

A few cooperative graduate fellows may spend a portion or all of their fellowship tenure on field work at foreign institutions, but in doing so they remain under the responsibility of U.S. institutions. In the graduate program, however, fellows may affiliate directly with foreign institutions of their choice, and 33 awardees made such a selection in fiscal year 1962. Of these, 13 chose one of three institutions in England; each of the remaining 15 chose a different institution—5 in Germany, 2 in Canada, and 1 each in Australia, Denmark, Israel, the Netherlands, Norway, and Switzerland. In general, graduate fellows studying abroad—less than 2 per cent of award recipients—tend to concentrate at English and German institutions, but in each case the choice of institution is based mainly on the particular unique type of training offered.

Postdoctoral Fellowships. Of the first two fellowship programs instituted by the foundation in 1952, one was the regular

postdoctoral program. These fellowships provide support to individuals with doctorates in science, mathematics, or engineering who need and are qualified for additional advanced training preparatory to work in a specialized scientific field. To give persons receiving the doctorate in early summer or the mid-year an equal opportunity to begin postdoctoral research as quickly as possible after attainment of the degree, a competition is held in late summer for announcing awards in early fall, and a second competition is conducted in mid-winter for March awards.

In recent years, in all fields of science, it has become increasingly important to continue research training beyond the Ph.D. degree. The most compelling reason for postdoctoral study is the time required to master the subject matter, which is growing constantly in amount. As a leading mathematician has stated it, the recipient of a Ph.D. today has had, in effect, a general education in his subject; he still needs the specialization that postdoctoral work can provide. The number of persons embarking upon postdoctoral studies—both recent Ph.D.'s and more mature scholars—has multiplied noticeably in the past 15 years, especially in the sciences. The fellowships offered for study and research at this level by the Federal government through the National Science Foundation and the National Institutes of Health have contributed substantially to this development and, additionally, have helped to promote recognition in academic circles of the importance of postdoctoral training.

After a few years of operation, an analysis of the applicants in the regular postdoctoral program—intended primarily for recent Ph.D.'s—showed that a need also existed for a fellowship program for scientists who had already demonstrated superior accomplishments in special fields. Therefore, in 1956, the Foundation instituted a senior postdoctoral program, open to U.S. scientists who at the time of applying have held a Ph.D. or equivalent degree for at least five years. These fellowships

provide opportunities for established scientists to become even more proficient in their respective specialties by studying or doing research, during sabbatical leave period or otherwise, in outstanding laboratories and by close and continuous association with others who are in the forefront of their fields of research. Because of their senior status and in recognition of the fixed financial obligations that such status invariably entails, the Foundation established in this program a "salary-matching" stipend, which is adjusted to take into account other support expected during the period of fellowship tenure. Applications are accepted throughout the summer and early fall; the closing date is normally in October, and the awards are announced in December.

Selection of fellows in these two postdoctoral programs is made on the basis of ability. No preferential treatment is accorded any particular field of study. Table 3 gives, for several of the major fields of study supported by the Foundation, the ratio of regular plus senior awards offered during the entire period of operation of each program, to the combined number of applicants.

Table 3.—Distribution by Major Fields of Study of Applicants and Awards Offered in Two Postdoctoral Programs—Fiscal Years 1952 through 1962

Major field of study	Applicants	Awards offered	
		Number	Percent
Chemistry	1,418	367	26
Physics	1,157	352	30
Life sciences	3,840	769	20
Mathematics	694	243	35
Engineering	290	88	30
Other fields	554	164	30

It is clear from even a cursory reading of the final reports of postdoctoral NSF fellows that these awards are accomplishing their principal objective. These fellowships have opened opportunities for more than 1,900 scientists of outstanding ability to advance their research training and acquire essential additional specialization in their chosen fields of science. But both programs do more than just this.

A high percentage of postdoctoral NSF fellows affiliate with world-famous foreign institutions while on tenure. If one accepts the premise that close cooperation between U.S. scientists and their foreign colleagues, through an exchange of ideas and scientific information, strengthens the science potential of the United States, then the postdoctoral fellowships utilized abroad have additional significance.

In fiscal year 1962, 897 individuals applied in the regular postdoctoral program and 245 were offered awards, of whom 132 (55 percent) chose foreign institutions. Of these, 55 chose 15 institutions in England; 16 went to 11 institutions in Germany; 14 to 8 institutions in France; 11 to 4 institutions in Switzerland; and 6 to 2 institutions in Israel. Five each went to Denmark and Sweden; 4 to Scotland; 2 each to Belgium, India, and Norway; and one each to Canada, Italy, Japan, Spain, Uganda, and Wales.

In fiscal year 1962, 270 individuals applied in the senior postdoctoral program and 92 were offered awards, of whom 75 (82 percent) chose foreign institutions. Of these, 20 chose 9 institutions in England; 12 went to 10 institutions in France; 7 to 3 institutions in Israel; 7 to 3 institutions in Switzerland; and 5 to 4 institutions in Italy. Four each went to Germany and the Netherlands; 3 each to Australia and Denmark; 2 each to Austria, Belgium, and Sweden; and one each to Madagascar, New Zealand, Norway, and Spain.

Science Faculty Fellowships. By increasing through fellowship support the opportunities for study and research in the sciences, the Foundation provides an inducement to individuals of superior intellectual capacity to enter graduate school. It also encourages by its fellowships these students and other persons talented in science to continue their training to the highest reaches of which they are capable. By and large, however, it is the undergraduate teacher who is in the best position to motivate able students to obtain their doctorate and pursue science as a career.

Thus, the presence of stimulating and challenging teachers of science on our undergraduate campuses is of prime importance to the production of future scientists.

A teacher must know his subject matter well if he is to stimulate the latent interests and abilities of his students. Because of the remarkable expansion in volume and rate of scientific discoveries in the past two decades, many college teachers have found it extremely difficult, along with their other duties, to keep abreast of new developments in their fields. Still others were drawn into teaching with too little training to begin with, and consequently lack a rounded educational and scientific background. The Foundation decided in 1957 that the best immediate answer to this problem was a fellowship program especially designed to enable college teachers of science, mathematics, and engineering to improve their competence as teachers by means of additional advanced study in their subject matter fields. It therefore instituted in that year the science faculty fellowship program.

The primary objective of this program is to improve the standards of college-level instruction—first, by affording opportunities for refresher training to those teachers who, despite a background of education which at one time was adequate, have lost touch with recent developments in science; and second, by providing inadequately trained college teachers of science with opportunities to obtain a better understanding and knowledge of the subject matter they teach. In addition, a Federal program of this kind helps to focus greater attention upon the national importance of encouraging, recognizing, and rewarding high competence in teaching.

As in other Foundation fellowship programs, no particular field of study has received preferential treatment in the selection of science faculty award recipients. The percentage of awards offered to the total number of applicants over the years has been 33.6 per cent across all fields: the

percentages in several of the major fields of science supported by the Foundation are given in Table 4.

Table 4.—Distribution by Major Fields of Study of Applicants and Awards Offered in Science Faculty Program—Fiscal Years 1957 through 1962

Major field of study	Applicants	Awards offered	
		Number	Percent
Chemistry	573	189	33
Physics	451	150	33.3
Life sciences	1,103	329	29.8
Mathematics	885	301	34
Engineering	1,136	456	40.1
Other fields	358	88	24.6

In fiscal year 1962, 864 individuals applied in the science faculty program and 325 were offered awards, of whom 32 (10 per cent) chose foreign institutions. Of these, 17 chose 5 institutions in England; 5 chose 5 institutions in Germany; 4 chose 3 institutions in Sweden; 2 chose one institution in Switzerland; and one each went to Canada, India, the Netherlands, and Norway.

Senior Foreign Scientist Fellowships. Under the authority granted the National Science Foundation in Public Law 507, as amended by the Act of September 8, 1959, the Foundation may, with the approval of the Secretary of State, undertake programs granting fellowships to, or making other similar arrangements with, foreign nationals for scientific study or scientific work in the United States.

In fiscal year 1963 the National Science Foundation inaugurated a new fellowship program for senior scientists of foreign nationality. The program will enable outstanding foreign scientists to spend an extended period of time at U.S. institutions of higher education where they will share their learning with, and provide intellectual stimulation to, graduate students and members of the science faculty, thereby enriching graduate science training in the United States and enlarging the scientific research potential of this country. At an estimated cost of \$500,000, approximately 40 awards will be granted in the mathematical, physical, biological, and engineer-

ing sciences, and interdisciplinary fields comprised of two or more of these sciences.

In this new fellowship program, the Foundation will have the U.S.-participating institutions nominate those foreign applicants who will compete for awards; any application without an endorsement of a participating institution will not be considered.

Fellowships Administered by the National Science Foundation for International Agencies

In addition to its own fellowship programs, the Foundation has been administering two fellowship programs, whose financial support is provided by organizations concerned with international cooperation—the North Atlantic Treaty Organization (NATO) and the Organization for Economic Cooperation and Development (OECD).

NATO Postdoctoral Fellowships in Science. These fellowships are awarded to citizens of the United States mainly for study in NATO countries. Each NATO country administers the NATO fellowships for its own nationals. The National Science Foundation, in administering this program on behalf of the U.S. Department of State, is responsible for the final selection of fellows. Approximately 50 U.S. scientists study abroad under this program each year. A shift of scheduling of the competition in calendar year 1963 to a fall award period appears likely.

OECD Senior Visiting Fellowships. These fellowships have permitted *institutions* in the United States to send senior scientists, mathematicians, or engineers on their staffs to study new techniques and developments at advanced research and educational institutions located primarily in the OECD member countries.

Only a limited number of awards has been available in the past, and the scheduling of the program is dependent upon the firm allocation of funds by OECD to a national center—the National Science Foundation in the United States.

Some Observations on NSF Fellowship Programs in Action Abroad

In fiscal year 1963, as in 1962, it is estimated that about 275 U.S. scientists will study abroad under the provisions of National Science Foundation fellowships, for which the Foundation will obligate approximately \$1.5 million dollars. The general pattern of distribution of NSF fellows is expected to be about the same as in earlier years, but with varying numbers in each country.

Each year, institutions in England attract the greatest number of NSF fellows; but in respect to institution involvement, Germany leads the list, with almost as many fellowship institutions as fellows in each program. English institutions attract NSF fellows in many broad fields, but the number of fellows in each of four fields, in descending order, is as follows: physics, chemistry, engineering, and mathematics. In Germany, the pattern is chemistry, physics, mathematics, and engineering; in France, mathematics, physics, chemistry, and engineering; in Switzerland, Denmark, and the Netherlands, physics, chemistry, engineering, and life sciences. In countries like Australia, Madagascar, Kenya, and Uganda, the major field interests appear to be anthropology and genetics.

Before an award recipient may activate his fellowship abroad, the Foundation requires, as a matter of record, a letter from the foreign host institution indicating its willingness to accept the individual and provide space, equipment, etc., for him to carry out his fellowship program. Since the Foundation instituted this requirement, the very warm welcome with which NSF fellows are received abroad has become apparent. It also has become apparent that NSF fellows choose to be associated with many of the world authorities in their respective fields. For example, as the new Nobel prizewinners are announced each year, our records are likely to show that NSF fellows are currently studying and working in their laboratories. Such are the opportunities afforded U.S. scientists

through NSF fellowships—to be in the advancing frontiers of science.

In September 1962, I had the pleasure of meeting with about 80 NSF fellows studying in France, Switzerland, Italy, Germany, Sweden, Denmark, and England, and a number of their scientific advisers and associates. These visits were scheduled in such a way as to bring me in contact with NSF fellows in each program, at institutions with many fellows and at those with only one. On first hand observation, it seemed to me that fellows were being accorded excellent opportunities to carry out their fellowship programs, to grow in scientific stature, and to associate with visiting scientists from other countries. In a number of cases it was obvious that NSF fellows were considered to be vital to the accomplishment of a particular basic scientific objective, while others were receiving valuable training in fields of specialization which on their return to the U.S. would enrich U.S. science directly through research or improved teaching, or both.

NSF fellows (and families), however, have their problems. Appropriate housing is difficult to arrange for in advance; children must be entered in foreign school systems (many to have a traumatic but wonderful year of schooling with instruction in a language other than English); and wives have to learn a somewhat different way of shopping and must adjust to new social conditions and customs.

There is not very much the Foundation can do to assist in these adjustments, except to advise fellows that they should try to anticipate these problems. To the extent that it will be helpful, the Foundation is now providing each fellow who is studying or planning to study abroad, with a list of all fellows on tenure or planning to begin tenure at his and other fellowship institutions abroad. The first list was distributed in August 1962, and appears to have fulfilled a particular need.

With the current number of NSF fellows studying abroad, it has become abundantly clear that closer ties need to be established with the Department of State scientific

attaches, and with cultural attaches in those countries where there is not now a scientific attache. Accordingly, the list of NSF fellows studying or planning to study abroad has been made available to them, and revised lists will be supplied from time to time. Each scientific attache visited in September expressed particular interest in, and need for, such a list. For example, one attache remarked that the Ambassador was particularly interested in science, and each year invited the leading scientists in the country to dinner. On such occasions, it became the attache's responsibility to locate, if possible, senior U.S. scientists who might also be invited.

In the October 1962 issue of *Science*, D. S. Greenberg discussed "Science and Foreign Affairs: New Effort Under Way to Enlarge Roles of Scientists in Policy Planning." He wrote, "It would be heresy today to deny that science should be considered in the formulation of foreign policy. At the same time, there is no abundance of accomplished scientists willing to put their careers aside, if only temporarily, for the strange world of the diplomatic service." Scientists are accustomed to dealing with "strange worlds," and it is hard to believe that "accomplished scientists" will not answer the call to service when the need for them has been established. Indeed, if the diplomat is willing to accept Greenberg's statement that "A scientist at his elbow is the mark of the statesman who recognizes that the laboratory has become a decisive force in the world," then the scientist is prepared to march shoulder to shoulder with him into the international fray. Granted that there is no easy way to develop a training ground for the type of people needed by our nation in this field, I submit that NSF and other fellows may be a reservoir worthy of investigation, for they are carefully selected on the basis of their demonstrated and potential scientific ability and have completed their fellowship tenure in foreign countries. Two desirable ingredients are present—scientific competence and established personal associations in a foreign country—and some knowledge

of the people and their language appears likely. I am confident that scientists will meet all their international challenges.

THE BROWNSTONE TOWER



On January 9 there appeared on the front page of the *Washington Post* a story by Nate Haseltine on a kind of inebriation in persons who had been given experimentally large doses of tryptophane in orange juice. When science writing was very young, this story either would not have made the front page, or if it had it would have been treated with ridicule or presented as having great significance for the cure of disease. Times have changed, and Nate played the story as straight as the authors themselves might have done if they had had his experience and skill in making a scientific investigation understandable and interesting to laymen. He made only one speculation: i.e., "The results suggest that amino acid imbalances in body chemistry might be a cause of some mental disorders," a modest and sensible hypothesis.

Who is this Nate Haseltine (pronounced Hazelteen) whose by-line has appeared in the *Post* since 1946? I thought it would be an interesting experience to find out—to interview an interviewer. Moreover, Nate has been a member of the Washington Academy of Sciences for a number of years, yet is known to few of its members except as a name. I wanted to introduce him to you, since his work and family do not permit him to attend meetings of the Academy or to serve on its Journal or committees. Therefore I made a date with him for lunch and arranged to meet him at his desk in the *Post* building at 1515 L St., N.W. I had expected to find him in a cubicle, but instead he sat at a simple typist's desk among dozens of other simi-

lar desks on the open floor of the City Room. Here he reads journals, keeps a small file of information and a few reference books, and writes most of his stories. One would never guess from his modest demeanor and his uncarpeted, unwindowed, and crowded environment that he has any more status than a GS-5 clerk in an inner ring of the Pentagon. And yet, my friends, he is a gentleman of distinction, the current president of the National Association of Science Writers and a winner, in 1953, of the AAAS-Westinghouse Award.

We walked around the corner to the Brush and Palate (sic) for lunch, I full of curiosity about how one becomes a professional science writer. I do not know whether Nate's progression is typical, but he started at the very bottom, a Philadelphia boy deprived of college education by the Great Depression. He was willing to work at anything, anywhere, anytime, at any wages. In 1931, when he was 20, he became by chance an assistant to the librarian of the *Philadelphia Evening Ledger* and was paid \$9.11 per week. (That doesn't deserve an exclamation point: in 1916 I worked for the Philadelphia Commercial Museum for \$5.00 per week!) While copy boys were getting opportunities to serve as reporters, he was passed over until he persuaded the managing editor to try him out. The boy made good in all kinds of reporting and discovered that he enjoyed covering medical conventions. He did not enjoy World War II until it was nearly over, when he was selected to attend the Biarritz Army University in France. After emerging from this university and the Army, he came to Washington in June 1946 as a general assignment reporter for the *Washington Post*. Soon he advanced to rewriter, and in 1949 the *Post* prevented him from moving to another newspaper by making him its science writer, with the privilege of considerable freedom in the scheduling of his work. So during the past 13 years Nate has learned science and science writing on the job. He had always preferred the medical

sciences, and during recent years he has been permitted to specialize in the life sciences, leaving the physical sciences to another reporter, Howard Simons, 1962 winner of the AAAS-Westinghouse award.

I asked Nate if he thinks it possible for a reporter to write a story on a scientific subject that he himself does not understand. He thinks so, but neither advocates nor practices it. For example, he knows well the lingo of "cracking the genetic code," but he has not yet written on the subject because he does not feel that he understands it thoroughly. Apparently lucid explanations by specialists become opaque by the time he gets back to his typewriter.

Nate does not do all his work at his own manual typewriter: he is to be found in the press room of the larger national meetings, e.g., AAAS, Federation, ACS, AIBS, and AMA. Through the year he averages more than one story a day, not all appearing under his by-line. Nearly all of his professional writing is published by the *Washington Post*, and some of it is used also by other newspapers with which the *Post* is affiliated. He does not keep a scrapbook of his published stories, for he depends upon his memory and the *Post's* indexes to find what he wants.

Science writing has its ethics, which alone would make an interesting story. I can give only an illustration of how one problem was handled by Nate. Having the privilege last year of visiting the marine laboratory of the University of Washington at Friday Harbor, he learned there that giant muscle fibers had been discovered by Graham Hoyle and Thomas Smyth, Jr., in a barnacle. He could not use the story because the work had not yet been published. He was told that it was scheduled for publication in *Science* in the issue of January 4, and he planned to use it immediately thereafter. However, the work was presented at the recent meetings of the AAAS, at which Nate was present. Thus it became public information and could have been used by any reporter

present. Nate alone chose to use it, having been apprised of its significance at the source. As he was released from his pledge to follow *Science*, the first published announcement of giant muscle fibers in *Balanus nubilus* Darwin appeared in the *Washington Post*!

When it seems desirable and he has time. Nate consults the authors of scientific articles that he chooses to report. He does not, however, send his copy to them for review prior to publication, nor do they receive clippings from him after publication. A reporter's life is much too busy for such amenities.

Anyone wishing to identify Nate will find a happy picture of him on page 8 of the September 1962 issue of the *Newsletter* of the National Association of Science Writers. And on pages 9 and 10 following is a more detailed and intimate biography than I have given here.

Finally, let it be known, but for his sake forgotten, that Nate was christened Nathan Stone Haseltine, Junior.

—*Frank L. Campbell*

EDITORIAL COMMENT

• At the Board of Managers meeting of January 8, only one candidate was presented for Second Reading and consequent election to fellowship in the Academy. There were no candidates for First Reading.

This dearth of candidates constitutes no reflection on the Membership Committee, which within our memory has built up an enviable reputation for hard work and devotion to duty. The Committee's job is to process applications received; the generation of applications is up to the membership.

Despite the best of intentions, it is easy enough to become forgetful of the Academy's needs under the pressure of daily affairs. We share the failing. But we'd like to reform to the extent, say, of attempting once each quarter to single out a likely prospect for fellowship, selling him on the merits of belonging to the Academy, finding an application form, filling it out, and passing it along to the Membership Com-

mittee. If a hundred colleagues would join us in this resolution, we could in a short space immeasurably increase the Academy's effectiveness in representing the scientific fraternity of the Washington area.

• When the Academy's secretary, in mid-December, mailed out to the membership the ballots for election of officers and ratification of the Bylaws changes, he instructed the voters (1) to place the ballots in an inner ballot envelope, and (2) to sign the outer mailing envelope in which the ballot envelope was to be returned to the Academy office.

Compliance with these instructions was complicated by the fact that—because of one of those monumental boobos that can occur when two firms are involved in a mailing—there was no ballot envelope.

This situation undoubtedly placed considerable strain on the secretary's traditionally even disposition. The tellers, however, were provided with some free but thought-provoking and perhaps statistically significant data on the Scientific Mind at Work.

In all, 279 ballots were returned (from 24 percent of the membership): 88 percent of them were from resident active members. They may be divided into Group I (the Conscientious Ones) and Group II (the Carefree Ones).

Group I contained 121 voters who followed the instruction to sign the outer mailing envelope. Of these, 79 (65 percent) tried also to follow the instruction about the inner ballot envelope. Accordingly, perhaps visualizing the summary invalidation of their ballots by a crew of hard-hearted tellers, they hunted up their own ballot envelopes, ranging from coin envelopes on up. As an added precaution, these returns were generally accompanied by advice of the lack of a regular ballot envelope: at least one voter, however, apologized for having lost his envelope.

The remaining 42 voters in Group I apparently decided to leave bad enough alone, and forwarded their ballots loose in the outer envelope.

Group II contained 158 voters who disregarded the instruction to sign the outer mailing envelope. (Actually, the lack of signature was of no great concern to the tellers, since the secretary had thoughtfully stencilled the addressee's name on the back of each envelope, and this was taken as evidence of authenticity.) Of these, only 34 (22 percent) were sufficiently concerned with the lack of a ballot envelope to hunt up a substitute; the remaining 124 voters were content to do without.

Election Results Announced

Returns from the annual mail ballot of the membership, sent out in mid-December, were tallied by a Committee of Tellers on January 11 and reported at the Academy's annual meeting on January 17.

The balloting covered a new slate of officers for 1963, several changes in the Bylaws, and a new affiliation by a scientific society.

Benjamin D. Van Evera, George W. Irving, Jr., and Malcolm C. Henderson were re-elected president, secretary, and treasurer, respectively, without opposition.

Dean Van Evera's candidacy was necessitated by the resignation last fall of Heinz Specht, then president-elect of the Academy, who left the country to take up a post in Japan. This marks the first occasion since 1910 that an Academy president has succeeded himself.

For the post of president-elect, Francois N. Frenkiel defeated Marion W. Parker by a narrow margin. Dr. Frenkiel will automatically accede to the presidency in 1964.

John K. Taylor and Mary L. Robbins were elected managers-at-large for the period 1963-65, defeating Allen L. Alexander and Harold T. Cook.

The complete roster of officers, managers, and committee chairmen will be published in the March *Journal*.

Also voted upon, and passed by far more than the necessary two-thirds majority, were proposals to amend four articles

of the Bylaws (Articles II, III, IV, and VIII). Purpose of these revisions was to recognize two classes of membership—"fellows" and "members"—instead of one class as heretofore. The term "fellow" is assigned to present members of the Academy and to future candidates of equivalent scientific status. The term "member" will be assigned to persons interested in supporting science but not otherwise qualified for membership in the Academy.

A new edition of the Bylaws, reflecting the amendments just accepted by the membership, appears at the end of this issue.

Also in the voting, a proposal for affiliation with the Academy, of the Baltimore-Washington Section of the American Ceramic Society, was approved by a wide margin. The ceramists thus become the 29th scientific group to be associated with the Academy.

Additional Bylaws Changes Proposed

New proposed Bylaws changes, concerned with Article IV (Officers), were approved by the Board of Managers at its meeting of January 8, and will be brought before the membership in the near future for formal ratification. They will supplement the changes that were approved in December.

According to the present Bylaws, there are eight officers—president, president-elect, secretary, treasurer, editor, managing editor, archivist, and custodian of publications—of which the first four are elected by the membership and the last four are appointed. Purpose of the changes is to recognize that the four elected officers are the true officers and policy-makers of the Academy.

The changes also will reflect present Academy practice as concerns the four present appointive posts. The position of managing editor will be consolidated with that of editor: the appointment of an archivist will be made permissive rather than mandatory; and the post of custodian of publications will be abolished, since the

Academy's Proceedings and back issues of the *Journal* are now being stocked and sold by a private firm in New York.

The proposed changes are as follows:

ARTICLE IV—OFFICERS

Section 1. The officers of the Academy shall be a President, a President-elect, a Secretary, and a Treasurer. All shall be chosen from resident fellows of the Academy.

Section 2. The President shall appoint all committees and such non-elective officers as are needed 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. Unchanged.

Section 4. Unchanged.

Section 5. Unchanged.

Section 6. An Editor shall be in charge of all activities connected with the Academy's publications. He shall be nominated by the Executive Committee and appointed by the President for an indefinite term subject to annual review by the Board of Managers. The Editor shall serve as a nonvoting member of the Board.

Section 7. Delete.

Section 8 becomes Section 7. An Archivist may be appointed by the President. If appointed, he 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.

Section 9. Delete.

Section 10 becomes Section 8.

Section 11 becomes Section 9.

Section 12 becomes Section 10. 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 or more, will not be counted. The Committee of Tellers shall count the votes and report the results at the annual meeting of the Academy.

Section 13 becomes Section 11.

SCIENCE AND DEVELOPMENT

The earth's crust is 30 miles thick in eastern Colorado, 20 miles thick in the high mountains of central Nevada, and only 10 miles thick in the central valley of California. This information has resulted from seismic probings of the earth's interior, conducted under the direction of L. C. Pakiser of the Geological Survey. It is based on a network of about 2,000 recordings of seismic waves from underground nuclear and conventional explosions, extending from eastern Colorado to the California coastline, and from central Idaho to the Mexican border.

The Food and Drug Administration released new figures on January 8 on the strontium-90 content of the diet of an average 19-year old boy. They are based on "market basket" samplings in Washington, Atlanta, Minneapolis, St. Louis, and San Francisco. As of August 1962, the average daily intake from the Washington sample would have been 25.9 micromicrocuries, or about 13 percent of the radiation protection guide for average daily intake as established by the Federal Radiation Council. This represents an increase from 6 percent as reported in March, for samples collected in May, August, and November 1961. The August samples taken in the other four cities showed levels of daily intake of 12.8 micromicrocuries in San Francisco, 31.6 in Minneapolis, 19.6 in Atlanta, and 33 in St. Louis.

A cubic meter of air may contain as many as 10 million particles of ragweed pollen—a major cause of hay fever—in season, according to an article in the Smithsonian Institution's annual report by P. H. Gregory of Rothamsted Experimental Station. In addition, the air may contain spores of important plant pathogens, such as rusts and smuts of cereals, downy mildews, and mushrooms. The kind and quantity of this material varies greatly with the season, and between night and day. The periodic cycles are determined largely by meteorological conditions. Most of the spores come from plants and vegetable debris, rather than from the soil itself.

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.

GEOLOGICAL SURVEY

S. Kenneth Love was given the Department of the Interior's Award for Distinguished Service on December 12, in recognition of exceptional contributions in the field of water resources during his continuous service of over 34 years.

Edwin W. Roedder received a citation on January 2 from Secretary Udall, for his work on the Department of Interior's prize-winning film, "Eruption of Kilauea, 1959-1960."

GEORGE WASHINGTON UNIVERSITY

Provost O. S. Colclough has appointed a University Committee on Biophysics, which will function under the guidance of **Benjamin D. Van Evera**, dean for sponsored research. Members of the committee are A. H. Desmond, F. P. J. Diecke, R. C. Fowler, H. Jehle, **W. F. Sager**, and S. S. Yeandle, Jr. (chairman).

HARRIS RESEARCH LABORATORIES

Alfred E. Brown spoke before the Science Bureau of the Metropolitan Washington Board of Trade on January 8, on "Research and Development Activities in the Washington Area." Dr. Brown also addressed the Chemical Engineers Club of Washington on January 21, on "Areas of Interest of Harris Research Laboratories."

John Menkart attended a meeting of the Research Advisory Committee of the Textile Research Institute, held December 14 in Princeton, N. J.

John F. Krasny attended a Symposium on Fibrous Materials at the Biltmore Hotel in Dayton, Ohio, October 16-17.

HOWARD UNIVERSITY

Kurt H. Stern, a physical chemist at NBS, lectured to the Advanced Inorganic Chemistry Seminar on October 23, on "Electrochemistry of Fused Salt Systems."

Lloyd N. Ferguson, head of the Department, was recently appointed to the Educational Subcommittee of the Science Bureau, Washington Board of Trade. On November 16, Professor Ferguson spoke on "Bimolecular Studies of the Sense of Taste" in the seminar series of the Department of Food Science and Technology at the University of California, Davis.

Joseph B. Morris addressed the December 7 meeting of the Analytical Group of the ACS New York Section, on "The Graphite Electrode in Electroanalytical Chemistry."

George C. Turrell gave two papers at the 10th Annual Basic Research Groups Symposium at Fort Belvoir on October 9. Dr. Turrell, who has been promoted to associate professor, recently received a grant from the Air Force Office of Scientific Research, in the amount of \$37,500, for studies on spectra of compressed gases.

NATIONAL BUREAU OF STANDARDS

Recent talks by NBS Washington personnel:

W. J. Hamer: "Significance of Recent Changes in Fundamental Constants"—Mohawk-Hudson Section of the Electrochemical Society, at General Electric Research Laboratories, Schenectady; and "The Significance of Recent Changes in Fundamental Constants"—Westinghouse Electric Corporation, Research and Development Center, Pittsburgh.

H. S. Isbell: "Isotope Effects and Multiple Labeled Techniques in Biological Research"—New York Medical College, Department of Biochemistry, New York.

J. Kruger: "The Passivity of Iron"—Chemistry Department, University of Virginia, Charlottesville.

A. T. McPherson: "Some Problems in Estimating the Cost and Optimum Time of Conversion"—Annual Meeting of the Metric Association, Philadelphia.

M. D. Scheer: "Adsorption Lifetimes of Cs⁺ and Ba⁺ Polycrystalline W and Re"—Chemistry Department, Antioch College, Yellow Springs, Ohio.

J. K. Taylor: "The Establishment of Standards of Measurement"—North Carolina Committee on High School Physics, University of North Carolina, Chapel Hill.

L. S. Taylor: "Radiation Protection and Some of Its Associated and Technical Problems"—New England Roentgen Ray Society, Boston.

C. M. Tchen: "Kinetic Equations for Plasmas"—Aero Space Corporation, Los Angeles; "Interaction of the Solar Corpuscular Stream with the Geomagnetic Field" and "Landau Damping with Collective Correlations"—Jet Propulsion Laboratory, California Institute of Technology, Pasadena; and "Plasma Oscillations with the Effects of Correlations"—Lawrence Radiation Laboratory, University of California, Livermore.

Lauriston S. Taylor has been named acting associate director, succeeding **I. C. Schoonover**, who has been detailed to the Department of Commerce as acting deputy to the Assistant Secretary for Science and Technology. In his new position, Dr. Taylor will be the principal staff advisor to the director on program development, coordination, and evaluation. He will be particularly concerned with the long-range activities of the Bureau in relation to the needs of science and technology.

Julian Eisenstein, a physicist in the Cryogenic Physics Section, was recently selected first president of the Board of Trustees of the new Washington Gallery of Modern Art. One of the organizers of the gallery, Dr. Eisenstein has been working on the project for about two years.

SMITHSONIAN INSTITUTION

T. D. Stewart, director of the Smithsonian Institution's Museum of Natural

History, is author of an article on the Neanderthal men, appearing in the latest annual report of the Institution. The article is based on Dr. Stewart's restoration of two Neanderthal skulls from Shanidar Cave in northern Iraq.

USDA, BELTSVILLE

C. H. Hoffmann presented an invitational paper entitled "Biological, Chemical, and Other Specific Methods for Control of Orchard Insects" at the 58th Annual Meeting of the Washington State Horticulture Association, Yakima, Washington, on December 5. Dr. Hoffmann also was guest speaker at the first regular meeting of the Association, on December 17. He spoke on "What Can We Conclude About Pesticides—Their Necessity, Value, and Safety as Used by the Pest Control Operator."

Stanley A. Hall, chief of the Pesticide Chemicals Research Branch, has been named chairman of the Interdepartmental Committee on Pest Control.

Edna M. Buhner, nematologist of ARS, retired on December 31. She will continue to serve as corresponding secretary-treasurer of the Helminthological Society of Washington.

USDA, WASHINGTON

Justus C. Ward gave a talk on "Registration Requirements Under the Federal Insecticide, Fungicide, and Rodenticide Act Brought Up-to-Date," before the Insecticide Division of the Chemical Specialties Manufacturers Association, meeting in Washington on December 6.

Ohio State University conferred an honorary Doctor of Science degree on **Hazel K. Stiebeling** at its winter commencement on December 14.

As chairman of AAAS Section 0 (Agriculture), **George W. Irving, Jr.**, arranged for and attended the five sessions of the Symposium on Food Quality as Affected by Production Practices and Processing, as part of the 129th meeting of AAAS held in Philadelphia, December 26-30. **W. T. Pentzer**, Agricultural Marketing Service, was chairman of Session One (Fruits and

Vegetables). **Lloyd Ryall**, also of AMS, spoke on "Protecting the Quality of Fruits and Vegetables after Harvesting." **T. C. Byerly**, administrator of Cooperative State Experiment Stations, took part in Session Five (Meats), speaking on "Genetic and Environmental Factors in Development and Performance." **Frederick J. Stevenson** (retired) was coauthor of a paper on "Potato Quality as Related to Heredity and Environment."

DEATH

J. Howard Dellinger, an internationally-known physicist, died December 28 at Suburban Hospital, at the age of 76.

Dr. Dellinger was born in Cleveland in 1886. He received the A.B. degree from George Washington University in 1908, the Ph.D. degree from Princeton University in 1913, and the D.Sc. degree from GWU in 1932.

He served as a physicist at the National Bureau of Standards from 1907 to 1948. He was chief of the Radio Section from 1919 to 1946, and chief of the Central Radio Propagation Laboratory from 1946 to 1948. He conducted extensive research studies on physical, mathematical, radio, electronic, aviation, and telecommunication subjects, and was the author of 136 published articles, books, and treatises.

Among his many other activities, Dr. Dellinger was co-organizer, chairman, etc., of the Interdepartmental Radio Advisory Committee (1922-48); chairman of the International Radio Consultative Committee's study group on ionospheric radio propagation (1948-57); secretary of the Government's Liaison Committee on Aeronautic Radio Research (1929-34), and chairman of the successor group, the Radio Technical Commission for Aeronautics (1941-57); chairman of the Radio Technical Commission for Marine Services (1947-56); and member of many other Government committees and organizations on radio, electronic, aviation, and telecommunication matters in the period 1912-62.

Dr. Dellinger supervised the development of numerous basic radio aids to air

navigation, such as the directive radio beacon for airplane guidance; the airways radio range beacon system; a blind landing system; and radiosonde. During World War II he supervised the beginning of the proximity fuse project, established and directed the Interservice Radio Propagation Laboratory, and held various committee posts with defense agencies. He discovered the simultaneous occurrence of visible solar eruptions and semi-worldwide sudden radio fadeouts ("Dellinger effect"), supervised the initiation and development of the standard frequency broadcast service (WWV), and served as U.S. delegate to international radio and telecommunication conferences in many countries from 1921 to 1962.

Among his numerous organizational memberships, Dr. Dellinger was past vice-president of the Washington Academy of Sciences, and honorary president (for life) of the International Scientific Radio Union. He held many gold medals and other awards for his achievements.

CALENDAR OF EVENTS

February 18—Society of American Military Engineers

Regular luncheon meeting.

Noon, Barker Hall, YWCA, 17th & K Sts., N.W.

February 19—Anthropological Society of Washington

Gordon Gibson, Smithsonian Institution, "Fieldwork in Southwest Africa."

8:15 p.m., Room 43, National Museum, 10th St. & Constitution Ave., N.W.

February 20—American Meteorological Society

Program to be announced.

8:00 p.m., National Academy of Sciences.

February 20—American Society for Quality Control.

Joseph Steinberg, Bureau of Census, "Sampling and Automation."

6:30 p.m., refreshments; 7:00 p.m., dinner; 8:00 p.m., meeting, ballroom of Roger Smith Hotel.

February 20—Washington Society of Engineers

“Current Status of the National Fallout Shelter and Marking Programs,” by a representative of the Department of Defense.

8:00 p.m., Powell Auditorium, Cosmos Club.

February 20—Zoology Colloquium

Bernard Patten, Virginia Institute of Marine Science, “Use of Cybernetic Models in the Analysis of Community Stability.”

4:00 p.m., Room 405 McKeldin Library, University of Maryland.

February 25—American Society of Metals

Dinner meeting. J. Herbert Hollomon, Assistant Secretary for Science & Technology, Department of Commerce, “Technology and Economic Growth.”

6:30 p.m., AAUW building, 2401 Virginia Ave., N.W.

February 25—D. C. Society of Professional Engineers

Program to be announced.

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

February 26—American Society of Civil Engineers

Luncheon meeting. Maj.-Gen. Augustus Minton, “The Challenge of the Engineer in the Space Age.”

Noon, YWCA, 17th & K Sts., N.W.

February 26—American Society for Microbiology

Program to be announced.

8:00 p.m., Sternberg Auditorium, Walter Reed.

February 27—Geological Society of Washington

Program to be announced.

8:00 p.m., Powell Auditorium, Cosmos Club.

February 28—American Society of Mechanical Engineers

Program to be announced.

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

NEW MEMBER ELECTED

The following was elected to membership in the Academy at the Board of Managers meeting of January 8:

Walter G. Wadey, branch chief, Bowles Engineering Corporation, Silver Spring, Md., “in recognition of his widely recognized competence in the new field of pure fluid systems.” (Sponsors: Ronald E. Bowles, Billy M. Horton, Israel Rotkin.)

BOARD OF MANAGERS

MEETING NOTES

January Meeting

The Board of Managers held its 552nd meeting on January 8 at the National Academy of Sciences, with President Van Evera presiding.

The minutes of the 551st meeting were approved with a minor correction.

Appointments. Dr. Van Evera announced the following committee appointments for 1963: Mary L. Robbins as chairman of the Committee on Meetings, and Robert B. Hobbs as chairman of the Committee on Membership. He had appointed the following Committee of Tellers to count the ballots cast in the recent mail voting for officers and Bylaws revisions: Harry Fowells (chairman), Norman Bekkedahl, and S. B. Detwiler, Jr.

Meetings. Dr. Robbins reported that the annual meeting on January 17 would be addressed by Freeman H. Quimby of NASA (with his colleague Orr E. Reynolds if in the country) on “Biological Exploration of Space.”

Membership. No nominations were presented for First Reading.

Awards for Scientific Achievement. Chairman John S. Toll reported the following selections to receive awards for scientific achievement in 1963: *Biological sciences*, Marshall Nirenberg of NIH; *engineering sciences*, Lindell E. Steele of NRL; *physical sciences*, Edward A. Mason, University of Maryland; *mathematics*, Bruce L. Reinhart, University of Maryland; and *teaching of science*, Rev. Francis J. Heyden, S.J., Georgetown University.

(See also story elsewhere in this issue.)

Grants-in-Aid. The Board approved a grant of \$50 to Allan J. Reiter for investigation of the participation of calcium in the conversion of prothrombin to thrombin.

Encouragement of Science Talent. Dr. Van Evera read a letter from Chairman Brenner, summarizing the committee's activities over the past year, and indicating Dr. Brenner's desire to retire from his post.

Policy and Planning. Chairman Wayne Hall presented proposed changes in Article IV of the Bylaws, dealing with officers of the Academy, designed to clarify the present language and bring it into accordance with the actual practice of the Academy. The changes would recognize four officers—president, president-elect, secretary, and treasurer—who are elected by the membership. Of the four appointive offices previously recognized, the post of managing editor would be consolidated with that of the editor: the appointment of an archivist would be made permissive rather than mandatory; and the post of custodian of publications would be abolished, since the Academy's Proceedings and back issues of the *Journal* are now being stocked and sold by a private firm in New York.

Election of Member. Following the Second Reading of his name by Dr. Robbins, Walter G. Wadey was elected to membership in the Academy.

Treasurer. Dr. Henderson reported year-end cash balances as follows: Academy, \$5,681; Junior Academy, \$2,553; Joint Board on Science Education, \$8,932.

New Business. Dr. McPherson called the Board's attention to the activity report for 1962 of the New Mexico Academy of Sciences. This report stimulated a general discussion of science fairs. Dr. Schubert commented on the diminishing value of the National Science Fair in accomplishing its original purpose, alluding to the fact that

the National Science Fair is increasingly in the hands of non-scientific "professionals," and that the activities involved in these fairs detract from the general education of students. Others joined in the discussion, agreeing generally with Dr. Schubert's comments and concluding that there is less objection to the National Science Fair itself than to the way in which it is now being conducted. Dr. Allen suggested that he would prefer constructive action to correct deficiencies in the conduct of science fairs, rather than unconstructive criticism and condemnation of such fairs as they now exist. Dr. McPherson suggested that constructive action to improve science fairs might be discussed and initiated at the meeting of the Academies of Science, held annually at the AAAS meeting; the next opportunity would be at the 1963 meeting in Cleveland.

Dr. Van Evera read a letter from Dr. McPherson, concerning the desirability of considering ways to encourage the construction of a headquarters building for science and engineering activities in the District of Columbia. Dr. Brown described the current interest of the Chemical Society of Washington in this topic, and the suggestions made by Joseph Gilman of the CSW Long-Range Planning Committee, involving a multimillion dollar building underwritten at least in part by science-interested industries. There was general agreement that action through the D. C. Council, as proposed by Dr. McPherson, would be preferable to individual action by the several scientific societies in the District.

It was agreed that future Board meetings would be held at 7:30 p.m. on the second Tuesday of each month.

Secretary Irving reported that a request for affiliation of the Washington-Baltimore Section of the Electrochemical Society, made in January 1962, had been mislaid and had received no attention. The request was referred to the Committee on Policy and Planning for consideration and report at the February Board meeting.



**BYLAWS
OF THE
WASHINGTON ACADEMY OF SCIENCES**

(Last Revised in December 1962)

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: members, fellows 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.

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.

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.

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.

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.

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.

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.

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.

Section 11. Former members or fellows who resigned in good standing may be reinstated upon application to the Secretary and approval by the Board of Managers. No reconsideration of the applicant's qualifications need be made by the Membership Committee in these cases.

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 the 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.

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.

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

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 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 fellows 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. 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 12. 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.

Section 13. 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. 11). 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, Sect. 12, 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—COOPERATION

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
Washington Section of Institute of Food Technologists
Baltimore-Washington Section of the American Ceramic 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 Delegate to the Academy who is a resident member or fellow of the Academy.

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	R. D. MYERS
Anthropological Society of Washington	REGINA FLANNERY HERZFELD
Biological Society of Washington	JOHN A. PARADISO
Chemical Society of Washington	LEO SCHUBERT
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	GERHARD M. BRAUER
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
American Ceramic Society	Delegate not appointed

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

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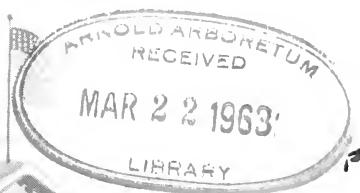
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This Journal, the official organ of the Washington Academy of Sciences, publishes historical articles, critical reviews, and scholarly scientific articles; notices of meetings and abstract proceedings of meetings of the Academy and its affiliated societies;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

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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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A Brief Look at the Dismal Swamp And Its Natural History, Especially the Insects¹

Ashley B. Gurney

Entomology Research Division, Agricultural Research Service, USDA

Introduction

The name Dismal Swamp gives a sense of mystery and foreboding to persons unfamiliar with it; but, with the exception of hunters, lumbermen, and other outdoor people in the vicinity of Norfolk, Va., few people have explored the area in sufficient detail to determine whether the name is well chosen. The Swamp appealed to my son and me as a collecting place for grasshoppers and related insects, because it is known as an area where some southeastern plants and animals reach their northern distributional limits; thus, there was a chance that species previously unknown in Virginia might be found. Further, collecting and camping trips in the Dismal Swamp afforded opportunities to see at first hand a large area which still has many attributes of a wilderness. It is an important reservoir for living things, in a period when man's penchant for radically changing landscape features and biota is well known.

Publicized by poets and tellers of fanciful tales, who have helped to give the region a wide reputation as an impenetrable morass filled with risk for the uninitiated visitor, as well as one graced with romance and mystery, the Dismal Swamp's dangers

for the traveler lost on foot have become legendary. On a hunting trip during the 1660's, the first colonial governor of North Carolina, William Drummond, found the central lake which now bears his name; however, his companions on the trip were lost. In 1728, Col. William Byrd II of Virginia led a group which penetrated the Swamp while surveying the line between the Colonies of Virginia and North Carolina. The party survived, but the rigorous ordeal caused Byrd to apply the name Dismal Swamp to the area. George Washington made seven trips into the Swamp. Together with Patrick Henry and other contemporaries, he organized a company that began to dig drainage ditches before the Revolutionary War. Dismal Town, now indicated only by historical markers beside the trail and artifacts occasionally discovered, was a settlement built before 1763 on the Washington Ditch, near the western edge of the Swamp.

Following an 1803 visit to Norfolk and the Swamp, Sir Thomas Moore wrote the ballad, "The Lake of Dismal Swamp," which was based on a romantic Indian legend. During the Civil War period, Harriet Beecher Stowe wrote a novel that pictured a runaway slave who hid in the Dismal Swamp; and Henry W. Longfellow wrote a poem on the same theme. Another writer of fiction who used the Swamp as a locale was Walter Prichard Eaton, who wrote a boys' adventure story, "Boy Scouts in the Dismal Swamp," in 1913, following an on-the-spot visit to Lake Drummond.

¹ The author and his son, Richard D. Gurney, received a grant-in-aid from the Washington Academy of Sciences in 1962 to make a preliminary survey of the Orthoptera (grasshoppers, katydids, crickets, cockroaches, mantids, walkingsticks) of the Dismal Swamp. Two collecting trips to the area were made in the summer of 1962; this article summarizes observations to date.

In the latest popular account of the Swamp, Davis (1962) summarizes the folklore as well as history and general aspects. Indeed, there is no shortage of background material for readers interested in the fictional heritage that has grown up since Washington's time.

General Description

The Dismal Swamp (Figure 1) is located southwest of Norfolk, mainly in Nansemond and Norfolk Counties, Virginia, and Camden County, North Carolina. It is the most northern of the large southeastern swamps near the Atlantic Coast. The main swamp area in Virginia is roughly 10 miles wide, with some additional outlying eastern sections. Originally, the Swamp probably was more than 20 miles wide, east to west. By 1890 it was estimated that a third of the Swamp had been drained and cleared for agricultural use; and slow but steady inroads have continued. (Pressure to further decrease the Swamp's size is discussed in *Time* for November 30, 1962, page 21.) The western boundary is the Nansemond Escarpment, the border of a prehistoric sea. White Marsh Road, the highway running south from Suffolk, on top of the escarpment, is about 45 to 60 feet above present sea level. The main swamp area is nearly level, sloping from 30 feet at the foot of the western escarpment to about 20 feet along the Dismal Swamp Canal (part of the Intracoastal Waterway system), the eastern border of the main body of the Swamp. Lake Drummond is 3 miles long, and most of it is not more than 6 feet deep.

Water runs to the Dismal Swamp Canal from the east side of Lake Drummond through the $3\frac{1}{2}$ -mile-long Feeder Ditch. A control dam maintained by men of the U. S. Army Corps of Engineers, who are constantly in attendance, regulates the water level. Several ditches drain into Lake Drummond, notably the Washington and Jericho Ditches from the northwest and the Portsmouth Ditch from the northeast. The water in Lake Drummond and the principal ditches is brown; the color comes from a large amount of woody material, including

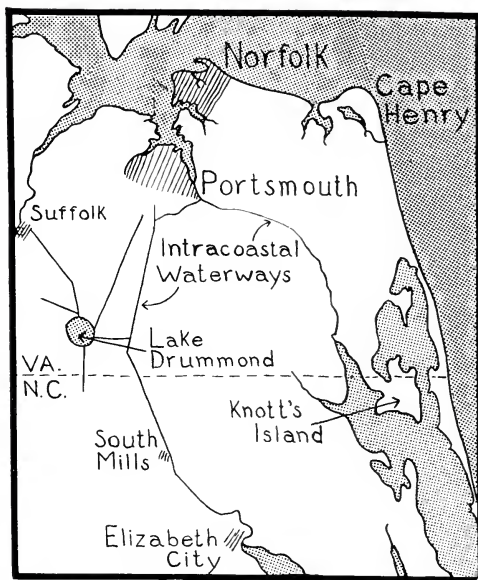


Figure 1.—Portions of southeastern Virginia and northeastern North Carolina, showing location of Lake Drummond. Except for the coastal dunes and beaches, most of this area was included in the Dismal Swamp prior to drainage and other human activities.

tannin. It does not have a pleasant taste, but is harmless. For many years casks of "juniper water," as it is called locally, were carried on ships because it remained potable for long periods regardless of its peculiar flavor. A few fish thrive in it. Along most of the ditches are trails, several of which are quite passable for passenger cars in dry weather. Until recent years, small boats in the ditches were the principal means of access to Lake Drummond. Narrow-gauge railways for bringing out logs were used for many years; but they have been largely, if not entirely, superseded by trucks that are driven on the sand roads paralleling the main ditches.

During periods of normal rainfall, many sections do not have standing water and are dry enough for foot travel. Snakes are prevalent, and include the copperhead, a rattlesnake, and the cottonmouth moccasin; here the cottonmouth is very close to its northern limit of distribution. However, we saw no poisonous snakes, and with precautions that are standard in "snake country"

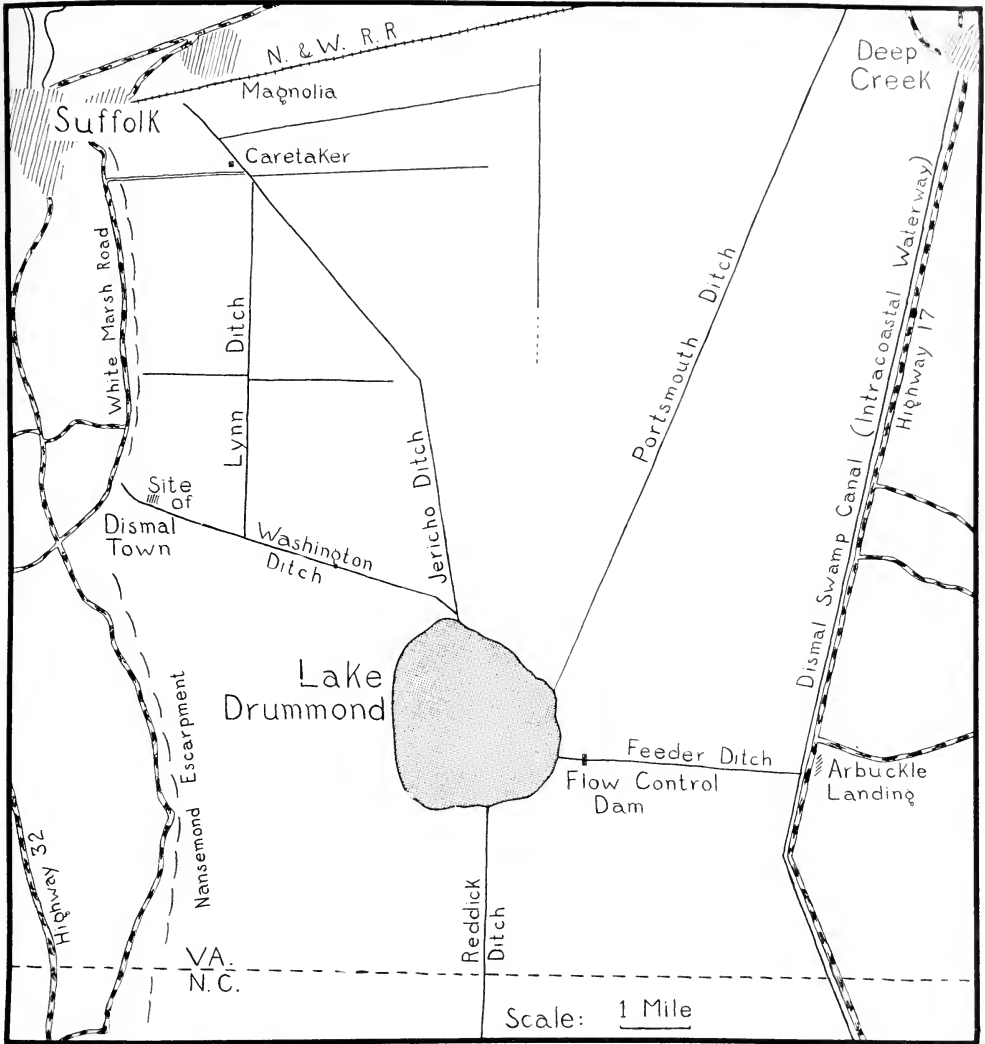


Figure 2.—Virginia portion of the Dismal Swamp. An equally large area still is swampland in North Carolina. Some ditches exist which are not shown here.

they need not be feared. In wet weather, the dirt roads are said to become impassable for ordinary passenger cars. We found sand flies (punkies, *Culicoides*) somewhat disagreeable, but did not notice many mosquitoes. Horse flies and deer flies are particularly abundant, and in early summer one of the former, the famed "yellow fly" (*Diachlorus ferrugatus* (F.)) of the Southeast, is especially annoying until its season of high adult abundance passes in early August. The chief danger lies in wandering

too far from established trails and thus losing one's sense of direction. Certainly, no extensive overland travel through the woods should be attempted without a compass, food, and a willingness to get wet.

In peat areas, fire is a constant threat when the soil surface is dry. Chickering (1873) reported seeing several fires in the peaty soil during his visit, and there have been some fires of many months' duration over the past 30 years. The summer of 1962 was so dry that in late August the

water level of Lake Drummond was at least a foot lower than in July, and a strip of lake bottom nearly a hundred feet wide was exposed along the shore at the mouth of Jericho Ditch.

Most of the Dismal Swamp is well wooded, but lumbering has eliminated most large stands of mature trees. White cedar (*Chamaecyparis*) is an important timber tree, as in swamps of the New Jersey pine barrens; it is prevalent in areas where the soil is rich in peat. There is also a great deal of rich black soil with red maple (*Acer rubrum* L.), cypress (*Taxodium*), black gum (*Nyssa*), and sweet gum (*Liquidambar*) among the dominant trees. The aerial "knees" of cypress are conspicuous in sections that are frequently flooded. The inkberry (*Ilex glabra* (L.) Gray), sweet bay (*Magnolia virginiana* L.), and many other shrubs are common along the ditches. Small bamboos (*Arundinaria tecta* (Walt.) Muhl. and *A. macrosperma* Michx.) also occur along the ditches, and in some open areas they make up small canebrakes.

Vines are abundant, and include several green briars (*Smilax* spp.), wild grape, poison ivy, honeysuckle, "rattan" (*Berchemia*), and others: the briars with prickles are a particular handicap to persons walking through the thicker vegetation of wooded areas. Spanish moss (*Tillandsia*) occurs on trees in some parts of the Dismal Swamp. We did not observe it in 1962, and so conclude that within the Swamp its distribution is spotty. We saw thriving examples of this conspicuous epiphyte attached to trees in the well-cared-for and protected Seashore State Park at Cape Henry, and at Knott's Island, both localities near the coast east of the Dismal Swamp. Spanish moss rarely occurs north of this location in Virginia.

Current Activities in the Dismal Swamp

As has been true for more than 200 years, lumbering and hunting are the principal human activities in the Swamp. However, the limited amount of merchantable timber appears to be responsible for

keeping present cutting operations at a low level. Several lumbering or paper-making firms control most of the Swamp land. For instance, one such firm manages the northwest quarter of the Swamp and maintains a cottage for a caretaker near the north end of Jericho Ditch.

The principal game animal is the deer, which is hunted primarily by groups of hunters who take stands along the trails and at other vantage points, and wait for their quarry to be flushed into a favorable position by dogs, as described in *Sports Illustrated* for November 26, 1962, pp. 68-32. Some rough foot trails lead for short distances into the woodland, but there is little direct stalking of deer off the main improved trails that parallel the ditches. A few bears are taken each year by hunters. About 20 cottages, mainly used as hunting lodges, are located on the shore of Lake Drummond; several belong to cooperative hunting clubs. Fairly good dirt roads along the ditch banks were recently developed, partly as a convenience for hunters who find them useful for access, and for hunting stands. The hunters cooperate in road maintenance and brush control with the lumber companies, which regulate the hunting rights. Some of the cottages are used during the summer by those coming to the Lake for boating and fishing. Numerous visitors to the Lake, including the curious attracted by the distinctive nature of the Swamp's legendary past, come by small boats up the Feeder Ditch from Arbuckle Landing. One local citizen there (Mr. Dunn) has an active summer business taking parties up the Ditch and around the Lake with his motorboat.

Natural History Work in the Dismal Swamp

The chief botanical survey of the area, based on field work done in 1898, is that of Kearney (1901). An earlier general account of the Swamp was given by Shaler (1890); and Chickering (1873) discussed the flora briefly. M. L. Fernald of Harvard University visited the Swamp in the 1930's, and various of his plant records are pre-

sented in a series of papers dealing with southeastern Virginia, that appeared in *Rhodora* beginning in 1935. A Philadelphia botanist, Bayard Long, collected plants as well as insects in the area. Roger Rageot, curator of natural history at the Norfolk Museum of Arts and Sciences and one of the best informed students of the Dismal Swamp, has actively collected vertebrate animals in the Swamp and adjacent areas during the past 10 years. He is particularly interested in snakes, which have attracted other herpetologists to the area. Charles Handley of the U.S. National Museum has collected small mammals.

Among entomologists who have collected in the Swamp, Austin H. Clark is best known to Washingtonians. This naturalist, well known for his broad interests and his volumes on the butterflies of the District of Columbia and Virginia, spent more than 15 years preparing (with Mrs. Clark) "The Butterflies of Virginia" (1951); he visited each of the 100 counties at least twice. One of his favorite collecting sites was a woodland road at the northwest corner of the Swamp, where by 1939 he had taken 73 species of butterflies (Clark and Clark, 1939). Other well-known collectors of Lepidoptera who visited the Swamp were Otto Buchholtz of Westfield, N. J., and Frank Morton Jones of Wilmington, Del. Charles Covell, a student at Virginia Polytechnic Institute, has made numerous visits to the northern end of Jericho Ditch, near the village of Magnolia, where he found a rich variety of butterflies. Herbert S. Barber and other Washington entomologists occasionally have visited the Dismal Swamp; but it seems fair to say that little comprehensive insect collecting has been conducted there except by the Clarks.

In recent years, the Virginia Academy of Sciences has sponsored a project on the natural history of the Dismal Swamp: and reports are being assembled for publication by J. T. Baldwin, Jr., of the College of William and Mary.

Collecting Orthoptera in 1962

In 1962 we collected in the Dismal

Swamp for several days in early July, and again at the end of August. Each time, we drove in from Suffolk to the cottage of the caretaker, Mr. Lynn (Figure 2), where permission to enter the Swamp was secured; thence we proceeded along parts of Jericho Ditch, Lynn Ditch, and Washington Ditch to the the shore of Lake Drummond, where we camped and collected insects. On each trip we later drove around to work on the eastern side near the Dismal Swamp Canal. In July we investigated the area between the Swamp and the coast, including Knott's Island and Cape Henry.² In August we collected and camped one night near South Mills, N. C., and also went by boat up the Feeder Ditch and onto Lake Drummond.

Methods of collecting Orthoptera included sweeping grasses and weeds and beating shrubbery with a net; illuminating a white sheet with a gasoline pressure lantern and a low-voltage vapor-tube light for attraction at night; setting glass jars, baited with molasses, flush with the ground surface, to attract cockroaches and crickets; and attracting cockroaches and crickets to dry oatmeal flakes on the forest floor at night—the so-called "oatmeal trail" method. Each method produced some species not obtained in any other way.

Several hundred specimens of Orthoptera, representing a total of 45 species, were obtained. Among them were 4 cockroaches (all native outdoor species), 2 mantids, 9 katydids, 11 crickets, and 19 grasshoppers. Included were three species of grasshoppers from outside the Swamp proper; they occurred only near the coast—one of them a beach inhabitant, the other two confined to the vicinity of brackish water which is not found in the Swamp itself. The Orthoptera found are mainly widespread species of the southern Middle Atlantic states, with

² On the July trip, three other entomologists participated, each with separate interests: Don R. Davis, Microlepidoptera; Oliver S. Flint, Jr., Trichoptera and Neuroptera; David C. M. Manson, general and Acarina. On the August trip, only the two Gurneys participated.

none limited to the southeastern coastal region. Judging from the species previously known to occur in Virginia and North Carolina, a dozen or two additional species probably live in or near the Swamp. No camel-crickets (*Ceuthophilus*), which are collected most readily by molasses-baited jars, were taken in spite of efforts directed to their detection. This genus is almost universally present in the Eastern states; it will be interesting to conduct more extensive trapping to determine whether the 1962 collecting was simply insufficient, or whether the Swamp is unsuited to these insects. Late August is favorable for collecting a maximum number of Orthoptera, because some species do not mature until midsummer or later. However, a few occur as adults in spring and early summer.

Faunistic Affinities of Other Dismal Swamp Insects

Most of the Trichoptera and Lepidoptera collected on our 1962 trips are fairly widespread Eastern species. One microlepidopteron, *Compsolechia coverdalella* (Kearfott), had not been recorded before from Virginia or an adjacent State, having been described from Louisiana; consequently, its occurrence in the swamp is of much interest. One trichopteron (caddis-fly), *Cernotina truncona* Ross, was described from Florida and is also known from southern North Carolina; hence, this northern extension of the range is an important addition. A second trichopteron, *Molanna uniophila* Vorhies, is known as an inhabitant of New England and nearby states, so that it is an example of a normally northern species penetrating the edge of the coastal southeast.

In his work on butterflies, Austin Clark discovered that several species occur in Virginia only in the southeastern swamps, some restricted to the Dismal Swamp, others also reaching north to the Dalm Swamp in Accomac County, on the Eastern Shore of Virginia. Clark concluded that the Dismal Swamp has a sprinkling of northern species amid the many widespread and the fairly numerous more

southeastern ones, because of pockets of cold ground water which create localized areas suitable for northern insects. He pointed out (Clark, 1937, p. 259) that oozing ground water along the western border of the Dismal Swamp produces such a situation.

A supposedly much more southern butterfly, *Strymon kingi* Klots and Clench, has been collected by Charles Covell near Norfolk. This record is a notable addition to the distributional "surprises" taken by the Clarks.

With the possible exception of butterflies, no group of insects has been collected sufficiently well in the Dismal Swamp to permit a thorough analysis of its zoogeographical affinities. The Swamp fauna appears not to be peculiar in itself, but is Lower Austral³ (Austro-riparian) in the main. Some primarily northern insect species and others, usually found farther south than Virginia, occur. This situation agrees with the conclusions of Kearney (1901), who found that the plants show a mixture of affinities but that the largest number are Lower Austral. He pointed out that some northern ferns and sedges have found in the cool, wet soil of the Swamp, a habitat that marks their most southern limits.

Refined analyses of insect distribution in the United States are still fragmentary, in spite of considerable scattered information in literature and large but incompletely studied collections in museums. Some species that appear to be freaks of distribution, when first found in an area far from the usual range, later prove to be very widespread. Insects of the Dismal Swamp well illustrate this point. There simply has been too little comprehensive collecting to support final conclusions as

³ Lower Austral is the term given by C. Hart Merriam many years ago to the Life Zone which comprises most of the southern United States, particularly in the Southeast, minus the tropical portion of peninsular Florida. Along the Atlantic Coast, this zone extends northward to approximately the mouth of the Potomac River.

to number of species present or distributional relationships, beyond the general impressions which now are evident. Even if a thorough survey were made, it could be fully meaningful only after the entire eastern fauna is better understood than it is at present.

The Dismal Swamp is an interesting place to collect insects, and for most groups has a rich fauna which will well repay the serious collector for his efforts. With the rapid elimination of many excellent collecting grounds and the problem of finding large natural habitats for undisturbed work, it is stimulating to have this fine, unspoiled region nearby.

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The Personal Side of a Research Project

Archibald T. McPherson *

Associate Director, Office of Technical Services, Department of Commerce

This is a story from real life about Richard, Daniel, their mother, and a series of studies on field mice. Also concerned in the story are the boys' father, whose job keeps him away from home much of the time, a curator of the Smithsonian Institution, and other scientists.

The Committee on Grants-in-Aid of Research is presenting this story because all too often the human side of research is left unrecorded. Only occasionally, by reading between the lines of published reports, is it possible to conjecture some of the many problems, difficulties, and disappointments that were encountered, and some of the rewards and satisfactions that came from doing the work. The principal characters in this story have cooperated in preparing this account, and it is presented, for the most part, in their own words. The Com-

mittee hopes that this account may aid in stimulating the collaboration of sons and daughters with scientist parents in worthwhile original investigations.

Background

The Mother speaks: "It would be very convenient for me if I could say that I set out deliberately to prepare my two sons for careers in science, but such is not the case so this article is difficult to write.

"Just as scientific discoveries can seldom be foreseen, likewise just which contact or combination of circumstances will be the 'magic button' that releases the latent capabilities of a child cannot be predicted. Sometimes it may not be what we do, as parents, but what we do not do that brings results. With this in mind, I shall try to give an account of our efforts.

"Since I have been a bird bander for the Fish and Wildlife Service for 13 years on a voluntary basis, the boys were aware

* Dr. McPherson is chairman of the Academy's Committee on Grants-in-Aid of Research.

more than most children of the problems connected with research. They saw the reams of records which had to be kept faithfully and the constant vigilance that had to be maintained to keep stray cats and dogs from harming the birds in traps and nets. Also, they knew that their mother worked hard without pay while other working mothers in the neighborhood bought expensive toys for their children and lived in houses whose living rooms could almost hold their entire home. For me there was no choice. I had to pursue the mystery of 'where the wild bird flieth.' Also, next to baseball, both boys enjoyed the birds and found their greatest enjoyment in bird walks and family outings with the Virginia Society of Ornithology."

How the Project Started

In his request for a grant from the Washington Academy of Sciences, Richard describes the beginning of his project very concisely as follows: "I first became aware of the rodent situation at Dulles Airport during a field trip with the Northern Virginia Chapter of the Virginia Society of Ornithology in November 1959, on which I saw a large concentration of hawks and short-eared owls. While observing the birds of prey, I noticed that the ground was honeycombed with runs and small holes. Mice were seen running everywhere. I asked Dr. C. O. Handley, Jr., mammalogist of the U. S. National Museum, to suggest a science project. He said, 'You are *standing* on the best one I know of.' I took his suggestion and began an intensive study of the mouse eruption."

The Mother fills in the details: ". . . . Since the boys had always pretended that they could not take a tangled bird out of a net, their decision to study the mouse eruption at Dulles Airport was not met with any enthusiasm from me. The difficulty of working 20 miles from home and checking traps at least twice a day and the problem of getting back to school on time, made the idea seem too ambitious and too costly for boys who had never done any serious work before. But something

happened to them on that cold, gray November morning in 1959 as we stood on ground spongy from mouse runs and watched the hawks and owls wheel and swoop for their prey. The study of ecology had real meaning for them for the first time. So dramatic was nature's performance that a curiosity was born that no practical consideration could dampen.

"They were adamant. I was equally determined that it should be a real scientific study and not just another science project. Because Dr. Handley was leaving for Panama shortly, I told them that we would cooperate if they met certain conditions. First, it had to be a joint project and each had to keep meticulous daily notes as a check on each other's accuracy. Finally, I was not going to skin a single mouse!

". . . . Since then I have had reason to regret that last statement. Several times when they have been bowed down with routine assignments, I have suggested that I could do some trapping. 'And what would you do with the specimens, Mother?' was the reply in such a condescending manner, that I have not had the nerve to reply, 'You could teach me.'"

Conduct of the Investigation

Richard describes the purpose and method of the investigation in impersonal terms as follows: ". . . . The purpose of my investigation was: (1) To compare the density of mice per acre at Dullas Airport with acres of similar habitat away from the airport. (2) To determine the extent of the eruption. (3) To follow any relative change in the population. (4) To find the predator-prey relationship between the short-eared owl and the mice. (5) To determine, if possible, the cause of the mouse eruption.

"*Methods.* The density studies were performed by using saturation trappings, which consists of setting 100 traps per acre for three consecutive nights. This is the standard method of determining the number of small mammals per acre. 'Museum Special' snap traps were used. These are similar to ordinary household mouse

traps but are larger. They are designed to kill the mouse in such a manner that the skull is not crushed, as the skull is most important in the identification of a mammal.

"Moistened oatmeal was used for bait, and the traps were checked at least once a day. The extent of the eruption was calculated by making local inquiries, by observing birds of prey, and by trapping. The progress of the eruption was determined by trapping in different areas over a period of two years.

"Specimens of each species caught were carefully measured and preserved by skinning according to museum standards and deposited in the collection of the U. S. National Museum, Washington, D. C.

"The predator-prey relationship between the short-eared owl and the mice was determined each winter by an analysis of short-eared owl pellets. A pellet is a cylindrical piece of undigested hair and bone which is regurgitated by the owl."

The results of the investigation will not be given here, since they have been published in *The Junior Science and Humanities Symposium Brochure* (Walter Reed Army Institute of Research, Washington, D. C.). Richard comments on the investigation as follows: ". . . . One of the most rewarding byproducts of the study was the trapping of rare mice. While trapping on one of the comparative acres on January 3, 1960, the first record of the eastern harvest mouse, *Reithrodontomys humulis*, was obtained for Fairfax County since 1902. An article on this mouse was published in the November issue of the *Journal of Mammalogy*. On December 7, 1960, the first specimens for Virginia of the prairie deer mouse, *Peromyscus maniculatus bairdii*, were taken on Site 'E' at the airport. In August of 1961, I caught an abnormally white-spotted meadow jumping mouse, *Zapus hudsonius*, 1.1 miles south-southwest of Merrifield, in Fairfax County, Virginia. The specimen was requested by the U. S. National Museum and represents the only one in their collection."

The discovery that the prairie deer mouse had migrated eastward to Virginia was reported by Daniel in the *Journal of Mammalogy* (Vol. 43, p. 98, February 1962), as follows:

"Ever since the prairie deer mouse, *Peromyscus maniculatus bairdii*, started its march eastward, it has been the subject of many biological papers as it was captured in new states. From our trapping data in northern Virginia, *bairdii* now appears to have become established in the State. (William H. Stickel (Proc. Biol. Soc. Wash. 64:25) reported that Osgood (1909) only knew this mouse from Central Ohio, but by 1949 it had spread to the states of Pennsylvania, West Virginia, New York, Tennessee, and Maryland.)

"The first four Virginia specimens of *bairdii* were trapped 2.6 miles north-northwest of Chantilly at the Dulles International Airport on an abandoned field, sloping down to Cub Run, with moderately thick cover of grass and weeds. Dr. Handley confirmed our identification and suggested further trapping. After line-trapping in adjoining fields with his help, it was concluded that the mice probably had moved into the area recently. But they are now established in view of their relative abundance and distribution."

Extension of the Investigation

Richard entered Randolph-Macon College at Ashland, Va., in the fall of 1962. His mother reports that ". . . . he is enjoying his courses in biology and history. He misses dinner sometimes in order to spend five hours or more in the laboratory. His professor has bought traps and other supplies so that he can make a collection of mammals for Hanover County while he is at college. . . ."

Daniel, who had been working with Richard, continued the study of Virginia field mice over a larger area, with the assistance of a grant from the Washington Academy of Sciences. In Daniel's words: "After I trapped the prairie deer mouse near Warrenton on Route 17 in August, I decided to undertake a more ambitious

study. As you know, Route 17 runs SE down the middle peninsula to Gloucester County. I now plan to use an old farm house there as 'home base' and trap in the counties of Essex, Middlesex, Mathews, King and Queen, and Gloucester. No work has been done at all in this area and two weekend trips have already yielded new records for *Zapus*, *Blarina*, and *Reithrodontomys*. Dr. Handley is especially interested in obtaining specimens of *Blarina* from the Tappahannock area. In this way I can add to the study of mammals in general while still studying *bairdii* in particular."

The Parents' Part in the Investigation

A paper by Daniel on "The Prairie Deer Mouse in Northern Virginia" contains an acknowledgment to his mother for checking traps while he was at school, to his father for typing the manuscript, and to Dr. Handley for assistance in the identification of specimens. This brief acknowledgment only hints at what went on in the field work or the impact on the home life. The Mother tells more about this as follows: ". . . As a parent, one of my tasks has been to convince the teachers that the field study of mammals is important enough to warrant taking time out from school. This is especially true since Daniel has been working 100-140 miles from home this fall. Again it takes time to convince the owner of the area on which you wish to trap that you are serious. With the sunlight already fading, Daniel has to start his trap line while I try to find the owner. We always find people cooperative, but it does take time to answer questions and to reassure them.

"When working in unfamiliar territory, in order to conserve both time and expense, it is of practical importance to be able to select the most productive habitats. Here is where past experience and keen observation pay off. Such things as amount and type of cover, number of years a field has been fallow, and the glimpse of a hawk may tell as much as actual examination for runs and other mammal signs. No less

important are the nuisance factors to be avoided in order to obtain the maximum 'catch.'

"As to the use of the refrigerator for specimens, etc., we have given the boys the privilege of using anything in the house needed for their study. In return they have given us their confidence and the comfort of their presence while they were engrossed in their work. It is true that my living room, in addition to being strewn with bird feathers and wet leaves, now has boxes of pinned insects on the table and the piano seems to be the favorite display place for the last collection of mammals. Also there are strings of small skulls hanging in the basement and a colony of dermestid beetles live in a tin under Daniel's bed."

Consequences of the Study

The boys received awards in Science Fairs and recognition in the Future Scientists of America contest, but their Mother states: "Both boys consider the following their best prizes: (1) The privilege of going with Dr. Handley on a two-week collecting trip to southwest Virginia last June; and (2) the opportunity of working on a natural history inventory of Wildcat Mountain near Warrenton, Va. under the direction of Dr. Raymond Fosberg." Further, she notes, ". . . I do not know whether they will ever be true research scientists and work in a laboratory and make a big salary as most people envision, but they are developing strength of character and work habits which are important no matter how they may have to make a livelihood."



MARCH MEETING

(472nd Meeting of the Washington Academy of Sciences)



SPEAKER: Raymond J. Seeger

Special Assistant to the Director,
National Science Foundation

SUBJECT: On the Sociology of Science

DATE: Thursday, March 21, 1963
8:15 P. M.

PLACE: John Wesley Powell Auditorium, Cosmos
Club
2170 Florida Avenue, N. W.

Abstract of Address—Science for the sake of science is not sufficient, though necessary, for its own growth; science for the sake of man is a *sine qua non*. Why, then, does the sociology of science lag behind the increasing role of science in society? Is it because sociology itself is not properly a science? What, indeed, is a science? To what extent, if any, can the development of science be planned? Is the obvious lag owing to different systems of social thought being too intimately related to the philosophy of science, too deeply embedded in the technology of society? How can the history of science and technology be of assistance in our attempt to achieve a more scientific understanding about science as a social phenomenon?

The Speaker—Born in Elizabeth, N. J., Raymond J. Seeger received the B.A. degree from Rutgers University in 1926 and, in 1929, the Ph.D. degree from Yale University, where he was a Loomis fellow. He holds honorary D.Sc. degrees from Kent State University and Duquesne University. He began his professional life as an associate professor of physics, first at Presbyterian College in South Carolina, then, from 1930 to 1946, at George Washington University. Then followed six years with the Naval Ordnance Laboratory. In 1952 he went to the National Science Foundation, assuming his present position of special assistant to the director in 1962. He has continuously maintained contact with the academic world, and is now adjunct professor of physics at American University. Dr. Seeger spent his sabbatical leave last year at the University of Oxford, studying not only theoretical physics but also his other absorbing interest, the history and philosophy of science.



THE BROWNSTONE TOWER



Wishing to write on legislative matters, a field in which I, like most scientists, am not at home, I consulted my old friend, Joseph S. Lawrence, M.D., who before his retirement was the

lobbyist for the American Medical Association in Washington. He knows how important it is to inform Congressional leaders of the significance of technical bills while they are in committee. A professional man of wisdom and integrity, he represented the medical profession in the public interest and performed a real public service. He responded most cordially to my request for help.

I told Dr. Lawrence that some of the leaders of the Washington Academy of Sciences are concerned about a current bill (S.533) that is intended "to provide (by regulation and enforcement) for the humane treatment of vertebrate animals used in experiments and tests by recipients of grants from the United States." We doubt, I said, that the Committee on Labor and Public Welfare, to whom the bill was referred, will have a complete picture of the possible consequences of such legislation unless interested and knowledgeable scientists take the trouble to tell the committee what effect it would have, if passed, on them and their work. Dr. Lawrence advised that a representative of the Academy should visit the chairman to discuss the bill, and that the president of the Academy should request in writing that the chairman invite a representative of the Academy to testify, if and when hearings are held. Informative letters to the chairman from individual users of laboratory animals also will be helpful. Please remember that these proposed actions would not interfere with the legislative process but would

assist it; that the right to be heard is also a civic duty.

Now I should like to comment on S.533 and similar bills. The intent of these bills is worthy; no normal person would deliberately cause unnecessary pain in any animal. But by implication the bill charges all users of laboratory animals with acts of cruelty, which, it implies, can be prevented only by policing the users and threatening them with the loss of grant funds if they do not comply. The Committee in charge of the bill needs to know whether this alleged cruelty actually exists and to what extent, with respect to what animals, used for what purposes. And what criteria are used to draw the conclusion that the animals are actually suffering "pain and fear"? Presumably the proponents of the bill can supply such information.

If considerable demonstrable abuse of animals is found, the next question to ask is whether the objective of protecting the animals cannot be attained by the preparation and dissemination of information and recommendations: for example, by the Department of Health, Education and Welfare; the Institute of Laboratory Animal Resources, NAS-NRC; or the Animal Care Panel. This would be a positive step that would recognize the humanity of most scientists and technicians and would assume that existing abuses are the result of ignorance or carelessness. Corrective supervision by professional personnel might be anticipated, since the best scientific results are to be expected from "contented" animals. The Animal Care Panel, as the name implies, is trying to improve animal care not only for humanitarian reasons but also because sound animals give reliable results. There needs no Government appear with a big stick to force users of animals to do what is obviously to their advantage. If education in animal care and treatment is believed to be insufficient to take care of the situation, the Government might be helpful by offering support for the im-

provement of housing and equipment used in care and treatment of animals.

Nevertheless, the Committee may be persuaded that users of laboratory animals are irresponsible and that nothing but strict licensing and policing of their work will give real protection to the animals. In that case the Committee should know what this proposed regulatory activity will cost in terms of money and of scientific manpower and, more important, what effect it may have on medical research and training, and indirectly on public health. Investigators and teachers subject to the harassments of licensing, record keeping, and reporting will not be able to do as much work as they could without it. Indeed, their incentive and motivation may be considerably dampened. I repeat, every user of laboratory animals should tell the Committee on Labor and Public Welfare how this bill, if passed, would affect him and his work. Then the well-informed Committee can decide whether the gain that might be made under the bill would justify the cost of it.

—*Frank L. Campbell*

LETTER TO THE EDITOR

Prospect Harbor, Maine
January 29, 1963

Dear Sir:

On my return from a conference with the Department of Economic Development in Augusta, I was much pleased to see that you had transmitted my offer of assistance to those who may contemplate visiting Maine this coming summer to observe the eclipse. For more specific information regarding sites for observations and weather probabilities, you may care to refer your readers to a series of articles in the Decem-

ber 1962, and January and February 1963 issues of *Sky and Telescope* (Sky Publishing Company, 49 Bay State Road, Cambridge 38, Mass.). The last of these contains important notice that Acadia National Park has set aside certain areas as reserved for exclusive use of scientific parties with programs of observation, and that space may be applied for by addressing Harold A. Hubler, superintendent, Acadia National Park, Bar Harbor, Maine.

In addition, this material is supplemented by information which is now being assembled for general distribution by the Department of Economic Development free on request. It is also contemplated that about May 1, a special strip map of the path of totality will be available, showing not only the principal highways, but also the byways leading to favorable sites.

You have my present geographic position correctly stated, but for 24 hours prior to the eclipse this will be approximately lat. $44^{\circ} 21' 04.530''$ N, long. $68^{\circ} 13' 37.542''$ W (North American datum of 1927) or in other words, the top of Cadillac, as Mr. Hubler has asked me to assist in looking out for parties that make reservations for space.

It certainly would be a pleasure to meet members of the Academy, and I appreciate your conveying this thought to your readers.

Sincerely,

Carroll F. Merriam

(Mr. Merriam refers to the total solar eclipse that will occur on July 20, 1963: the path of totality will pass through the neighborhood of Prospect Harbor. (See also the January issue of this *Journal*, page 11.) On the day of the eclipse, Mr. Merriam will be stationed, not at Prospect Harbor, but rather atop Cadillac Mountain (el. 1530 feet), which is located within Acadia National Park, about 2.5 miles SbyW of Bar Harbor. —Ed.)



WASHINGTON ACADEMY OF SCIENCES

ORGANIZATION FOR 1963

Officers

<i>President</i>	BENJAMIN D. VAN EVERA	George Washington University (FE 8-0250 X681; home CL 6-3298)
<i>President-Elect</i>	FRANCOIS N. FRENKIEL	David Taylor Model Basin (EM 5-2600 X292; home WO 6-2344)
<i>Secretary</i>	GEORGE W. IRVING, JR.	Department of Agriculture (DU 8-5134; home OL 2-8564)
<i>Treasurer</i>	MALCOLM C. HENDERSON	Catholic University (LA 9-6000 X313; home CO 5-1252)

Managers

<i>Term through</i>		
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)
1965	JOHN K. TAYLOR	National Bureau of Standards (EM 2-4040 X7855; home WA 7-4659)
1965	MARY L. ROBBINS	George Washington University (FE 3-9000 X510; home OL 2-5410)

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 John K. Taylor and Russell B. Stevens for the Board of Managers.)	
Meetings	MARY L. ROBBINS	George Washington University (FE 3-9000 X510; home OL 2-5410)
Membership	ROBERT B. HOBBS	National Bureau of Standards (EM 2-4040 X478; home OL 4-6042)
Awards for Scientific Achievement	To be appointed.	
Grants-in-Aid of Research	ARCHIBALD T. MCPHERSON	Office of Technical Services, USDC (EM 2-4040 X7218; home WH 2-4065)
Policy and Planning	To be appointed	
Encouragement of Science Talent	REV. FRANCIS J. HEYDEN, S.J.	Georgetown University (FE 7-3300 X577)
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 HAROLD T. COOK RICHARD P. FARROW RUSSELL B. STEVENS JOHN K. TAYLOR LAWRENCE A. WOOD	National Academy of Sciences Department of Agriculture National Canners Association George Washington University National Bureau of Standards National Bureau of Standards

Summary Annual Report of Secretary for 1962

The Secretary's annual report of Academy activities in 1962 is intended to supplement, and in some instances summarize, detailed reports of other officers and committee chairmen.

Membership. The following changes in membership occurred between the secretary's report in January 1962 and January 31, 1963: Sixty-nine new members qualified for membership; thirty-five members resigned and four were dropped from the rolls; seven members changed to emeritus status; eighteen members changed from resident to nonresident with four reversing the process, changing from nonresident to resident status.

The following deaths were reported on the dates indicated where known: Ray S. Bassler, October 3, 1961; Charles S. Gilman, January 25, 1962; W. F. G. Swann, January 29, 1962; L. B. Tuckerman, February 4, 1962; Oscar S. Adams, March 4, 1962; Eugene C. Sullivan, May 12, 1962; Erich Mosettig, May 31, 1962; Arthur C. Christie, Maurice B. Linford, William D. Strong and Harry Wexler.

Meetings. Except for the November and March meetings of the Academy, all regular meetings in 1962 were held in the John Wesley Powell Auditorium of the Cosmos Club. The November meeting was held in the lecture hall of the National Academy of Sciences, and the March meeting at the Carnegie Institution of Washington.

Philip H. Abelson, retiring president, addressed the 463rd regular meeting of the

Academy on February 15, 1962, on the subject, "Long Term Fate of Biochemicals."

"Energetic Particles Near the Earth," was the subject of the address of James A. Van Allen of the State University of Iowa, at the 464th meeting on March 22.

The 465th meeting of the Academy on April 19 was sponsored jointly with the Washington Junior Academy of Sciences. The speaker was Prof. Samuel Bilenberg of Columbia University, on the subject, "New Horizons in Pure Mathematics."

Marshall Nirenberg of the National Institutes of Health (winner of the 1962 WAS award for scientific achievement in the biological sciences), addressed the Academy at its 466th meeting on May 17, on "Characteristics of Genetic Coding Units."

In view of the great interest in insecticides as a result of the publication of Rachel Carson's book, "Silent Spring," President Van Evera, acting as Meetings Committee chairman, arranged a panel discussion for the 467th meeting on October 18, on the subject, "Insecticides: Benefit or Peril?" Clarence Hoffman of the Agricultural Research Service, USDA, spoke of the benefits; Walter Dykstra of the Fish and Wildlife Service, Department of the Interior, spoke of the perils; and Russell Stevens of George Washington University served as a "neutral."

Merredith P. Crawford of George Washington University, director of HumRRO, was the lecturer at the 468th meeting of

the Academy of November 28. His subject was, "Practical Aspects of Behavioral Sciences."

John D. Hoffman of the National Bureau of Standards, who received the Academy's award for scientific achievement in the physical sciences in 1961, was the lecturer at the 469th meeting of the Academy on December 20, on the subject, "The Crystallization of Linear Polymers with Chain Folding."

The 470th meeting of the Academy on January 17, 1963 was concerned with the "Biological Exploration of Space," presented by Freeman H. Quimby of the National Aeronautics and Space Administration.

The annual dinner, usually held in January and devoted to listening to the retiring president, was held this year on February 21, 1963; this situation was made possible and reasonable because B. D. Van Evera, president for 1962, succeeded himself as president for 1963. Featuring the dinner was the presentation of Academy awards for scientific achievement in 1962 to: Marshall Nirenberg of the National Institutes of Health (biological sciences); Lindell E. Steele of the Naval Research Laboratory (engineering sciences); Bruce L. Reinhart of the University of Maryland (mathematics); Edward A. Mason of the University of Maryland (physical sciences); and Rev. Francis J. Heyden of Georgetown University (teaching of science).

Miscellany. One of the highlights of the year was a dinner on April 4 at Georgetown University, arranged by Abner Brenner, chairman of the Committee for the Encouragement of Science Talent, to

honor outstanding high school science students. Forty-four certificates of merit and technical books of their choice were presented to these students. The program included presentation of the certificates and books by President Van Evera, and a talk by Chester Page on "Mathematics: A Useful Game."

Upon recommendation of the committee headed by A. T. McPherson, the Academy's Board approved nine grants-in-aid for aspiring young scientists to pursue personal science projects, and authorized the American Association for the Advancement of Science to disburse \$740.00 for this purpose.

The Academy operated most of the year without a president-elect, since the incumbent, Heinz Specht, was sent to Japan by the Office of International Research, and will remain there for two years.

Volume 52 of the Academy's *Journal* appeared during the year, in nine issues having a total of 228 pages. Eight of the issues, as in 1961, 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. The ninth issue appearing in September, contained a directory of the membership, classified alphabetically, by place of employment, and by membership in affiliated societies. It is expected that the directory will continue as a regular annual feature of the *Journal*, rather than as an occasional separate publication as in previous years.

—George W. Irving, Jr., Secretary, 1962



Summary Annual Report of Treasurer for 1962

Washington Academy of Sciences

Statement of Receipts and Disbursements

Receipts

Dues:			
1961	.....	\$ 52.50	
1962	.....	8,790.75	
1963	.....	167.75	\$ 9,011.00
Subscriptions to <i>Journal</i> :			
1961	.....	36.75	
1962	.....	735.25	
1963	.....	925.50	
1964	.....	13.50	
1965	.....	6.75	1,717.75
Sales of back issues of <i>Journal</i>			1,289.57
Sales of <i>Journal</i> reprints			247.90
Miscellaneous sales			45.65
Meetings and committees			521.75
Tax reimbursement			117.32
Grants reimbursed			750.60
Dividends and interest			2,951.30
Capital receipts			752.93
Reimbursements and refunds			136.26
Junior Academy receipts undistributed			190.00
Total receipts			\$17,732.03
Balance carried forward from 1961			5,680.70
Total			\$23,412.73

Disbursements

Journal:			
Printing and mailing 8 budgeted issues plus directory (September) issue		\$6,941.36	
Reprints	.....	406.80	\$ 7,348.16
Secretary (printing and office expenses)			1,133.25
Treasurer (printing, postage, miscellaneous)			142.14
Meetings Committee:			
Rental of Cosmos Club auditorium	.....	1,307.46	
Printing, notices, etc.	.....	800.74	2,108.20
Outright grants:			
Joint Board	.....	500.00	
Academy conference	.....	21.62	
Summer education program	.....	200.00	
Science talent activities	.....	250.00	
Junior Academy Proceedings	.....	68.17	1,039.79
Reimbursable grants:			
Loguirato	.....	41.60	
Smul	.....	39.00	
Gurney	.....	150.00	
Thomas	.....	75.00	
Steakley	.....	75.00	
Peacock	.....	100.00	
Tibbits	.....	54.00	
Curtis	.....	200.00	690.60

Headquarters office:

Supplies, postage, equipment (purchase of duplicator and adding machine shared with Joint Board)	1,174.42	
Salaries (assistant treasurer and occasional help)	2,449.96	3,624.38
Taxes (withholding on social security, Federal income, D. C. income):		
Academy	439.64	
Advance to Joint Board (reimbursable)	1,283.25	1,722.89
Science talent awards, dinner, etc.		210.95
Science calendar		74.00
Refunds (back issues of <i>Journal</i> not available)		91.85
Packing expenses (reimbursable)		264.92
Miscellaneous		34.78
Total		<u>\$18,485.91</u>
Balance carried forward to 1963		4,926.82
Total		<u>\$23,412.73</u>

Income Account

Receipts, less capital and Junior Academy	\$16,777.10	Expenditures	\$18,473.91
Accounts receivable:		Accounts payable:	
Joint Board	\$ 200.00	Joint Board, 2/5 of exec. secy's salary	1,256.66
Joint Board taxes	1,404.25	Joint Board, taxes on same	120.40
W. J. Johnson	309.00		
	<u>1,913.25</u>		
Sub-total	\$18,690.35		\$19,850.97
Excess exp./rec.	1,160.62		
	<u>\$19,850.97</u>		

Cash Account

		1/1/62	12/21/62
Cash balance in bank		\$5,680.70	\$4,926.82
Capital cash received		752.93	
Accounts payable		1,377.06	
Accounts receivable			1,913.25
Junior Academy funds		190.00	
Excess exp./rec.			1,160.62
		<u>\$8,000.69</u>	<u>\$8,000.69</u>

Membership and Dues

New members, 1962: Elected, 59; qualified, 47.

Delinquent (billed for third time 12/14/62):		Retired:	
1960 or previous	6	Paying \$2.00	1
1961	15	Paying \$3.75	4
1962	<u>62</u>		5
	83	Dues excused, 1962	22
Life members	10	Dues paid:	
		1962	904
		1963	21
			<u>925</u>

Investments

Dividends Received

Massachusetts Investors Trust (plus 107 shares @ 1633.20)	\$ 831.49
Investment Company of America (including capital gains dividend 382.16)	584.48
State Street Investment Company (plus 3 shares @ 106.50)	65.53
Washington Mutual Investment Fund (including capital gains dividend 847.50)	1,423.80
Discount earned on Treasury bills	34.00
Total	<u>\$2,939.30</u>

Capital Funds

(as of 1/4/63)

2829 shares Massachusetts Investors Trust @ 13.42 bid	\$37,965.18
1124 shares Investment Company of America @ 9.54	10,722.96
61 shares State Street Investment Company @ 35.50	2,165.50
1695 shares Washington Mutual Investment Fund @ 9.91	16,797.43
Capital cash (sold \$800 New York City Corporate Stock, 6/20/62)	752.93
Income cash	4,173.89
Total	\$72,577.89

Summary of Assets

(market value and cash)

	1/1/62	12/21/62
Stocks	\$78,117.38	\$67,651.07
Cash	5,680.70	4,926.82
Total	\$83,798.08	\$72,577.89

Joint Board on Science Education

Balance carried forward from 1961	\$10,077.46
Receipts:	
From National Science Foundation	\$18,600.00
Other	456.60
Total	\$19,056.60
Expenditures (paid through WAS)	20,202.38
Balance carried forward to 1963	\$ 8,931.68

Assets

	1/1/62	12/21/62
Cash in checking account	\$10,077.46	\$8,931.68

Washington Junior Academy of Sciences

	Savings account	Checking account	Total
Balances carried forward from 1961	\$2,149.28	\$ 403.25	\$2,552.53
Receipts	1,090.64	5,129.72	6,220.36
Total	\$3,239.92	\$5,532.97	\$8,772.89
Expenditures (paid through WAS)	1,800.00	5,183.38	6,983.38
Balance carried forward to 1963	\$1,439.92	\$ 349.59	\$1,789.51

Assets

Cash in checking and savings accounts	\$1,789.51
On deposit with WAS	190.00
Total	\$1,979.51

—Malcolm C. Henderson, Treasurer, 1962

1963 Budget Approved

The following budget for 1963 was approved by the Board of Managers at its meeting of February 12. For comparative purposes, estimated and actual figures for 1962 also are included.

	1962 estimated	1962 actual	1963 estimated
Receipts			
Dues	\$ 9,930	\$ 9,011.00	\$ 9,050
<i>Journal</i> subscriptions, back issues, reprints	3,500	3,300.87	2,000 ^{1,2}
Interest, dividends	4,000	2,939.30	2,000
Services to Joint Board	200	0.00	400
Receipts from meetings, committees, dinners	0	521.75	500
Acct. receivable from W. J. Johnson, Inc.	0	0.00	309
Estd. sales of back issues by W. J. Johnson, Inc.	0	0.00	50
	<hr/>	<hr/>	<hr/>
Total	\$17,630	\$15,772.92	\$14,309
Expenses			
<i>Journal</i> printing, addressing, postage, miscellaneous	\$ 6,500 ³	\$ 6,941.36 ⁴	\$ 8,000 ⁴
Reprints	0	406.90	0 ²
Grants	1,205	1,324.74 ⁵	1,300
Meetings Committee (hall, refreshments, etc.)	1,700	2,108.20	2,500
Secretary (printing, mailing, list maintenance)	2,500	1,133.25	1,000
Treasurer (headquarters office equipment, printing, mailing, etc.)	980	1,316.56 ⁶	1,000
Part-time assistant treasurer and occasional help in headquarters office	2,880	2,889.60	3,000
Executive secretary at Academy headquarters ⁷	2,000	1,377.06	1,000
Miscellaneous debits (packing, tips, Christmas fund, parking, taxis, etc.)	100	379.55 ⁸	100
	<hr/>	<hr/>	<hr/>
Total	\$17,865	\$17,877.22	\$17,900

¹ Sale of back issues is now handled by W. J. Johnson, Inc., of New York City.

² Reprints are eventually a reimbursable item, and are omitted in 1963.

³ Eight issues, not including Directory issue.

⁴ Nine issues, including Directory issue.

⁵ Breakdown: Committee on Science Education, for summer program, etc., 784.79; Committee on Encouragement of Science Talent, 406.60; Committee on Awards for Scientific Achievement, 54.35; science calendar, 74.00.

⁶ About \$380 was paid for adding machine, duplicator, etc., which are shared with the Joint Board.

⁷ Represents two-fifths of salary in 1962, one-fifth in 1963.

⁸ Of this, \$264.92 is a non-recurring packing expense, for which the Academy is to be reimbursed.

Summary of Journal Operations for 1962 (Volume 52)

(At the beginning of 1962, the Board approved a budget item of \$6,500 for eight issues of the *Journal* (January through May, and October through December); it later authorized publication of a ninth (September) issue, containing the directory of members. These nine issues contained 228 pages of text, as compared with 148 pages for eight issues in 1961.)

	1962, eight budgeted issues	1962, directory issue	1962, total	1961, eight issues
Expenses ¹				
Composition	\$2,793.11	\$ 28.00	\$2,821.11	\$2,401.48
Printing and binding	2,441.62	515.00	2,956.62	2,047.13
Engraving	346.84	0.00	346.84	90.28
Addressing and mailing (excludes list maintenance)	144.73	18.73	163.46	150.56
Mailing envelopes	57.75	0.00	57.75	43.00
Postage deposits	110.20	63.82	174.02	125.00
Staff expenses	41.61	0.00	41.61	4.72
IBM services	0.00	359.07	359.07	0.00
Directory questionnaire, etc.	0.00	89.83	89.83	0.00
Total	\$5,935.86	\$1,074.45	\$7,010.31	\$4,862.17
Income Credits ²				
Subscriptions			\$1,717.00	\$2,382.20
Sale of back issues			1,238.07	617.00
Total			\$2,955.07	\$2,999.20
Reprints ³				
Reprint income received			\$ 246.90	\$ 249.34
Plus reprint income due			296.40	21.40
Minus reprint costs			493.20	254.20
Net reprint income			\$ 50.10	\$ 16.54
Summary				
<i>Journal</i> expenses			\$7,010.31	\$4,862.17
Minus income credits			2,955.07	2,999.20
Minus income on reprints			50.10	16.54
Net cost of <i>Journal</i>			\$4,005.14	\$1,846.13

¹ *Obligated* in year.

² *Received* in year.

³ Income *earned*, expenses *obligated* in year.

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 management teams at David Taylor Model Basin on January 17; the title of his talk was, "Systems Approach to Management of Research and Development." On January 11 Dr. Gibson addressed an audience at the Catonsville (Md.) Community College on the subject, "Cultural Implications of Scientific Research."

A. M. Stone participated in the Strategy for Peace Conference at Airlie House, Warrenton, Va., January 24-26.

DEPARTMENT OF AGRICULTURE

A. L. Ryall served as a U.S. delegate to the United Nations Conference on Application of Science and Technology for the Benefit of Less Developed Areas, held in Geneva February 2-19. He was discussion leader of sessions on transportation of perishables, and on handling, storage, and processing of agriculture produce.

Karl H. Norris was recently awarded a USDA Certificate of Merit for his achievements in the development of instruments and techniques for rapid, nondestructive measurement of quality in agricultural commodities.

John W. Mitchell was recently selected as one of the original 12 for the new Alumni Hall of Fame at the University of Idaho.

GEOLOGICAL SURVEY

S. Kenneth Love has received a distinguished service citation from the Department of the Interior, in recognition of exceptional contributions in the field of

water resources during continuous service of more than 34 years in the Geological Survey.

GEORGE WASHINGTON UNIVERSITY

B. D. Van Evera and President Thomas H. Carroll visited George Washington University research units at Fort Knox, Ky., Fort Bliss, Texas, and the Presidio of Monterey, Calif., during the last two weeks of December.

W. F. Sager of the Department of Chemistry gave a talk on application of linear free energy relationships to biochemical systems, at the Chemistry Seminar, Catholic University, on January 4.

HARRIS RESEARCH LABORATORIES

Milton Harris participated in a conference on Engineering Education and the Development of Industrial Technology on January 29, at a meeting of the Commission on Engineering Education in Washington.

Milton Harris and **Alfred E. Brown** attended the annual meeting of the Gillette Company directors of research on January 23-25; this year the meeting was held at the Paper Mate Laboratories in Santa Monica, Calif.

On the same trip, Dr. Brown also visited USDA's Western Regional Research Laboratory at Albany, Calif., and gave a seminar on technical activities at HRL.

NATIONAL INSTITUTES OF HEALTH

Aaron S. Posner has been appointed chief of the newly-established Crystal Chemistry Section of the Laboratory of Histology and Pathology, National Institute of Dental Research. Before joining the NIDR staff in June 1961, Dr. Posner was an American Dental Associa-

tion Research Associate at the National Bureau of Standards.

NAVAL RESEARCH LABORATORY

William A. Geyger has been named as the outstanding writer of a technical paper on instrumentation for 1962, by the Institute of Electrical and Electronics Engineers. Dr. Geyger received \$100 and a certificate of award at the winter meeting of IEEE on January 28. The paper was entitled, "The Ring-Core Magnetometer—a New Type of Second Harmonic Flux-Gate Magnetometer."

Horace M. Trent, chief of the Applied Mathematics Staff, is presently serving a three-year term as a member of the Council of Acoustical Society of America. Dr. Trent has been invited to spend 16 weeks at Dartmouth College, commencing February 3, in a study of the basic curriculum of the Thayer School of Engineering.

Peter King, associate director of research for materials, recently completed the Weapons Orientation Advance Course at Sandia Air Force Base, Albuquerque, N.M.

SMITHSONIAN INSTITUTION

Richard S. Cowan has been moved from the Department of Botany, where he was associate curator of phanerogams, to the Director's Office, where he is assistant director. **Waldo R. Wedel** is the new head curator of anthropology, succeeding **T. D. Stewart**, who was recently made director of the Museum. Dr. Wedel was formerly curator of archeology. **Clifford Evans** succeeds Dr. Wedel as curator of archeology, having been an associate curator in that Division.

The following scientists have recently joined the staff of the Smithsonian's Museum of Natural History:

Richard E. Norris, formerly professor of botany at the University of Minnesota, as associate curator, Division of Cryptograms.

Stanley H. Weitzman, formerly of the Department of Anatomy, Stanford

University, as associate curator, Division of Fishes.

UNIVERSITY OF MARYLAND

New faculty appointments to the Department of Physics and Astronomy include **William C. Erickson**, as associate professor of astronomy, and **Charles A. Misner**, as associate professor of physics. Dr. Erickson, a radioastronomer, was senior staff scientist at Convair Astronautics in San Diego, Calif., where he built and used a large antenna for radioastronomy. Dr. Misner comes to the staff from Princeton University, where he has been active in studies on general relativity and quantum field theory.

Several visiting professors have been added to the staff for the 1963 spring semester, as follows:

L. Woltjer, professor of astrophysics at the University of Leiden, Holland, as visiting professor of astronomy;

Frank B. McDonald of NASA's Goddard Space Flight Center, as part-time visiting professor of physics;

A. A. Jaffe, a nuclear experimentalist, as visiting associate professor of physics;

David Korff, as visiting assistant professor of physics;

Dan W. Schlitt, a quantum field theorist, as visiting assistant professor of physics;

Carl E. Fichtel of NASA, as visiting lecturer in the program of the Center for Atmospheric and Space Physics.

DEATH

Herbert E. Merwin, a petrologist with the Carnegie Institution's Geophysical Laboratory for 36 years, died on January 28, aged 84. He retired in 1945, but remained a research associate with the Laboratory until 1959. He was particularly interested in volcanic and hot spring deposits, the relationship among volcanic rocks, and the optical properties of crystals and pigments. Dr. Merwin, a native of Newton, Kans., received his bachelor's and doctor's degrees from Harvard University.

CALENDAR OF EVENTS

March 11—Institute of Radio Engineers

Luncheon meeting, co-sponsored by IRE-PGEM and D.C. Science Chapter, Armed Forces Management Association. James Holahan, associate editor of *Space Aeronautics*, "A Primer on Space Flight Physics."

11:30 a.m., Knickerbocker Restaurant, 5510 Connecticut Ave., N.W.

March 11—American Society of Civil Engineers

Dinner meeting. Program to be announced.

6:30 p.m., Powell Auditorium, Cosmos Club.

March 11—American Society for Metals

Dinner meeting. Program to be announced.

6:00 p.m., AAUW Building, 2401 Virginia Ave., N.W.

March 11—Society of Photographic Scientists and Engineers

"Cronar Conversion Film."

8:15 p.m., National Academy of Sciences, 2101 Constitution Ave., N.W.

March 12—American Institute of Chemists

Luncheon meeting. George J. Rotarin, Division of Isotopes Development, AEC, on industrial uses of atomic energy.

Presidential Arms, 1320 G St., N.W.

March 13—Institute of Environmental Sciences

Annual meeting. Election of officers; review of the year's activities; preparation for national meeting (April 17-19).

8:00 p.m., National Housing Center, 1615 L St., N.W.

March 13—Geological Society of Washington

Program to be announced.

8:00 p.m., Powell Auditorium, Cosmos Club.

March 14—American Society of Mechanical Engineers

Program to be announced.

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

March 18—Society of American Military Engineers

Luncheon meeting. Program to be announced.

Noon, YWCA, 17th & K Sts., N.W.

March 19—Anthropological Society of Washington

Edward T. Hall, Washington School of Psychiatry, "Field Methodology in Proxemics."

8:15 p.m., Room 43, National Museum, 10th & Constitution Ave., N.W.

March 20—American Meteorological Society

Program to be announced.

8:00 p.m., National Academy of Sciences, 2101 Constitution Ave., N.W.

March 20—Washington Society of Engineers

Jack E. Walters, "Painting for Fun."

8:00 p.m., Powell Auditorium, Cosmos Club.

March 20—American Society for Quality Control

Dinner meeting. Victor Shellburne, quality control supervisor, Atlantic Research Corporation. "Characteristics of Production Weighing Accuracy." Tour of ARC facilities.

7:00 p.m., Atlantic Research Corporation, Shirley Highway at Edsall Rd., Alexandria, Va.

March 25—American Society of Photogrammetry

29th Annual Meeting, March 25-28, Shoreham Hotel. Also, the 23rd Annual Meeting of the **American Congress on Surveying and Mapping** will be held March 26-29.

March 25—D. C. Society of Professional Engineers

Program to be announced.

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

March 26—American Society of Civil Engineers

Luncheon meeting. Program to be announced.

Noon, YWCA, 17th & K Sts., N.W.

March 26—American Society for Microbiology

Program to be announced.

8:00 p.m., Sternberg Auditorium, Walter Reed Hospital.

March 27—Geological Society of Washington

Program to be announced.

8:00 p.m., Powell Auditorium, Cosmos Club.

March 28—American Society of Mechanical Engineers

Annual elections.

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

**JOINT BOARD ON
SCIENCE EDUCATION**

**Frontiers of Science
Lectures Scheduled**

The Joint Board announces that its annual Frontiers of Science lectures will be held during March, April, and May, in the Biology Building auditorium at Howard University. Howard E. Finley of Howard's Zoology Department, chairman of the JBSE Frontiers Committee, has arranged the outstanding program outlined below.

March 16—"Tekites and the Moon", by John A. O'Keefe, Goddard Space Flight Center.

April 13—"What Color Do You Really See?" by Z. V. Harvalik, Basic Research Group, Engineering and Development Laboratories, Ft. Belvoir, Va.

April 27—"Medicinal Chemistry," by Samuel Massey, Grants Division, National Science Foundation.

May 18—"Life in the Tropics, Parasites Permitting," by D. R. Lincicome,

Zoology Department, Howard University.

All sessions are scheduled to begin at 10:30 a.m. on the indicated dates: no tickets are required. This is the only series of lectures, and students from the entire Metropolitan Area junior and senior high schools are invited to come. This is in contrast to other years, when lectures were scheduled in several locations of the area.

A printed announcement of these lectures has been prepared and will be distributed for bulletin-board posting in the schools. Teachers are requested to urge their students to attend.

ES&A Day Science Teacher Awards

The Joint Board on February 20 presented Distinguished Teacher Awards to 12 science and mathematics teachers of the Washington area, and cited 62 others for outstanding accomplishment in teaching. Presentations were made at the annual Engineers, Scientists, and Architects Day luncheon, held at the Presidential Arms.

Both groups received Certificates of Citation as evidence of their teaching accomplishments. In addition, the award winners will receive an air trip to New York City, to visit the scientific and engineering laboratories of the International Telephone and Telegraph Company and the Bell Telephone Company. This will afford an opportunity to view the latest developments in many fields of science and technology.

Presentation of awards and citations to outstanding teachers is a major feature of ES&A Day, cosponsored by the D. C. Council of Engineering and Architectural Societies and the Washington Academy of Sciences. It is a method of recognizing the prime importance of good teaching in the advancement of these professions. Teachers receiving the honors are nominated by their principals, as well as by leading engineers and scientists of the community. A panel of distinguished members of these professions makes the selection of the award winners.

The judges noted that nominations were

well distributed geographically among elementary, junior high, and senior high schools of the Washington area. Participation by parochial and private schools was greater than in previous years. The nominations indicated high interest on the part of school principals, and attested to the depth and activity of the teachers themselves. A growing improvement was noted particularly in the basic educational qualifications, pursuit of additional courses, and ingenuity and resourcefulness of elementary school teachers in the inspiration of their students and getting scientific principles across.

Distinguished Teacher Award Winners

Sister Catharine Virginia, Academy of Notre Dame, Washington
 Col. Kenney T. Brunsvold (USA Retd.), St. Stephen's, Alexandria
 Arthur B. Bauley, Richard Montgomery High, Rockville
 Pamela Hanrahan, Oxon Hill Senior High, Oxon Hill
 Bertha H. Hall, Eliot Junior High, Washington
 Mabel Sturm, North Bethesda Junior High, Bethesda
 Sterling M. Derricotte, Hine Junior High, Washington
 Donald Buttermore, Gunston Junior High, Arlington
 Margaret K. Noble, Congress Heights Elementary, Washington
 Ann P. Faulconer, McKinley Elementary, Arlington
 Nancy K. Peirce, Beltsville Elementary, Beltsville
 Mrs. Ritchie B. Mathews, Wyngate Elementary, Bethesda

Recipients of Citations

Elementary School Teachers

Fredna D. Beluc, Crestwood (Fairfax); David Mason, Tall Oaks (Prince Georges); Elizabeth M. Conroy, Stephen Knolls (Montgomery); Mr. N. J. Poulos, Columbia Park (Prince Georges); Avis E. Dolecek, Forest Heights (Prince Georges); Elizabeth Reynolds, Somerset (Montgomery); Mrs. Richard B. Palmer, Connecticut Park (Montgomery); Elizabeth M. Pearson, Herndon (Fairfax); Mary K. Ewing, Belvedere (Fairfax); Frances C. Triplett, Annandale (Fairfax); Patricia S. Scharr, Camp Springs (Prince Georges); Alice E. Grizzard, Keene Mill (Fairfax); Pauline D. Powell, Randolph (D.C.); Catherine Readyhough, Woodley Hills (Fairfax); Rebecca Evans, Garfield (Fairfax); Louise Mullendore, Parkwood (Montgomery).

Nettie J. Hooks, Jennie Dean (Manassas); Eloise Hauver, Highland View (Montgomery); Mary G. Butler, James Monroe (D.C.); Alma Evensta, Georgetown Day School; Ruth H. Brewer, Fairlington (Arlington); David A. Mitchell, Suitland (Prince Georges); Mary Lou Munsey, Pine Spring (Fairfax).

Junior High School Teachers

Barbara Jureidini, Williamsburg (Arlington); Col. K. B. Potter, Flint Hill Private School; Leola W. Headley, Alice Deal (D.C.); Garland C. Dardee, Washington Irving (Fairfax); Elizabeth S. Smith, Terrell (D.C.); Robert L. Thompson, Henry Thoreau (Fairfax); Charles Coblentz, Broome (Montgomery); Mrs. Laurine C. Decker, Takoma Park (Montgomery).

Roland Foskey, Glenridge (Prince Georges); James C. Bryant, H. W. Longfellow (Fairfax); Mrs. Jo. Torpy, Jefferson (Alexandria); Evelyn H. Reid, Montgomery Hills (Montgomery); Sylvia H. Peppers, Taft (D.C.); Mrs. Marion B. DeBerry, Banneker (D.C.).

Senior High School Teachers

Thomas C. Beavers, Gar-Field (Prince William); Susan E. Aud, Montgomery Blair (Montgomery); Mr. Amil Jinar, Bladensburg (Prince Georges); Eugene W. Skinner, Luther Jackson (Fairfax); Edith M. Elliott, McLean (Fairfax); Theodore D. Lewis, Jr., Northwestern (Prince Georges); Bro. E. Stephen, FSC, Bishop O'Connell; Ruth Dial, Wakefield (Arlington); George B. Griswold, J.E.B. Stuart (Fairfax); Emily Lampert, Mt. Vernon Seminary.

Ruth M. Nelson, Calvin Coolidge (D.C.); Sister Marceline, S.P., Immaculata; Dorothy M. Allen, M. M. Washington Vocational (D.C.); Jane M. Randle, Lackey, (Charles County); John M. Woolford, Bethesda-Chevy Chase (Montgomery); Edward F. Scott, DuVal (Prince Georges); Melba B. Robinson, McKinley (D.C.); Bro. Eugene Peter, FSC, St. Johns; Earl Shaw, Damascus (Montgomery); Helen Iddings, George Washington (Alexandria); Louis R. Perkins, Dunbar (D.C.); Beatrice V. Barnes, Anacostia (D.C.).

—John K. Taylor

SCIENCE AND DEVELOPMENT

Several medical research seminars for teenage scientists were recently held at the National Institutes of Health and the Naval Medical Center. Presented by the Montgomery County Tuberculosis and Heart Associations, in cooperation with the National Heart Institute and the Naval Medical Center, they dealt with congenital heart disease, cause and treatment of hypertension, hypercholes-

terolemia and artery disease, and the kidney. Over 600 Montgomery County high school science students attended the four seminars; last year about 360 students participated.

“Friendship 7”, the first United States manned orbital spacecraft, officially became a part of the National Aeronautical and Space Collections of the Smithsonian Institution at a presentation ceremony on February 20. The ceremony marked the first anniversary of the historic flight of Astronaut John H. Glenn; the presentation was made by Hugh L. Dryden, deputy administrator of the National Aeronautics and Space Administration. The spacecraft will be placed on permanent display in the Air and Space Building of the National Air Museum.

The Ford Foundation has granted \$200,000 to NAS-NRC to support an examination of the nation’s utilization of its scientific and engineering manpower. Clark Kerr, president of the University of California, is chairman of a special committee that is conducting the study. The 16-member committee includes representatives of each of the three sectors of national life directly concerned—colleges and universities, industry, and the Government. Staff director for the committee is Richard H. Bolt, associate director for planning, National Science Foundation.

A new hall, “Life in the Sea,” was formally opened on February 18 at the Museum of Natural History. The exhibits attempt to show how some of the world’s marine animals—from the largest to the smallest—look in life; how they are adapted to resist the physical forces of their environment, to elude their enemies, and to reproduce, and how their existence benefits or harasses man. A unique feature is a life-size model of a blue whale, the largest mammal that has ever lived. It is 92 feet long, and represents a living whale that weighed about 135 tons.

BOARD OF MANAGERS MEETING NOTES

February Meeting

The Board of Managers held its 553rd meeting on February 12 at the National Academy of Sciences, with President Van Evera presiding.

The minutes of the 552nd meeting were approved with a correction. (Minutes as shown in February issue, page 49, have been corrected.)

Appointments. Dr. Van Evera announced that Father Francis J. Heyden would serve as chairman of the Committee on Science Talent. W. C. Brombacher has been appointed chairman of the Auditing Committee, with Carl L. Aslakson and Norman F. Braaten as members.

He also announced that the Executive Committee would meet regularly at noon at George Washington University beginning February 27, and thereafter every month on the Wednesday following the general meeting; and that the Committee would assume responsibility for more of the operating problems of the Academy, thus freeing the Policy and Planning Committee for other assignments. The Executive Committee will develop an agenda for the Board meeting to follow; this will be mailed to Board members with the meeting notice and minutes of the previous Board meeting.

Treasurer. Treasurer Henderson reported the following balances for January 1963: Washington Academy, \$6,756.65; Joint Board, \$7,923.77; Junior Academy, \$4,097.30. Dr. Henderson also filed with the secretary the treasurer’s annual report for 1962, which was to be summarized for the general meeting on February 21. (See also elsewhere in the present issue.)

Budget. The budget for 1963 was presented by the treasurer. (See elsewhere in this issue.) A question was raised by Dr. Saville concerning the budgeting of \$8,000 for the Journal; this was explained by Editor Detwiler as due primarily to the extra cost of printing a directory issue.

Also, Messrs. Saville and Weil questioned the policy of budgeting capital gains as operating income. It was moved by Weil that as a matter of policy, capital gains be considered by the treasurer as investment rather than operating funds. An amendment was offered by Saville, that the action proposed in the motion be considered as discretionary, subject to change by the Board as circumstances dictate, to avoid handicapping operations; but that it is desirable to increase the Academy's capital against the future, when sizeable commitments may need to be made for building costs. The motion was passed as amended.

The Board thereupon approved the proposed budget, as it will need to be modified by the action taken above.

Meetings. Chairman Robbins announced that the annual dinner and presentation of awards would be held on February 21. The March 21 meeting will be addressed by Raymond J. Seeger of the National Science Foundation, on the subject, "On the Sociology of Science." Members of the Committee on Meetings have not yet been appointed.

Membership. Chairman Hobbs presented the names of three candidates for resident fellow, for First Reading.

Dr. Hobbs announced that one new member, Donald H. Williams, had been elected by unanimous vote of the Committee. (Election of *members* is accomplished by a favorable vote of at least two-thirds of the Committee on Membership. Mr. Williams is the first official *member* of the Academy under the new membership rules.)

Dr. Hobbs asked and was answered affirmatively, "Can the Membership Committee offer membership to nominees who do not qualify for fellow, if the sponsors of the nominee do not wish to appeal directly to the Board?" Also, Dr. Van Evera asked Dr. Hobbs to consider and report at the next Board meeting what, if anything, the Academy should do to notify the former members of the Academy that they have become fellows under the change of membership rules.

Grants-in-Aid. On motion of Chairman McPherson, the Board approved a grant of not over \$50 to Myron Givits of Anacostia High School, to defray the cost of polishing a crystal for a ruby laser; it was understood that the grant would be made only after receipt of supporting information from Mr. Givits and Mr. Hopkins, assistant science director of D.C. Schools.

Editor. Editor Detwiler reported that the February issue of *The Journal* was about to go to press, featuring articles on the Academy's award winners, on lasers, and on Mr. Haseltine of the *Washington Post*.

New Business. The Board approved a motion for affiliation with the Academy of the Washington-Baltimore Section of the Electro-chemical Society.

The Board approved the recommendation of the Executive Committee, that Mr. Detwiler be continued in office for another year as editor and managing editor of *The Journal*.

Dr. Van Evera asked for an expression of opinion concerning the need for several committees, as follows: (1) Ways and Means Committee (no apparent need for one now); (2) Publicity Committee (probably no need for one now, but the suggestion was made that Dr. Henderson explore the possibility of obtaining occasional newspaper publicity about Academy affairs); (3) committee to consider what to do for or with affiliates of the Academy (consensus was that this might be desirable, and the suggestion was made that we explore the desirability of making certain meetings of the Academy, joint meetings with appropriate groups of affiliated societies); (4) committee to explore whether there are other societies that should be invited to affiliate with the Academy (reaction favorable).

Dr. Campbell suggested the desirability of having the Academy take a position and communicate it to the Congress, on bills now pending concerned with the care of laboratory animals. Dr. Van Evera expected to appoint a committee to prepare a statement for review by the Board.

**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	LEO SCHUBERT
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	GERHARD M. BRAUER
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
American Ceramic Society	Delegate not appointed

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

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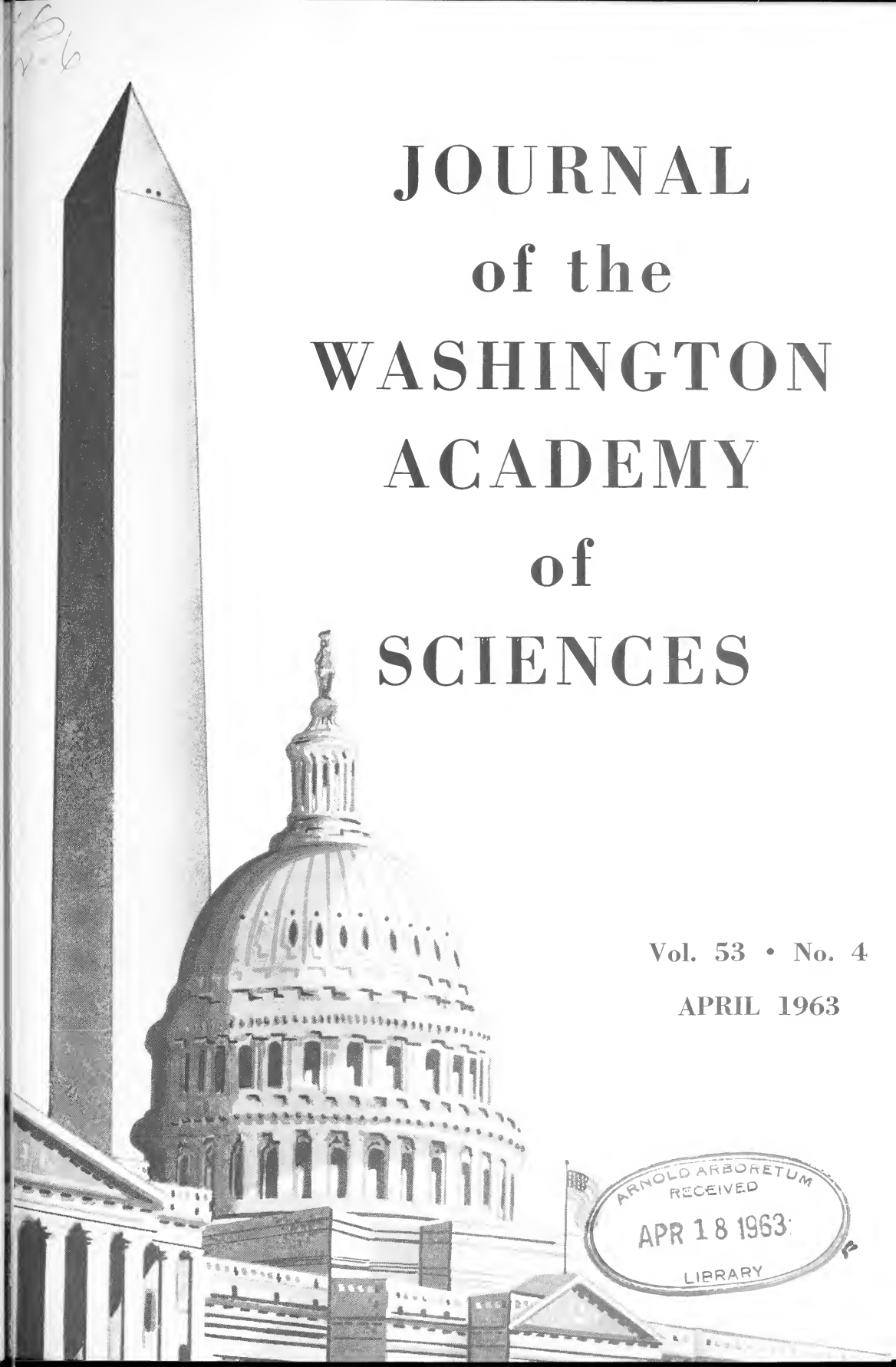
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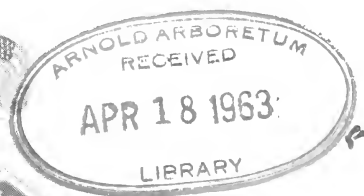
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This Journal, the official organ of the Washington Academy of Sciences, publishes historical articles, critical reviews, and scholarly scientific articles; notices of meetings and abstract proceedings of meetings of the Academy and its affiliated societies;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

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

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Agricultural Research: The First and Second Hundred Years*

Theodore C. Byerly

Administrator, Cooperative State Experiment Station Service, USDA

The centenary of the Morrill Act, which established the foundation for our Land Grant College system, is drawing to a close. We have come a long way. During the first hundred years, we have increased our farm output by five times and our farm input by two-and-a-half times, and thus have doubled our efficiency. Increase in efficiency of use of manpower on farms has been much greater than the increase in efficiency of all inputs. In 1860, one farm worker supplied farm products for 4.5 persons; in 1961, one farm worker supplied 27.4 persons, or about six times the 1860 rate. We almost doubled man-hour output on the farm during the fifties. Application of technology developed through information produced by research in the Land Grant Colleges and the USDA was a major factor, in that it increased efficiency. It is reasonable to suppose that we can double efficiency again in the next 100 years, if we continue to accelerate research achievement.

P.L. 84-352, the Hatch Act of 1887 as amended in 1955, states in Sec. 2—"It is also the intent of Congress to assure agriculture a position in research equal to that of industry, which will aid in maintaining an equitable balance between agriculture and other segments of our economy. It shall be the object and duty of the State Agricultural Experiment Stations through the expenditure of the appropriations hereinafter authorized to conduct original and other researches, investigations and ex-

periments bearing directly on and contributing to the establishment and maintenance of a permanent and effective agricultural industry of the United States, including researches basic to the problems of agriculture in its broadest aspects, and such investigations as have for their purpose the development and improvement of the rural home and rural life and the maximum contribution by agriculture to the welfare of the consumer, as may be deemed advisable, having due regard to the varying conditions and needs of the respective States."

The law further states, Sec. 7—"It shall be the duty of the Secretary to furnish such advice and assistance as will best promote the purposes of this Act, including participation in coordination of research initiated under this Act by the State Agricultural Experiment Stations from time to time to indicate such lines of inquiry as to him seem most important, and to encourage and assist in the establishment and maintenance of cooperation by and between the several State agricultural experiment stations, and between the stations and the United States Department of Agriculture."

The terms of reference of the Hatch Act provided well-tested guidelines for effective research for the past 75 years. What steps must we take to assure the future?

I have stated the improvement in efficiency of production we have achieved. As consumers, this has benefited all of us. On the average, each of us spends about \$75 less per year for food than would have been necessary at production efficiencies of 20 years ago. A large portion of our

* Condensation of speech before the annual meeting of the Experiment Station staff, Mississippi State University, December 5, 1962.

increase in efficiency has been achieved by increasing yield per acre, yield per annual breeding unit, and yield per unit of feed used. Since our land area is limited, we must continue to increase yield if our population continues to grow. Population of the USA has never taken longer than 50 years to double—this longest period was 1900-1950. A present reasonable population projection is that there will be a third more people in 1980 than there are now, and perhaps twice as many in the year 2000.

We have also increased the convenience of our food supply. We have processed, packaged, frozen, or concentrated many of our foods so that working wives and mothers can prepare good meals with a minimum of time and effort. Recent studies indicate that convenience foods constitute about 4 percent of total food sales in U.S. grocery stores and that they are on the average, no more expensive than the same foods purchased in original condition and prepared in the kitchen.

But enough of the past; the benefits of past achievements will continue but they will not be enough. We have problems. I shall discuss four very broad ones: first, research necessary for the sustained productive use and conservation of soil and water; second, research to develop more effective materials and methods for protection of crops and livestock against pests, including insects, diseases, parasites and weeds, and environmental hazards, e.g. air and water pollutants; third, secure adjustment of agriculture within the economy; and fourth, the stabilization and enhancement of product quality.

Use and Conservation of Soil and Water. We in the U.S. have enough good cropland for the present and the next generation. We have a total of 636 million acres of land in land-capability classes I—III, which may be used regularly for crop production. We harvested crops from only about half those acres last year. We have enough land and water for production of food, fiber, and forest products, wildlife,

recreation, and open space. We will continue to have enough only if we continue to gain new research knowledge and apply it.

Agriculture uses most of the land surface and most of the water—uses them lavishly. Growing crops, forests, and pastures return great quantities of moisture to the air by transpiration from their leaves. When plants are most actively forming and storing materials as seed, leaf, root, or fiber, they use most water. During warm weather, evaporation helps keep the leaf cool enough to stay alive. But we do not know how much transpiration is necessary for maximum plant efficiency. Recent studies at the Connecticut Experiment Station have demonstrated that a chemical may be used to regulate the stomatal openings on leaf surfaces, thus regulating the rate of transpiration. Use of this and other tools will help us determine how much reduction in transpiration is compatible with efficiency. Since plants vary widely in transpiration rate due to the nature of the leaf surface, from hydrophytic or phreatophytic to xerophytic, we have ample room for genetic modification, too.

If we can find ways to increase output per unit of water used, and ways to enhance production during periods of drought, we can plan more effective use of land and water. Of equal importance, as we learn the principles governing the movement of water with and through the many kinds of soils, we shall become capable of draining, irrigating, or cultivating the suitable soils effectively, and shift to alternate uses those not suited to cultivation.

Crop and Livestock Protection. Protection of crops and livestock against pests and environmental hazards presents many challenging problems. Recent research of the Cotton Insect Laboratory in Mississippi has isolated a chemical from the cotton plant which enables the boll weevil to recognize the cotton plant. This is a most important step toward selective control of the boll weevil. Analogous research at the Wisconsin Station has identified a substance

attracting termites to wood. The sex attractant of the gypsy moth has been synthesized, and provides a powerful tool for determining infestation of our woods with this defoliating pest. Attractants provide one means of reducing amount of insecticides required for control, as well as aids to more selective effects on insects.

We are beginning to learn about the immuno-genetic relations between host and parasite. Flor, a USDA phytopathologist stationed at the North Dakota Station, and his colleagues demonstrated a common chemical component in susceptible host flax and virulent flax rust. Genetic resistance is a major defense against cereal rusts, and against corn borers, Hessian flies, and several alfalfa insects, too.

The 1961-62 report of the CSIRO in Australia contains an intriguing note on an antifungal agent produced by infected peas. The compound, named "pisatin," has been established as 3-hydroxypterocarpin, an isoflavonoid. Pisatin is a weak antibiotic effective against a wide range of fungi. It is significant that fungi pathogenic for peas tolerate higher concentrations of pisatin than other pea fungi, although both pathogens and nonpathogens induce the formation of pisatin.

We are learning more about animal immunity, too. Some of the parthenogenetic turkeys produced by Olsen at Beltsville have been used in transplantation studies, being of special interest since they have a single parent. Studies on the use of radio-mimetic drugs which suppress the defense mechanism by which cells reject foreign cells, as does radiation in appropriate dosage, include 6-mercapto purine reported from the Prairie View Station in Texas.

Research at the Oregon Station has identified a microorganism, *Micrococcus radiodurans*, which is highly resistant to radiation. From cultures of this organism, a substance has been isolated which affords partial protection against radiation to mice injected with it.

Economic Adjustment. Of the third problem, economic adjustment, much has

been said. Too little recognition has been given to the enormous adjustments farmers have made. These include the doubling of the nation's beef cow herd during the past 20 years—a beef cow instead of a horse during much of the period, but a beef cow for a milk cow for the past several years. The growth of the broiler industry from about 40 million in the mid-thirties to about 2 billion now is more spectacular. While the beef enterprise has taken over our grazing land, broilers have provided a market for the feed grown on more than 5 million acres of cropland. Soybeans have increased in acreage from near nothing to more than 25 million acres. From the economic standpoint, yield of beef per head of cattle on hand January 1, has increased from about 200 pounds in 1929 to almost 300 in 1960. During the past few years, the proportion of beef and dairy cows has changed rapidly. In 1945, 60 percent of our cows were kept for milk; in 1961, 60 percent were beef cows.

For all livestock, we have doubled the output per animal breeding unit since 1919, while the number of animal breeding units has remained about the same.

While feed efficiency of broiler production has almost doubled during the past 30 years, efficiency of feed used in beef production has changed but little. Our course for the future, if we are to produce domestically the beef we want, presents no alternative to the necessity for improving feed efficiency. Questions we must ask and answer include whether or not the added beef we will want is to come from pasture and other forage or from concentrate. We have made real progress in feed-crop yields and related materials handling; very little in forage utilization.

Product Quality Enhancement. Research to maintain and enhance product quality presents one of our major challenges. Flavor, color, and texture of fruits and vegetables fresh and processed will yield to the skill of the biologist and the chemist. Strawberry flavor has been separated by chromatography into more than 100 com-

ponents. As we identify flavor components, we can develop methods for their stabilization in appropriate storage environments, their chemical enhancement, and their enhancement through genetic and cultural methods.

We have come a long way with sweet corn: it is available at reasonable prices most of the year. We have learned to control insects that otherwise would render the ears unattractive; but we have yet to learn how to get it from the grower's field to our tables with the flavor we can get in garden grown corn pulled, cooked, and eaten within the hour. Tomatoes present an even greater problem. They, too, are available the year round. But many of them do not have the color, texture, or flavor of the vine-ripened product. Tree-ripened peaches, vine-ripened muskmelons, garden fresh peas—the list is as long as the fruits and vegetables we eat. The problem can be solved.

Genetic selection for yield, appearance, disease resistance has been highly effective. Genetic selection can add flavor, color, and texture, too, to a much greater extent.

Deterioration in quality of many products—alfalfa meal, soybean oil, chicken—is due to oxidative changes which take place even at low temperatures. Antioxidants such as santolquin, BHT, and tocopherol are widely used. Other methods of chemical stabilization are under study, e.g., use of phosphates in frozen fried chicken.

Much of the research needed in the four problem areas I have discussed will be basic research. My definition of basic research is: identification and quantification of parameters, both constants and variables, and of their action and interaction throughout their effective range.

Certainly it is not enough to know soil science, plant physiology, hydrology, and ecology to build and maintain productive soil and to use water efficiently. We must have knowledge also of the interaction of various soils and various amounts of water at various fertility levels with crop plants of various genetic capacity.

Tomorrow's agricultural research workers will require more knowledge of physics, chemistry, biology, and mathematics than most of us have. They will need more knowledge of social science and economics too.

The rural population exceeds the urban population in 11 states: Alaska, Arkansas, Idaho, Kentucky, Mississippi, North Carolina, North Dakota, South Carolina, South Dakota, Vermont, and West Virginia. Only 30 percent of the people in the U.S. are rural. Tomorrow's world will be a city world, and agricultural research must help rural people to maintain their essential role compatibly with city dwellers.

For the future, many of our scientists must become adept at new systems of research that take into account the availability of computers which can solve in a moment equations which might require a lifetime of a man with pencil and paper. It is possible—indeed, it is desirable—in planning research for the future, to estimate the probable costs and benefits attached to our research undertakings. Computers will help in these estimates. But no matter how sophisticated our approach—whether through operations research, systems engineering, game theory, or some new approach—the machine is not a decision maker. Man must assign values. An excellent article on "The Man-Computer Relationship" appeared in *Science* for November 23, 1962. The authors, David L. Johnson, of the University of Washington, and Arthur L. Kobler, a clinical psychologist of Seattle, close their article with the following statement, "Let us be certain that, in response to Samuel Butler's question, 'May not man himself become a sort of parasite upon the machines; . . .?' we will always be able to answer, 'No.'"
Butler asked this question in his "Erewhon," published in 1872.

One further quotation in closing, from W. O. Atwater, first director of the OES (a predecessor organization of CSESS), in 1888 when he was director of the Storrs Connecticut Experiment Station:

"The Managers of the Station recognize that its duty is to select for study such questions as are of the most immediate and practical importance to the agriculture of the State; and that its work will be successful in proportion to the intimacy of its connection with the farmers whom it represents. But they feel bound to accept the lesson taught by years of experience, in this country and elsewhere, that the most valuable results will be obtained by selecting a small number of questions for investigation, by making them narrow and specific, and by studying them with the greatest possible thoroughness. And they desire to avoid, so far as may be, the error into which so many Stations, in their early

experience, have fallen, in failing to recognize that often the questions which seem most theoretical are really most practical; that the highest, and on the long run, the most useful work for agriculture is the discovery of the laws that underlie its practice and that not infrequently the interests of the farmer require that theoretical questions be considered first, for the same reason that the foundation of the house is the first part to be built. In using part of its resources for abstract research, the managers of the Station feel assured that it is doing its highest duty and will have the heartiest support of its constituency."

Those words are appropriate today.

The Role of Microbiologists in Assistance Programs for Underdeveloped Nations*

Carl Lamanna

Deputy Chief and Scientific Advisor, Life Sciences Division, Army Research Office

Here in Washington we reside at the focal point of all those activities of government that impinge upon the provision of material resources for the support of the sciences of microbiology, and the opportunities for utilization of microbiological knowledge for the advancement of our nation and the welfare of humanity. By reason of its location, and its large membership element of government scientists, it would be proper for the Washington Branch of the American Society for Microbiology to be especially concerned with

those broad issues of government and society that affect the progress of our scientific and professional interests. I have thought, therefore, that it would be proper for us to turn our attention to one current social issue, namely, the role of microbiologists in the efforts aimed at raising the standards of living in those areas of the world that are called underdeveloped.

The urgent social task we face is the discovery and adoption of those means that will lead to the peaceful evolution of human society to decent standards of conduct and material well being. Toward this effort the sciences of microbiology can make significant contributions. It is an

* A speech presented by Dr. Lamanna at the annual banquet of the Washington, D. C., Branch of the American Society for Microbiology, November 27, 1962.

ethical duty both as citizens and as members of an organized profession that microbiologists recognize such opportunities and accept the challenge for making such inputs.

Traditionally Americans have been interested in giving assistance to persons less fortunate than themselves. The American concept of individual responsibility and generosity coincides with our professional ethics. The tradition of assistance to one's neighbors has evolved to include the thought that we should act as a community when we can act more effectively, and has nurtured the political concept that as a nation we should render economic and technical assistance to underdeveloped areas as a matter of Federal Government policy. Since World War II this policy has resulted in the growth on an unprecedented scale of efforts to make available American material resources and scientific and technical know-how to other nations.

Concurrently the United Nations has come into existence, and has organized several international technical and scientific agencies which give assistance to so-called underdeveloped areas. These agencies make important contributions to social welfare, international good will, and the expansion of scientific activities by governments. The United States makes substantial contributions to these international assistance activities both in money and personnel, and in addition conducts both cooperative and independent efforts in these same areas through such groups as the Agency for International Development and the Peace Corps, and by participation in multilateral assistance pacts between allied nations as in the Colombo Plan, SEATO, and CENTO. As citizens we have a general interest in these activities, and as persons with special interests in the microbiological sciences, we should have a particular interest in the state of the microbiological sciences and technologies in underdeveloped nations, and our potential for making technical and scientific contributions to these assistance programs.

My excuse for having the temerity to speak to you on microbiologists' contributions to assistance programs in underdeveloped areas is that I have a personal curiosity and interest in the subject, aroused in part by having taught students from these areas. In addition, I had the good fortune to go with my family to serve in the Philippine Islands for a year on an assistance program at the Institute of Hygiene, University of the Philippines. These personal experiences, I hope, may lend some validity to what I have to say.

If we are to make intelligent contributions to assistance programs we must have some knowledge of the nature of the problems that exist in underdeveloped nations. I will draw upon the Philippine Islands for purposes of general illustration, though I recognize that each region we might be interested in will present special features.

The Philippine Islands are in a tropical environment and have predominantly an agricultural economy, characteristic of the underdeveloped nations as a whole. Also characteristic is the four-fold increase in population of the Philippines from about 7 million in 1900 to an estimated 28 million in 1963. This outburst of population has compounded difficulties in trying to raise standards of living, and threatens to frustrate efforts to increase economic growth significantly. It results, of course, in an abnormal distribution of age groups; only a minority of the population is available to feed and shelter the nation, and to provide for the amenities of life. The problem is more acute for these countries than for the industrially advanced nations, as indicated in Table 1. It is not surprising, therefore, that per capita wealth that makes possible savings for capital investments is woefully inadequate in underdeveloped areas, as compared to per capita wealth of the countries of North America.

For the increase in population we can credit in good part the control of infectious disease. While we can be proud of this proof of the efficacy of application of the microbiological sciences, can we ignore the

Table 1.—Age Distribution of Population

Age Years	Philippines (1948) Percent	U.S.A. (1940) Percent
0-4	16	8
5-19	38	26
20-44	33} 42 *	38} 58 *
45-64	9}	20}
65	3	7

* Economically productive segment of population, and that age group with the experience necessary for providing productive community leadership.

existence of new problems we have helped to create? Must we not be concerned that the uses of our science be within the context of a broader scientific and social program that relates one set of problems to others, so that we will proceed along a broad front of improvement of human welfare? We must take care that in solving one problem we are not creating equally serious ones. Microbiologists will be remiss as reasoning citizens and as professional workers if they ignore this challenge. I contend that as a profession we have an obligation to be concerned with the problem of control of population growth, and that we should be committed to particular ethical courses of action that promise solutions.

This does not suggest that we should stop microbiological progress and regress to a stage where infectious disease again plays one of its historical biological roles as a major device for population control. We can insist on the advance and application of our science, but we should demand simultaneous effort to solve the demographic problem we help create if our efforts are narrowly conceived and isolated from their consequences. We should recognize too that this population growth is a causative and sustaining factor in generating the political conflicts in underdeveloped nations that lead to the threat of war on the world scene. This threat of war has for us, as microbiologists, a special significance since it forces the microbiological community from traditional pursuits into pursuits of weaponry. Micro-

biologists must recognize that biological warfare is a threat that cannot be ignored, and that this threat exists in interconnection with those very applications of the science that have had both a practical economic and humanitarian impulse.

Those underdeveloped areas of the world with their population pressures are the very areas that are least equipped to feed their peoples. To the extent that the introduction of better farming practices and agricultural technology can improve yields (Table 2), we might hope that the population pressure can be alleviated, and certainly in the field of plant pathology, microbiologists can make immense utilitarian contributions. In a sense it might be said to be the better part of wisdom, that the study of the microbiology of parasitism in underdeveloped nations should be devoted more to plant diseases than to human and animal diseases. But no matter how we increase yield per acre, we cannot ignore the fact that each acre must feed an increasing number of people. It is doubtful that the progress in increasing the productivity of the underdeveloped nations by application of microbiological and other scientific knowledge can soon catch up with population growth to permit a standard of living that we are familiar with in the United States or western Europe. The problem, then, is whether we will seek peaceful means for controlling population growth while we press forward on the agricultural front, or permit misery and its accompanying violence to continue.

In this context we might inquire into the local resources for support and utilitarian application of microbiological knowl-

Table 2.—Comparison of Yields of Agricultural Produce Per Hectare

	Rice	Corn
Philippines	26.6	10.5
Philippine Agricultural College	67.5	
China	60	
Japan	87	
U.S.A.		41.6

edge. The role of microbiology rests on an educational base. At first blush, we can expect the educational resources in underdeveloped nations to be grossly inadequate in a quantitative sense. This is certainly true of many nations, but it is surprising and instructive to learn that this is not always true. Witness the Philippine Islands, which have a great number of students in schools (see Table 3).

Table 3.—College Population and National Income

	Students to population	Per capita income in U.S.A. dollars (1960)
U.S.A.	1 to 88	2222
Philippines	1 to 88	144
Denmark	1 to 412	1000
England	1 to 847	1352
Japan	1 to 972	307

It is clear that the Filipino people are committed to education, and this is indeed a progressive attitude. Unfortunately, the drive for education is not channeled to meet the existing needs. And this condition of the educational scene in the Philippines (Table 4) is true for other underdeveloped nations. I quote from the Bell report, which analyzed the problem of education and its impact in the Philippines:

“Only five per cent of all secondary school students are taking agricultural courses and an additional five per cent trade or vocational courses. The number preparing for a professional career is out of all proportion to the needs of the country. Instead of being well provided with trained workers and managers for agriculture and industry, where they can be employed, the country will soon be faced with the problem of white collar unemployment. This is a misdirection of education that must prove costly to the Philippine economy and painful to the unfortunate victims.”

Incidental to this pressure for education in certain professions, in disregard of national needs and balanced growth in

human resources, is the great desire for students in these lands to study for their chosen profession in the United States. On return to their country, the prestige attached to their association with an American university often places them at a competitive advantage relative to the stay-at-homes. These students educated in American schools will often become teachers and professional leaders in their communities. The question we must ask ourselves is whether or not we are properly preparing these student visitors and colleagues with the attitudes and skills they need to benefit their nation's economy. I have grave doubts that in microbiology we do. We offer them an educational experience designed for the American apprentice or student who will practice his skills in the economic and social context of our country, which is in many respects different from their homeland. I will try to visualize for you the character of some of these differences.

Table 4.—Ratio of Students to Population

	Philippines	U.S.
Law	1 to 1818	1 to 2800
Agriculture	1 to 6666	1 to 2700
Medicine	1 to 3510	1 to 5000

If we were to view a typical town or village away from the great metropolitan center of Manila we should note the absence of a skyline that we as Americans might expect. We should miss the presence of a conglomerate of buildings of varying height, chimneys, smokestacks, and water towers. In the town, the great majority of people are living in a one-room nipa hut, a well-ventilated, thatched-roof structure standing on stilts above the ground, which is kept free of vegetation by human passage, the ubiquitous chicken, and the occasional free-roaming pig. Only the more fastidious and well-to-do may have a special facility, though it lacks running water and Sears Roebuck catalog. The streets are unpaved, there is little evidence of motor transport, and there are none or

few telephone poles festooned with wires. Except for size, the picture of one village is the picture of all villages.

Can the people in this village and the outlying area use the services of a resident microbiologist? As microbiologists we tend to answer the question by reflex and unconscious selfish interest, and say, Yes. But are we sure that our answer is right? If we are sure, are we prepared to specify in terms of real needs what skills our microbiologist colleague, situated in this town, should have? Should he educate the people? If he does, are they prepared to follow his teachings? Should he diagnose their microbiological troubles? Should he do research? Will he have local resources to do the things we say he should be doing?

If we say he should do microbiology research because we in the United States are wedded to the primacy of research, what kind of research should he do? If his research interests are basic, will his efforts decrease his opportunity to contribute immediately to the welfare of his people?

If we could answer these questions wisely, we still must answer the most important question. Will our microbiologist colleague go to live and work in the community I have shown you? I am extremely doubtful that he will if he has been feeding on a diet rich in Warburg manometers, microbial genetics, or molecular biology, and if, as a possible result of this rich diet, he has ingested a measure of intellectual snobbery. By intellectual snobbery I mean an intolerance of the efforts of those who do not engage in the newest and supposedly sophisticated techniques. If we assume that our microbiologist colleague has escaped these pitfalls of attitude, we still have the problem that he may not be able to cope with the problems of practicing his profession in a resource-limited and thus backward area. He may tend to become cynical or discouraged and depart for greener pastures. It is the rare individual who will spend much time on re-educating himself. And so we come to

another sad and hard fact: in underdeveloped nations, professional workers, including trained microbiologists, are concentrated in a few metropolitan areas. They are not found in the hinterland that might use their services. The professionals are established in institutions that are modern in design and ambition. Though they are located in urban communities, they often stand in startling contrast to their immediate surroundings: they stand in the midst of evidence of another era, the paraphernalia of an agrarian economy resistant to change. The professionals in the university are often remote from these surroundings, and do not respond to them or to the challenge to prepare their students for a life of service in these areas.

If you will keep in mind this background picture I have painted we can proceed to consider what might be done to improve the contributions that microbiologists could and should be making.

First and foremost, I again emphasize that the allocation of resources, and the direction of efforts of microbiologists, should fit into a general scheme of balanced activities aimed at raising living standards as a whole. The variety of microbiological efforts should be proportioned among a spectrum of efforts seeking to reduce barriers to change and to raise the economic resources of the community. This means work in agricultural and industrial microbiology as well as in medical microbiology. Only in this way can we expect an optimum return from the limited capital resources that underdeveloped nations can devote to microbiological enterprises.

The efforts in medical microbiology should be tailored to meet needs promising the most ready expansion of economic activity. Thus, for example, collection of epidemiological data on the incidence of infectious disease should aim at giving an accurate account of the economic toll exacted by individual diseases. These data would then guide the allocation of priorities among projects in the field and laboratory. It might thus prove, for example,

more sensible to concentrate on efforts to understand, control, and treat the infectious diseases of the most productive age group in the population rather than the diseases of infants and old people.

Second, I believe we should seek and support efforts to reduce the cost of microbiological activities. The microbiological sciences are fundamentally laboratory sciences. A considerable capital investment in physical facilities and equipment is required to support the microbiologist. I recently directed a research laboratory where I calculated that it required \$45,000 per annum to support one professional worker. While these workers probably had an unusual appetite for conspicuous consumption, the experience is not unusual for our country. This figure would be reduced in an underdeveloped nation where salaries are lower. But it would be higher for items of equipment much, if not most, of which must be imported, even in the case of many consumable supplies. These facts then support the recommendation that to assist the role of microbiologists in underdeveloped nations, we must be interested in learning how to revise old ways, and invent new ways, of doing things more economically. For some time to come, I believe that it will be desirable and practical to adopt microbiological techniques that require less of an expenditure in laboratory equipment and utilities, even though they may require more manpower than currently accepted practice. In most cases manpower will be more readily available, certainly in the semiskilled and technician categories, than resources for sophisticated laboratory facilities and gadgetry. As a matter of fact, we should have more knowledge of how to reduce the educational requirement for training of technicians.

A corollary of this recommendation is that we should seek for local substitutes for imported materiel. Often unexploited possibilities exist in this area, particularly for consumable supplies.

These considerations lead to a third rec-

ommendation, having to do with the development of research programs. Microbiological research programs in an underdeveloped nation should evolve by a natural progression from efforts to solve practical needs. The basic research program would initially be small and slowly develop as a response to the stimuli provided by the attempts to meet the needs of the nation's economy. This approach would have a number of purposes and advantages.

It would promise an immediate return for the investment made in microbiological activities. If this return adds to the true wealth of the nation, an increase in the total amount, if not the proportion, of the national wealth can then be added to developing the local resources for advancing the microbiological sciences. In this way we provide for a self-generating indigenous expansion of the material bases needed for the practice and research of microbiologists in underdeveloped countries.

There are also significant psychological benefits in such an approach that should be noted.

First, it would provide objective evidence of the social worthwhileness of microbiology, and in doing so would aid in marshalling community and political support for necessary professional scientific pursuits. This consideration is of particular importance in democratically organized underdeveloped nations.

Secondly, and in my opinion more important, it would clearly place the microbiologist in a situation where he must accept his social responsibilities. In the long run this is good for his soul and his science. By becoming more responsive to social needs he will become a better citizen, and incidentally most rapidly advance his scientific cause.

For illustration, I would now like to briefly review a slight effort of research which was generated in the Philippine Islands in response to the aforementioned thoughts.

A chief cause of morbidity in the Philip-

pine Islands is the diarrheal group of diseases. In spite of the importance of diarrheal diseases, there is little systematic attempt at routine bacteriological diagnoses. This is particularly true in villages and rural areas, since there are few diagnostic facilities. A systematic attack on the problem of diarrheal diseases would be greatly assisted if there were available reliable knowledge of the causes of such diseases and the relative role played by *Salmonella-Shigella* infections. Attempts to simplify and reduce the cost of bacteriological diagnostic procedures are desirable since this would provide an incentive for more routine application of diagnostic procedures—and epidemiological surveys.

We undertook the task of determining how important it might be to control the temperature when incubating plates of SS agar medium inoculated with specimens from stools. If there were no necessity for precise control of incubation temperature with this selective medium, then it would be more practical than hitherto considered to do bacteriological diagnosis in the Philippine hinterland. For one thing, any local health officer, physician, practical nurse, or sanitarian could streak specimens on SS agar plates and hope to isolate pathogenic organisms, even though a bacteriological incubator were not available. We must not forget that often a reliable, inexpensive source of energy on a 24-hour basis is not available to operate a bacteriological incubator.

In a tropical country such as the Philippines, the annual mean temperature is about 27°C., with minor fluctuations in temperature between day and night. Often, however, in many areas the temperature will be higher, and frequently approaches 34°C. Therefore, if the temperatures at which pathogens will grow on agar include the range from 25 to 37°C., it should be possible to ship inoculated SS agar without harm and without giving any attention to special means for maintenance of a controlled temperature during transit of the specimens. SS agar could be streaked with

fecal material at the patient's bedside and mailed or otherwise transported to a central diagnostic laboratory, the time during transit at atmospheric temperatures constituting a portion of the incubation period necessary for development of bacterial colonies.

At the Manila Health Department a study was undertaken with stool specimens obtained from the gastroenteritis clinics and wards of the San Lazaro Hospital in Manila. The procedure was to take a pea-sized fecal sample and emulsify it in a tube of tetrathionate broth. After overnight incubation, a loopful of the emulsion was streaked on each of two SS agar plates, one plate being kept for 24 hours at room temperature and the other plate at 37°C. Suspicious-appearing nonpigmented colonies were then picked into Kligler iron agar tubes. The isolated organisms were identified by their morphological, staining, and biochemical characteristics. All presumed pathogens were sent for final serological identification to the referral laboratory of the 406th Medical General Laboratory of the U. S. Army stationed in Japan. A total of 2,011 stool specimens were studied, and 59 yielded *Shigella* or *Salmonella* species. The study was conducted in the month of February, one of the cooler months in Manila. The extremes of room temperature of the laboratory were 25 and 34°C., with about 30°C. representing the mean temperature; these values are somewhat higher than the actual atmospheric temperatures outdoors. From the results it was evident that no advantage was presented by controlled incubation at 37°C. As a matter of fact, with the procedure employed there was a distinct advantage to incubating each specimen at both room temperature and 37°C., since in numerous instances pathogens were isolated at one temperature and not the other. Experienced technicians who assisted in the study of these fecal specimens were asked to indicate their preference if they had to make a choice between 37°C. and room temperature as the only temperature of incubation. Since there was

less tendency for confluent growth to occur, and fewer lactose fermenting colonies appeared at room temperature, they chose room temperature.

From the results presented there can be no doubt of the capacity of pathogens to grow on SS agar medium at tropical ambient temperatures. In a tropical country the absence of equipment for controlled incubation at the temperatures recommended by commercial suppliers of media need not be a deterrent to efforts at isolation of pathogens on a selective medium such as SS agar. To the bacteriologist this should not be a surprising finding since the *Enterobacteriaceae* are known to grow over a wide range of temperatures on ordinary media.

It should be recalled that in the historical development of selective media, laboratory workers have proceeded on the basis of a controlled incubation temperature simulating the body environment. Thus the results reported would make for an optimistic prediction of success if qualified bacteriologists were to devote attention to modification of the usual selective media for employment in situations in underdeveloped countries where the best and oftentimes the simplest of scientific laboratory equipment is unavailable. Problems of communication and transportation exist which will require that serious thought be given to making laboratory facilities serve effectively the populations in the service areas at some distance from the immediate neighborhood of laboratories. The data presented are scientific justification for those having responsibility for planning operations of the laboratories, to explore the practical possibilities of having inoculated selective media instead of fecal and other clinical specimens transported to the laboratories. In the past, thinking has centered upon preserving stool specimens for transit to a laboratory. For reasons of economy in time, practical difficulties of maintaining pathogens viable in stool specimens during transit in the tropics, and esthetics, this may be less desirable than

the submission of inoculated selective or enrichment media. We also have reason to believe that it will be easier for public health personnel to get village and rural people to submit and transport bacteriological media than stool specimens for examination.

Experiments suggest that even in the United States there may be an advantage in incubating cultures below 30°C. Thus, by starting with a practical problem, we are led to some interesting questions regarding optimum temperatures of bacterial growth in selective and inhibitory media, which with a little imagination could lead to some significant basic research in bacterial physiology and disinfection. I hope I have succeeded in communicating an example of how a practical effort to meet a real need can succeed in its objective, and at the same time raise questions for basic research efforts.

If we can succeed in reducing the capital equipment requirements for microbiological work, we are contributing to solving the most important problem of getting microbiologists to work effectively in underdeveloped areas. We are increasing the opportunity for meaningful work in situations where lack of equipment and reliable sources of energy have been a deterrent to the employment of microbiologists. In essence, we are making the working situation more tolerable for the disadvantaged worker who does volunteer to serve under difficult circumstances. If this can be done, and at the same time we can communicate a feeling that the work being done is recognized as important and commands respect in the eyes of professional peers, we will have gone a long way in keeping the microbiologist out in the fields and villages where he is needed in underdeveloped nations.

To help achieve the dispersal of members of the microbiological community away from favored metropolitan centers, we must combat tendencies to develop an intellectual caste system within our closed fraternity. In plain words, this means that you do not let the other fellow know you

believe he is a lower order of microbiologist because he is not working on what you consider to be the frontiers of knowledge at the favored institutions. As a matter of fact, if we want to go to heaven we should not have any mean or snobbish feelings to hide from our less fortunately placed colleagues who are doing the work of the world that must be done.

Specifically, what can we do in the United States to maximize the contributions that microbiologists can make to assistance programs in underdeveloped nations? By improving the training offered, I believe that American universities can make a special contribution to help the foreign student meet the problems he will face at home. This may be asking too much of the American university whose main concern is with the American community and student, and which attracts foreign students from all over the globe. Perhaps this latter situation needs reform. Might it not be possible to arrange for students from a particular underdeveloped nation to be channeled to a given American university? The number and concentration of students would then justify development of a special program to meet the needs of these students from a selected underdeveloped nation or region. In part, this could be done by developing a faculty which includes numbers of persons knowledgeable in the language, history, customs, and problems of the underdeveloped nation. At the same time, numbers of American students could be involved in such a program, and thus prepare them for possible future assignments in assistance programs to the underdeveloped nation. Under this scheme, an individual university would not attempt to be all things to all students from all the varied corners of the earth.

Another possibility is to develop American knowledge of problems at the village level in underdeveloped nations by systematic tapping of the experience of Peace Corps members. The Peace Corps experi-

ence is outstanding in the opportunity it provides volunteers to learn at first hand the problems of underdeveloped nations at the grass roots level. It would be logical for American universities and other institutions to seek to utilize this experience in developing training and research programs of assistance. A catalogue of Peace Corps service-revealed problems would be a stimulus and guide of great value. In such a catalogue, I am sure we would find numerous microbiological problems listed to which we might profitably devote attention in our own American laboratories.

In our Armed Forces we face problems of microbiology that arise from logistics that as civilians we are not often seriously concerned with. As a result the military have solved or are striving to solve problems of organization, support, transportation, and equipment of which the civilian community is ignorant. I have a suspicion that in underdeveloped nations these techniques and equipment would often be practical substitutes for more elaborate ways of doing things that are common in the civilian community. It would be worthwhile to explore this situation systematically. I know of no one who is doing so.

Can our American Society for Microbiology take any action to assist the role of microbiologists in assistance programs in underdeveloped nations? Might not the Washington Branch be best equipped to raise this question? While I could suggest answers to these questions, I prefer that you answer them. It is stated in the constitution of our organization that an object of our society is to "stimulate scientific investigations and their applications, to plan, organize and administer projects for the advancement of knowledge in this field, and to improve professional qualifications." One of these projects might well be to understand how microbiologists can play an increasingly significant role in assistance programs to underdeveloped nations.

CALENDAR OF EVENTS

April 15—Society of American Military Engineers

Luncheon meeting.

Noon, Barker Hall, YWCA.

April 16—Anthropological Society of Washington

William Crocker, Smithsonian Institution. "Fieldwork in Brazil."

8:15 p.m., Room 43 National Museum, 10th St. and Constitution Ave., N.W.

April 17—American Society of Quality Control

Joint meeting with Institute of Radio Engineers. H. Dean Voegtlen, RCA Service Company, "Maintenance and Support Aspects—The Neglected Elements in Quality Control."

Refreshments, 6:30 p.m.; dinner, 7:00 p.m.; presentation, 8:00 p.m., Roger Smith Hotel ballroom.

April 17-19—American Institute of Electrical Engineers and Institute of Radio Engineers

International nonlinear magnetics conference.

Shoreham Hotel.

April 17-19—American Geophysical Union

Annual meeting. Papers will be presented at sessions on geodesy, seismology, meteorology, geomagnetism, oceanography, volcanology, and planetary sciences.

National Academy of Sciences. Activities will begin with an informal smoker on April 17 at 8:30 p.m., in the National Press Club ballroom.

April 18—Washington Society of Engineers

Regular meeting.

8:00 p.m., Powell Auditorium, Cosmos Club.

April 22—Society of Professional Engineers

Regular meeting.

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

April 23—American Society of Civil Engineers

Luncheon meeting.

Noon, Barker Hall, YWCA.

April 23—American Society of Mechanical Engineers

Annual banquet. Carlos Fallon, administrator of value engineering, Missile and Surface Radar Division, RCA, "Decision Making for Greater Value in Design and Production, and at Home."

Dinner at 7:30, preceded by cocktail hour. Capital Plaza Room, Continental Hotel.

April 23—Washington History of Science Club

Dinner meeting. Raymond J. Seeger, special assistant to the director, National Science Foundation, "Impressions of Science from Oxford University."

7:00 p.m., Kennedy-Warren, 3133 Connecticut Ave., N.W.

April 24—Geological Society of Washington

Regular meeting.

8:00 p.m., Powell Auditorium, Cosmos Club.

CU Schedules

Summer Institute

A Summer Institute on Analog Computation is being offered by the Department of Mechanical Engineering at Catholic University. There will be two sessions of one week each, during June 10 through 21. Further particulars may be obtained from B. P. Shah, director of the Summer Institute, in care of the CU Department of Mechanical Engineering.



MARCH MEETING

(473rd Meeting of the Washington Academy of Sciences)



SPEAKER: Ragnar Rollefson

Director of International Scientific Affairs
Department of State

SUBJECT: Science in the Department of State

TIME: Thursday, April 18, 1963

8:15 P. M.

PLACE: John Wesley Powell Auditorium, Cosmos
Club

2170 Florida Avenue, N. W.

Abstract of Address—After World War II, the obvious involvement of science in international affairs prompted the establishment of a Science Office in the Department of State. Following a short burst of activity, the Office and the associated Science Attache Program were allowed to dwindle almost to zero; but they have since grown steadily with the general resurgence of science in government following Sputnik. The Office now includes sections on the peaceful uses of atomic energy and on space, as well as the group on general science with which it started. All three groups have what might be called service functions in support of the activities of the scientific community, but perhaps their most important function is to see that foreign policy is correctly influenced by science and technology. Among the groups of the scientific community with which the Office must keep in close contact to carry out its responsibilities are the universities, the government scientific agencies, the National Academy of Sciences, the international scientific unions, and the industrial scientific organizations. The scientific fields of activity which have an important role in foreign policy include atomic energy, outer space, experiments with large-scale environmental effects, and international cooperative programs. The Science Office is concerned both with formulation of policy in these fields and with anticipating, and thereby avoiding, initial difficulties which might arise.

The Speaker—A native of Chicago, Ragnar Rollefson received the B.A., M.A., and Ph.D. (1930) degrees from the University of Wisconsin. He taught at his alma mater from 1930 to 1961, and was chairman of the Physics Department from 1947 until he left the University. During World War II he worked with the radar laboratory at the Massachusetts Institute of Technology. After the War he served as chief scientist of the Naval Research Laboratory field station in Boston, while transferring his radiation laboratory program to the Navy. He helped start the Lincoln Laboratory at MIT in 1951-52, worked for the President's Scientific Advisory Committee in 1954, and in 1956-57 served as chief scientist of the United States Army. From 1957 to 1960 he was acting director of the Midwestern Universities Research Association (MURA) Accelerator Development Laboratory in Madison. In the fall of 1962 he was appointed to his present position as director of the newly-created Office of International Scientific Affairs of the Department of State.

Science in Washington

ELECTIONS TO FELLOWSHIP

The following persons were elected to fellowship in the Academy at the Board of Managers meeting of March 12:

Aaron D. Alexander, chief of the Veterinary Bacteriology Section, Division of Veterinary Medicine, Walter Reed Army Institute of Research, and chief, WHO/FAO Leptospirosis Reference Laboratory, "in recognition of his contributions to microbiology, and in particular his research on leptospirosis and his international leadership as chief of the World Health Organization Leptospirosis Reference Laboratory." (Sponsors: Mary L. Robbins, Howard E. Noyes, L. S. Baron.)

Robert C. Parlett, professor of microbiology and chairman of the Department of Microbiology, George Washington University, "in recognition of his contributions to immunology, and in particular his research on antigens of the mycobacteria." (Sponsors: Mary L. Robbins, Carleton R. Treadwell, H. George Mandel.)

Roy E. Ritts, Jr., professor of microbiology and chairman of the Department of Microbiology, Georgetown University, "in recognition of his contributions to immunology, and in particular his research on the fate of labelled antigens in immunologic unresponsiveness and in delayed-type hypersensitivity." (Sponsors: Mary L. Robbins, Carlton R. Treadwell, Howard E. Noyes.)

ELECTIONS TO MEMBERSHIP

At the Board meeting of February 12, the Membership Committee announced that **Donald H. Williams** of the Dairy Industries Supply Association had been elected to membership by unanimous vote of the Committee. Mr. Williams is thus the first official *member* of the Academy to be elected under Article II, Section 2 of the revised Bylaws (see February issue, page 51).

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.

AGRICULTURE DEPARTMENT

Harold Morrison, a member of the Washington Academy of Sciences for about 36 years, died on March 11, 1963.

W. D. McClellan served as chairman of the Science Fair sponsored by OPEDA (Organization of Professional Employees of the Department of Agriculture). This fair, previously held in the patio of USDA's Administration Building, was held this year in the Plant Industry Station Auditorium at Beltsville, April 9-10. The fair brings together the best agriculture-related science fair projects from the five area fairs held in Washington and the surrounding counties.

Joseph R. Spies gave a lecture entitled, "Oilseed Allergens" at the Seed Protein Conference in New Orleans on January 22, sponsored by USDA's Southern Utilization Research and Development Division.

Calvin Columbic attended the Transportation and Storage Research and Marketing Advisory Committee meeting in Orlando, Fla., March 5-8.

USDA Marketing Research Report No. 587, prepared by **Lawrence Zeleny** *et al.* and entitled, "Sedimentation as a Measure of Wheat Quality—1962 Crop," has just been issued. Sedimentation value determined by the wheat sedimentation test devised by USDA has replaced protein content as a basis for loan value premiums paid to farmers in connection with the Government's wheat price support program, starting with the 1962 crop. The merits of this action have been quite controversial. The new report presents strong

statistical evidence supporting the action of the Department.

GEOLOGICAL SURVEY

R. L. Nace attended a conference of American hydrologists in Chicago, February 12-15. The purpose of the conference was to draft proposals for U. S. participation in a program of international cooperation in scientific hydrology.

HARRIS RESEARCH LABORATORIES

Harris Research Laboratories was host to the Harvard Business School Club of Washington for its monthly meeting on March 5. **Alfred E. Brown** addressed the group on "Creative People in R&D—Their Selection and Stimulation." Several senior scientists at HRL then escorted small groups of Club members through the Laboratories.

Lyman Fourt attended a meeting of the American Society for Testing Materials, at which he presided as chairman of the Committee on Chemical and Performance Test Methods for Textiles. The meeting was held in New York on March 5-8.

Milton Harris was a panelist in a R&D Symposium on "The Role of Non-Defense Agencies in the Growth of Civilian Technology" on March 13 and 14. The Symposium was sponsored by the National Security Industrial Association.

NATIONAL BUREAU OF STANDARDS

Recent talks by staff members have included the following:

F. Alt: "Automatic Language Translation"—Syracuse (N.Y.) Section, Institute of Radio Engineers.

G. Dickson: "Dental Amalgam: Physical Properties and Clinical Service"—Lancaster County Dental Society, Lancaster, Pa.

A. F. Robertson: "Plans for an Expanded Fire Technology Program in the Department of Commerce"—M o - K a n Chapter of the Society of Fire Protection Engineers, Kansas City.

C. M. Tchen: "Landau Damping of Plasmas with Collective Correlations"—American Physical Society, New York.

W. J. Youden: "Picking Winners and Losers"—Philadelphia Section, American Society for Quality Control.

L. A. Wall: "Remarks on High Temperature Polymers"—Winter Gordon Research Conference, Santa Barbara, Calif.

R. G. Bates: "Thermodynamic Behavior of Electrolytes in Alcohol-Water Media"—Solution Chemistry Seminar, University of Maryland.

R. K. Cook: "Infrasonic Waves in the Atmosphere"—Texas Western College, El Paso.

D. P. Johnson: "Problems in Pressure Measurements"—Chemical Engineering Department, University of Oklahoma, Norman.

K. Kessler: "The Spectroscopy Program at the National Bureau of Standards, Washington"—JILA Colloquia, Boulder, Colo.

L. A. Wall: "High Pressure Polymerization"—North American Aviation Science Center, Canoga Park, Calif.

G. C. Paffengarger: "Denture Base Resins", "Research and the Saving of Teeth," and "Fillings, Resins and Silicate Cements"—Pinellas County Dental Society, St. Petersburg, Fla.

H. S. Peiser: "NBS/ARPA Research Program on Crystal Growth and Defect Characterization"—Pennsylvania State University, University Park.

J. R. McNesby: "Vacuum Ultraviolet Photochemistry of Hydrocarbons"—Carnegie Institute of Technology, Pittsburgh, and "Vacuum Ultraviolet Photolysis of Hydrocarbons"—American Chemical Society, Houston, Tex.

W. J. Youden: "The Procedure and the Laboratory"—Delaware Section, American Chemical Society, University of Delaware.

Early in February, **Allen V. Astin** took part in a United Nations conference in Geneva and presented a paper, "The Role of the National Laboratory."

Forest K. Harris has been appointed chief of the Absolute Electrical Measurements Section, which studies methods for determining electrical units in terms of the mechanical units of length, mass, and time. It will also continually check the stability of the standards with which the Bureau preserves the national electrical units.

Bourdon F. Scribner is being congratulated on his marriage on February 22 to Sally Mount of Baltimore. Also, Mr. Scribner has been elected a Member of Honor of the Groupement pour l'Avancement des Methodes Spectrographiques of France, in recognition of his contributions as general chairman of the 10th Colloquium Spectroscopicum Internationale held at the University of Maryland last June.

Leroy L. Wyman, consultant on metallurgy, has returned from a 9-week trip through Mexico and South America, where he worked on uniform standards for materials in Latin America.

NATIONAL ACADEMY OF SCIENCES— NATIONAL RESEARCH COUNCIL

A cooperative program of research on foot-and-mouth disease between Argentina and the United States is about to begin under the Alliance for Progress. Its immediate purpose is to develop methods to process Argentine beef in such a way as to free it from the virus of foot-and-mouth disease and thus make it acceptable for import into the United States. NAS-NRC is the agency through which the United States Government is directing its part in the program. The administration of this project for NAS-NRC was assigned to the Division of Biology and Agriculture, of which **Frank L. Campbell** is Executive Secretary.

One of the most comprehensive projects ever undertaken by NAS-NRC was brought to completion recently by the staff of the Committee on Natural Resources, led by **John S. Coleman**. The study, requested by President Kennedy, covered all aspects of our nation's resources. The responsible committee held a series of meetings each

concerned with a different area of resources. At each meeting the Committee was briefed by specialists in the field being considered, the proceedings were recorded and later were converted into a series of reports from which the final recommendations of the Committee were distilled. This summary report is now available as Publication 1000 of NAS-NRC. The subjects of the supporting reports were as follows: Renewable Resources, Water Resources, Mineral Resources, Energy Resources, Marine Resources, Environmental Resources, and Social and Economic Aspects of Natural Resources.

SCIENCE AND DEVELOPMENT

Destruction of dams and other water barriers can be accomplished more effectively by placing the explosives under water rather than above, according to the Army Engineers at Fort Belvoir. Engineer Howard J. Vandersluis demonstrated the effectiveness of the underwater explosives in a series of spectacular tests on the Ohio River, in which two outmoded locks were destroyed. The tests showed that as little as 30 pounds of explosive effectively breached a five-foot wall as compared to 50 to 60 pounds of explosives above the water level. In one particular test, two 40-pound charges placed under water 26 feet apart were detonated by electric caps in series to blast a 35-foot breach in the wall.

The National Referral Center for Science and Technology, established last August, has initiated its referral service on a limited scale. Set up in the Library of Congress with NSF support, the Center intends to catalog all activities—facilities, collections, publications, and services—whose principal purposes include the provision of data or other material that may be of value in satisfying information requirements of the scientific and technical community. Major emphasis is given to specialized libraries and document centers, indexing and abstracting services, and sources of knowledge in unpublished form.

THE BROWNSTONE TOWER



Disregarding the ominous reputation of the ides of March, the officials of the American Type Culture Collection chose that day of 1963 to celebrate the beginning of construction of its new

home in the new industrial park area south of Rockville, Md. The sun shone brilliantly on that occasion as if to turn the celestial spotlight upon the successful culmination of the efforts of the devoted scientists who through many a crisis had struggled to preserve and strengthen the private enterprise and public service of the Collection, and to provide facilities in which its work could be done with increasing proficiency. To this reporter, who is old enough to have read Horatio Alger, the story of the Collection is heartwarming, like Alger's poor boy who made good and attracted wealthy clients but maintained his principles and independence.

To many in this area connected with medicine, agriculture, or industry in which microbiology plays a part, the foregoing paragraph will be meaningful; to the electronics and hardware people and others, it may not. The latter may ask, "What is this American Type Culture Collection? Could it be a museum collection of types of American culture being recognized and promoted by the New Frontier?" No, the "Culture" is not behavioral; it is microbiological. It is a collection of dormant, viable, pedigreed microorganisms or cell lines, not for display but for use by whoever needs an authentic species or strain for research, for clinical comparison, for seeding industrial cultures, for teaching, etc. Biologically, it is the microcounterpart of a zoo, aquarium, botanical garden, or arboretum. Here, ideally, one should find all species of microorganisms: viruses, rickettsiae, bacteriophages, bacteria, algae

and fungi, protozoa, and tissue cultures. Actually, representatives of all these groups are in the Collection, but bacteria, with which the Collection was at first exclusively concerned, are predominant. The Collection issues a catalog of its holdings and helps to support itself by making a charge for specimens ordered. It is feasible for the Collection to keep its stock of specimens in a relatively small space because most microorganisms can be preserved by freezing and drying in vacuo. Thus the visitor sees the bulk of the stock as numbered boxes on shelves, each containing tiny vials of bacterial residue within sealed tubes. Some specimens must be preserved in liquid nitrogen; others lie dormant in test tubes each containing a bacterial colony on a medium covered by a layer of mineral oil, the whole kept in a refrigerator.

There is not space here to tell of the beginning of the Collection in 1925 and of its moves from place to place, always trying to do its work in inadequate facilities with an insufficient staff. Now the laboratories of the Collection are located in an old, narrow, three-story brick house on the southeast corner of 21st and M Streets, N.W. The three floors and basement are crowded with equipment. One wonders how work that requires meticulous attention to detail can be done under such conditions. As there is no longer room for office work in the house, the offices of the Collection are located in nearby buildings.

How the members of the staff must look forward to the day when they can work in a new building designed for their use! They were all on hand at the ground-breaking ceremonies. The contractor had laid a boardwalk from the paved road to a temporary platform for the audience on the muddy field where the million-dollar building will stand. A small boardwalk and platform were provided for the speakers who came out one at a time and standing before a seated audience of about 90, spoke to them with the aid of a battery-powered microphone. Carl Lamanna, chairman of the Board of Trustees, gave the principal

address on the Collection. R. D. Coghill told the story of the fund-raising campaign for the building—how NIH had made a matching grant that had been more than equalled by generous contributions from industry, including a number of companies not directly concerned with the Collection. About 80 percent of these donations came from the pharmaceutical industry. Finally, NSF provided the largest grant of all, which put the project into the hands of an architect and builder. Representatives of the contributing agencies and companies were called upon to speak. With thanks all

around, Dr. Lamanna took a gilded shovel in hand and lifted a clod of mud as a toast to the future.

I am grateful to W. A. Clark, director of the Collection, to his assistant, I. C. Mohler, and to other members of the staff for their courtesies to me. I wish them all a productive future in their new home, which will undoubtedly become the world's leading establishment for research and practice in the preservation of microorganisms. Thus another jewel is to be added to Washington's crown of science.

—*Frank L. Campbell*



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American Society of Mechanical Engineers	WILLIAM G. ALLEN
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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.
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American Society for Metals	HUGH L. LOGAN
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Acoustical Society of America	MALCOLM C. HENDERSON
American Nuclear Society	GEORGE L. WEIL
Institute of Food Technologists	RICHARD P. FARROW
American Ceramic Society	Delegate not appointed

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

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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.

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Organic Geochemistry*

Philip H. Abelson

Geophysical Laboratory, Carnegie Institution of Washington

Since life began on earth, living forms have synthesized a mass of organic chemicals about equivalent to the weight of the earth. Most of this material has been destroyed or consumed through biological action, but a significant fraction remains, mainly distributed in sedimentary rocks, which make up about 80 percent of the rocks of the surface of the continents. Averaged over the world's entire surface, the thickness of these rocks is a little less than a mile. On the average, below each square centimeter of the earth's crust there are 1300 grams of organic chemicals or carbon of biological origin. These substances are found in rocks of all ages, including both recent and some of the oldest rocks on earth. Part of these chemicals are found as coal, oil, and natural gas, but the commercial occurrences represent a very small fraction of the total (Rubey, 1951). Moreover, in terms of scientific significance, the commercial aspects represent only a fraction of the interesting problems. Organic chemicals in rocks undergo with time and temperature a vast series of chemical transformations which challenge one's ingenuity to unravel. In the old sedimentary rocks are buried chemicals remaining from ancient life. These carry with them a potential wealth of information yet to be deciphered but nevertheless knowable.

In an oxygen-containing environment, organic matter is usually speedily de-

stroyed, although in a few notable instances, preservation of material has occurred under aerobic conditions. Under very dry conditions, organic matter may escape bacterial action for a long time; thus it has been possible to determine the blood types of some of the Egyptian mummies (Boyd and Boyd, 1937). Given long enough time, however, organic matter is degraded or destroyed in the presence of oxygen even without biological action.

A familiar example is the action of air on fats. Most living matter contains roughly a third of this material. In turn, most fats contain unsaturated fatty acids. The homemaker knows that fatty meats become rancid in the refrigerator or even in the deep freeze after a few months. Other materials are less easily affected by oxygen. Some amino acids are fairly resistant, but at room temperature in air even the stablest amino acids are destroyed in about 100,000 years (Abelson, 1959).

The action of oxygen is often more rapid when the substance involved is colored. I recall isolating some porphyrin from an old rock where it had been preserved in an anaerobic environment and in the absence of light. The porphyrin had remained substantially unchanged for more than 400 million years. This same material, when extracted and left in solution in a flask in the light, was destroyed in 24 hours by the combination of oxygen and the sun's rays. Fortunately for geochemistry, there are many environments in which oxygen is absent, and under these circumstances material can be preserved. Anaerobic organisms take their toll, but they are much less efficient in destroying the

*An address to the Chemical Society of Washington on March 14, 1963, following presentation to Dr. Abelson of the Hillebrand Award for 1962.

organic matter than are the aerobic organisms.

The natural anaerobic environments usually are wet, and it is not surprising that water has a significant role in effecting chemical changes. Shortly after deposition, fats are hydrolyzed to glycerol plus free fatty acids; glycerol disappears, but the acids or their salts often remain. Complex carbohydrates tend to be broken down to simple sugars; these smaller soluble molecules tend to be lost. Rarely, under favorable circumstances, cellulose and chitin (polymerized acetyl glucosamine) may persist for tens of millions of years. As we shall see, proteins are hydrolyzed in a damp environment in about 50,000 years, but under special circumstances some of the amino acids may remain.

Perhaps the most important chemical events affecting the organic matter are reactions among the constituents themselves. The components of living matter are highly reactive. In the organized cell their mutual interactions are limited, but on death and lysis of the cell many reactions can occur. For instance, in an alkaline environment the aldehyde groups of liberated carbohydrates react readily with amines to make non-biological materials. Within a year or two after deposition of organic matter in an anaerobic environment, profound changes have occurred. Biochemists have a simple set of procedures to fractionate the components of living matter into carbohydrates, lipides, and proteins. The fats can be isolated by solvent extraction and the amino acids of proteins liberated through acid hydrolysis. The organic matter in sediments presents a puzzling problem. In a short period and at temperatures of 5° to 20°C., profound changes have occurred. Carbon, hydrogen, oxygen, and nitrogen analyses are only moderately different from the original living matter, yet solvent extraction allows one to isolate only a tenth of a percent or less of the original fatty acids. Similarly, although much bound nitrogen is present,

only a small fraction of it can be isolated as amino acids.

The residual organic matter, often called kerogen, is practically insoluble in organic or inorganic solvents. It behaves like a plastic or a polymer of very high molecular weight. In an anaerobic environment, kerogen is apparently immune to biological attack. Being insoluble, it is not moved around by percolating ground waters. These properties lend great survival value, and it is not surprising that about 95 percent of the world's organic matter (Hunt and Jamieson, 1956) is in the form of kerogen. Asphaltenes, which are insoluble in water but can be extracted by carbon tetrachloride, constitute most of the remainder. However, a fraction of the original organic matter escapes incorporation into kerogen or asphaltenes and is found in rocks in an extractable form. These substances are present in low concentrations, but new techniques and modern instrumentation make them readily accessible for study.

Amino Acids in Fossils and Rocks

In 1953 it occurred to me that organic matter could be preserved in shells and bones under conditions where it might be free from bacterial attack. This fortunately proved to be the case. When a calcium carbonate-secreting organism forms its shell, it employs an organic matrix. Thus, one can dissolve a clam shell in trichloroacetic acid and find thin sheets of protein. If one examines shells that have been buried for a few years, the accompanying protein is not perceptibly different from that associated with living clams. After a few thousand years the layers of protein in the shell are no longer as resilient as previously, but they contain the same amino acids as before and have been little hydrolyzed. After 50,000 years in a moist environment, the proteins have largely hydrolyzed and most of the amino acids are present in the form of small peptides or even as free amino acids (Abelson, 1959). Through the action of ground

water, part of these tend to be lost, but even after millions of years the shell still contains some of the original amino acids.

One of my favorite collecting spots is on Chesapeake Bay. The shells in the vicinity of Scientists Cliffs were deposited about 25 million years ago. Many of these contain about a hundredth of a percent of amino acids. The technique for isolation of these is quite simple. About 5 grams of shell are dissolved in hydrochloric acid. The resulting solution is made up to a volume of 100 ml and placed on a Dowex-50 ion-exchange resin which is in the H^+ form. On washing with distilled water, calcium and the amino acids are retained, while hydrochloric acid is removed. After washing with water the column is treated with six volumes of 5N ammonium hydroxide. Owing to the amphoteric nature of amino acids, they are eluted while the calcium is retained. The ammonia solution is taken to dryness, leaving a residue containing the amino acids and very few impurities. Components of the mixture can subsequently be identified by paper or column chromatography.

Using these procedures I have examined a large number of shells, bones, and sedimentary rocks and have found amino acids in environments that were deposited as much as 450 million years ago.

There are some limitations. All amino acids are not sufficiently stable to exist for so long a period of time. Serine, threonine, and arginine can remain for only about 10 million years. Amino acids have been found only in geologic settings which have been clearly anaerobic. Amino acids have not been found in fossils showing evidence of recrystallization. Even the most stable amino acids are destroyed if exposed to elevated temperatures. Laboratory studies (Abelson, 1959) show that alanine could be expected to persist after three billion years at $25^\circ C.$, but that at $100^\circ C.$ it would last about 100,000 years. In the older fossils I found alanine, glycine, glutamic acid, the leucines, and valine. These are the most stable of the group. The laboratory studies show that the 4-carbon α -amino butyric

acid is as stable as alanine or valine, and there have been synthesized a large number of amino acids which would be equally stable. In my studies of old rocks I did not observe any of these amino acids. I was able to show that the organisms of 300 million years ago were using some of the same amino acids as are used today. If they had been employing sizable quantities of some of the other stable entities, it would have been possible to find them. The absence of these other substances is evidence for an unchanging pattern of utilization of amino acids.

Recently I have been associated with Drs. Hoering and Parker of the Geophysical Laboratory in a study of fatty acids in various rocks (Abelson, 1962). Photosynthetic algae make up a large fraction of the base and pyramid of marine life. They contain roughly 15 percent fatty acids, and these in turn are principally made up of compounds with 12, 14, 16, 18, and 20 carbons. Palmitic acid, a saturated compound with 16 carbons, is a ubiquitous

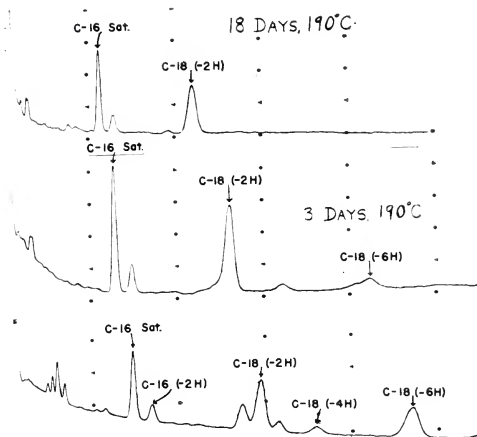


Figure 1. Gas-liquid chromatograms of methyl esters of fatty acids extracted from algae. The lower curve is the control, and the peaks represent most of the total fatty acid content. The upper two curves were obtained from extracts of algae which had been incubated at elevated temperatures. The label C-16 sat. stands for the saturated 16-carbon fatty acid, palmitic acid; C-16(-2H), palmitoleic; C-18(-2H), oleic; C-18(-4H), linoleic; and C-18(-6H), linolenic.

constituent of living matter. A large fraction of the fatty acids are unsaturated 18-carbon entities.

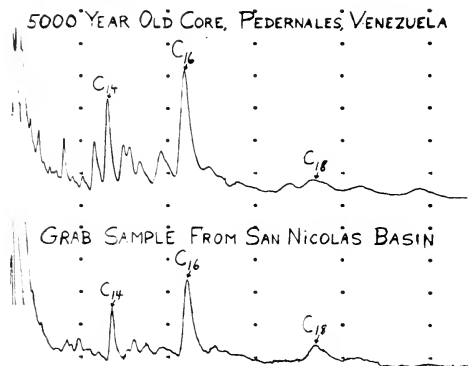


Figure 2. Gas-liquid chromatograms of methyl esters of fatty acids extracted from marine sediments. The peaks labelled C-14, C-16, and C-18 represent myristic, palmitic, and stearic acids, respectively.

If the material is a soft sediment, we extract it directly. If it is a hard rock, the material may be ground in a ball mill before extraction. In some instances it has been useful to treat the fine powder with hydrochloric acid and hydrofluoric acid to remove much of the mineral material. Following extraction, the fats are hydrolyzed when necessary and ultimately converted into the methyl ester. The mixtures can be purified by solvent extraction, or the fatty acids can be cleaned up by ion-exchange procedures. The components of the esters are separated and their amounts determined by means of gas-liquid chromatography. This tool permits the identification of a few micrograms of a substance.

To provide a basis for comparison, we have performed some studies of fatty acids in modern algae. In the lower curve in Figure 1 is a gas-liquid chromatogram of fatty acids in *Chlorella*. This chromatogram is similar to that obtained by others and also to results observed on examination of many photosynthetic marine organisms. The upper two curves were derived from experiments performed to give us information concerning the thermal stability of unsaturated fatty acids.

It may be noted that the highly unsaturated 18-carbon fatty acid disappears after 18 days at 190° C. It is significant that the 18-carbon oleic acid, containing only one double bond, survives this treatment rather well.

In Figure 2 are shown chromatograms of extracts from marine sediments. The lower curve represents a sample obtained from the San Nicolas Basin, which is located in the Pacific Ocean west of Los Angeles. The material was deposited just a few years ago. Below the surface of the fine-grained sediment anaerobic conditions prevail, and treatment with dilute HCl releases H₂S. The predominant fatty acids present are the saturated 14-carbon myristic acid and the 16-carbon palmitic acid; also present is a small amount of saturated 18-carbon stearic acid. It is significant that oleic acid, which is such a prominent component in the fats of algae, is missing. The upper chromatogram in Figure 2 was obtained from material extracted from a 5,000-year-old core. The upper and lower curves are quite similar. The extraction process was monitored by use of radioactive tracers. This technique indicated

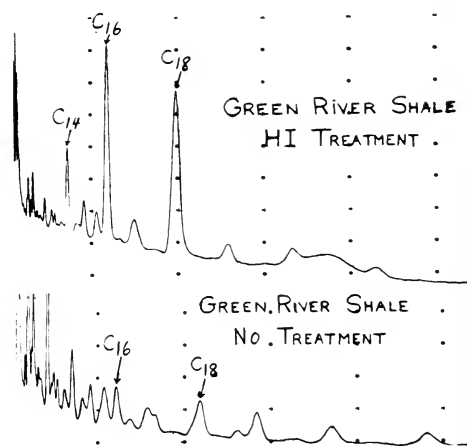


Figure 3. Gas-liquid chromatograms of methyl esters of fatty acids extracted from Green River shale. This is a 40-million-year-old formation occupying a large area in Colorado, Utah, and Wyoming. The lower curve was derived from a crude extract. The upper curve was obtained after purification with concentrated hydriodic acid.

that unless care is employed, incomplete recovery may ensue. In circumstances where the tracer was largely recovered, our best yields of fatty acid amounted to no more than one part in a thousand of organic matter present. These curves indicate that major changes in fatty acid content occur very quickly and that further changes are at a comparatively slow rate.

In Figure 3 are shown chromatograms obtained from treatment of the 40-million-year-old Green River shale. Extraction procedures yield a complex mixture of asphaltenes and fatty acids, with the former greatly predominating. Two percent of the total organic matter in a typical sample can be extracted, and of this only about two parts in a thousand are fatty acids. Substantial purification of the crude material can be achieved by solvent extraction, and by this means one can obtain a mixture like that which yielded the lower chromatogram in Figure 3. The fatty acids in the crude material can be further refined through chemical manipulation, such as boiling with concentrated hydriodic acid. In the upper curve the principal components are myristic, palmitic, and stearic acids.

In Figure 4 are shown chromatograms of an extract of a 500-million-year-old alun shale from Sweden. The crude extract in this experiment was purified by treatment with potassium permanganate. The major components again are myristic, palmitic, and stearic acids.

The very recent material off California and the old shale from Sweden contain fatty acids that are qualitatively almost identical. There is a quantitative difference which could be significant. In the very recent sample the ratio of stearic acid to palmitic is about 1 to 10, while in the old material we found more stearic present than palmitic. It is premature to attempt to interpret the significance of this interesting observation. A good deal remains to be learned concerning the fatty acids in rocks.

Earlier in this paper the quantitative

significance of kerogen was stressed. It is found in the youngest and the oldest sedimentary rocks and in the formations of intermediate age. Kerogen is not a pure chemical; rather, the name stands for the result of a series of chemical operations.

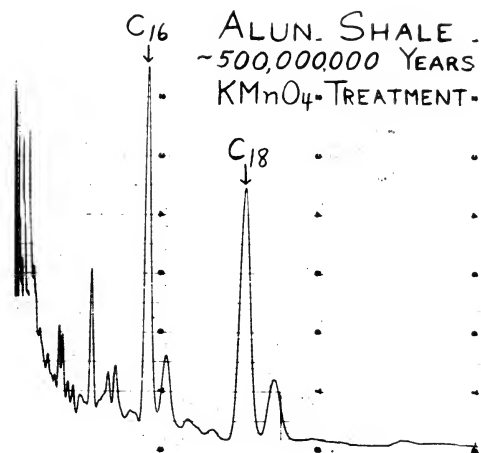


Figure 4. Gas-liquid chromatogram of methyl esters of fatty acids extracted from the Swedish Kolm shale. A crude extract from the rock was purified with dilute KMnO₄.

What is left after treatment with acids and organic solvents is a complex crude material containing carbon, hydrogen, oxygen, nitrogen, and sulfur. Under anaerobic conditions and at elevated temperatures the composition of kerogen changes. Carbon dioxide, nitrogen, and methane are evolved, and the residual end product tends toward graphite. Fortunately, there are available very old sedimentary rocks which have not been exposed to high temperatures and these contain material more reminiscent of young kerogen than of graphite. Dr. Hoering has told me of some observations on the so-called carbon leader, a 2-billion-year-old organic-rich sediment from South Africa. On heating this material, combustible hydrocarbons were evolved in considerable volume. His findings confirmed those of earlier South African workers.

Since kerogen is insoluble and complex, it is a difficult subject for experimental studies. However, it represents a rich po-

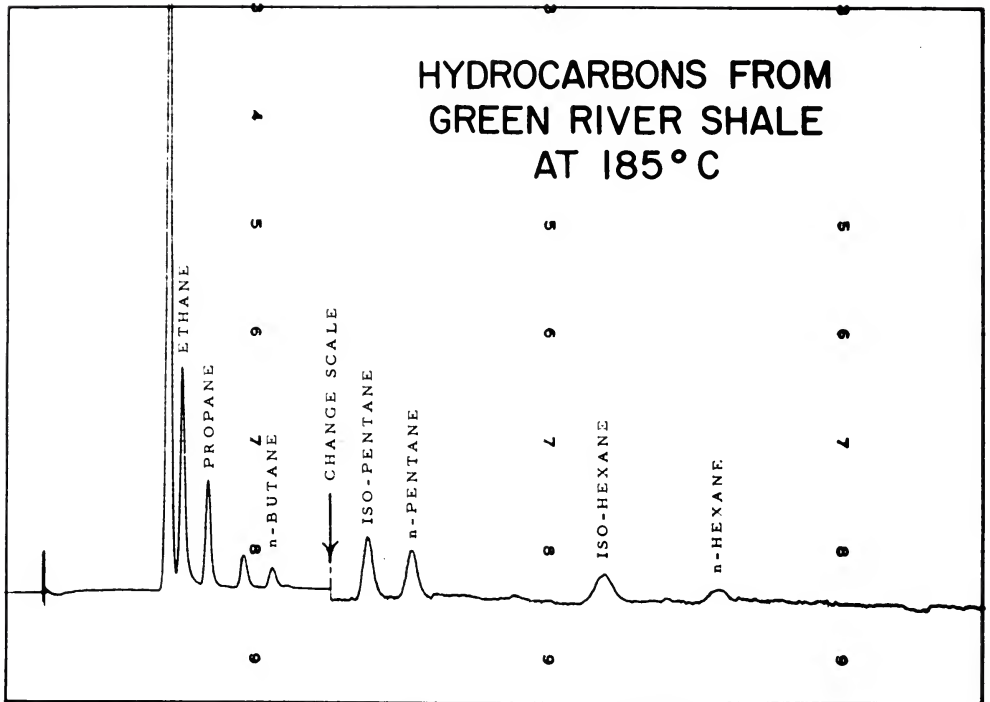


Figure 5. Gas-liquid chromatogram of hydrocarbons formed by incubation of kerogen at 185°C. The kerogen was prepared from Green River shale. The first peak on the left (unlabelled) is methane (off scale).

tential source of information to those who can find ways of dissecting it in a meaningful way. Our fossil record is fully satisfactory for only the last 550 million years. Some of Dr. Hoering's other studies provide confirmatory evidence that life began on earth about 2800 million years ago. Potentially, kerogen is our best source of information concerning living activities in the interval between the creation of life and 550 million years ago.

We have been groping for various means of approaching the study of kerogen. During the past few months, Dr. Hoering and I have been doing some rather simple experiments involving the thermal degradation of kerogen. Others have pyrolyzed shales, but in general these experiments have been conducted at temperatures above 400° C. Under these conditions cracking processes occur which have little relevance to what might happen in natural environments at much lower temperatures.

In Figure 5 is shown a chromatogram of the hydrocarbons liberated from 60 grams of Green River shale kerogen as the result of a 17-day exposure to a temperature of 185° C. This temperature is not much greater than those which have been observed in some deep oil wells. The principal hydrocarbon produced is methane, with lesser amounts of ethane, propane, iso-butane, n-butane, iso-pentane, n-pentane, iso-hexane, and n-hexane. The total amount of hydrocarbons represented by the curve is about 60 micrograms. In the chromatogram there was a change of scale at the point indicated, so that the sensitivity was increased by a factor of 8. The distribution of hydrocarbon shown in Figure 5 is reminiscent of what is seen in nature. Methane is the predominant component of natural gas.

In Figure 6 are shown chromatograms of hydrocarbons obtained from the 500-million-year-old Kolm shale and a recent San Nicolas Basin sediment. The two

500 MILLION YEAR OLD KOLM SHALE

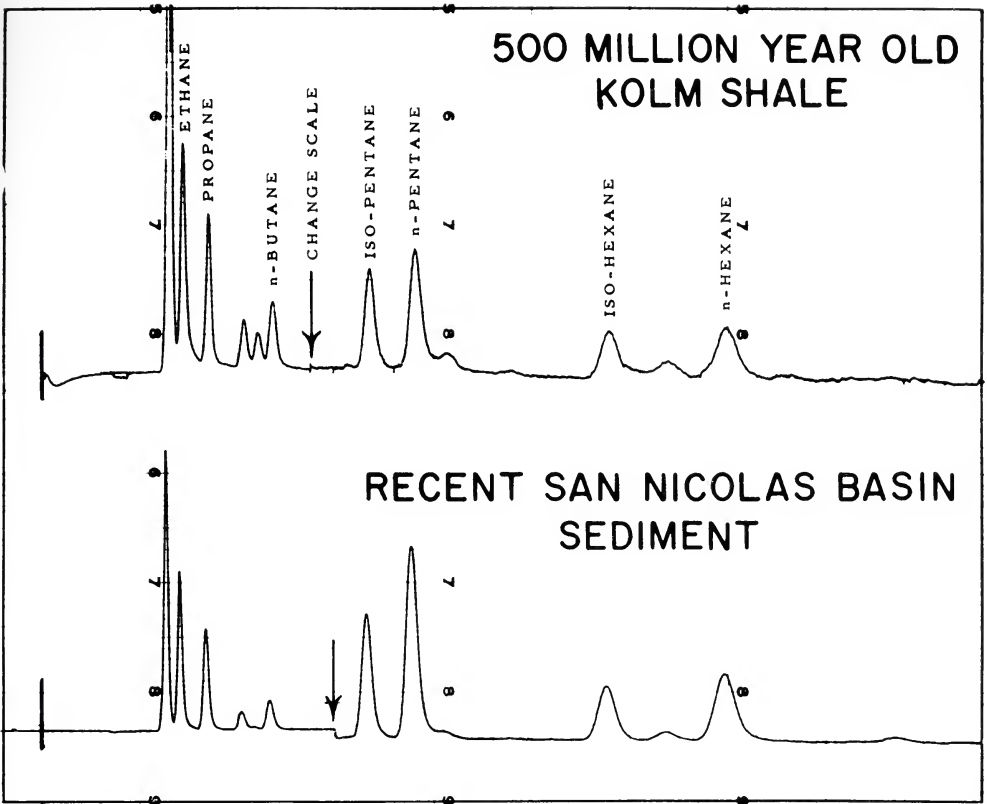


Figure 6. Gas-liquid chromatograms of hydrocarbons formed by incubation of organic matter at 275°C. An increase in amplification was made at the marked change scale.

curves are qualitatively quite similar and would appear even more so if the scale change had been identical in both instances; actually, the amplification factor in the lower curve was increased more than in the upper one. One could find two recent sediments whose hydrocarbons would differ more than those shown in the figures. The close similarity of the two chromatograms is suggestive. It would be unsafe to claim that this indicated great similarity between the organic matter in the old and in the young sediment. However, if the chemical content were vastly different, one would expect the hydrocarbons produced to reflect such differences.

In examining other shales, notably a core of the mid-continent Woodford shale, we found a pattern of hydrocarbons which was quite different. This core was obtained

at a depth of 6,500 feet and had had a more rigorous thermal history than that experienced by either of the two samples in Figure 6. In the hydrocarbons from the Woodford shale, ethane was slightly more abundant than methane.

We are not the first to discover organic materials in sedimentary rocks; others have been working and are working in this field. Those who are at present active have tremendous advantages over the earlier investigators. We have available a wonderful array of fine tools—gas-liquid chromatography, resin chromatography, infrared, mass spectrometry—which ease dramatically the problems of separation and identification of unknowns. In addition, the development of accurate radioactive dating gives us a time framework in dealing with old rocks. Thus we have

challenging questions and opportunities and the tools with which to obtain answers. We view an interesting vista for continuing research.

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Alchemical Manuscripts In Washington Area Libraries

Sister St. John Nepomucene *

Trinity College, Washington, D. C.

That amazing scientist Nicolaus Steno, in his Dissertation on the Anatomy of the Brain (1), made a statement that can serve as an introduction to this paper: "I begin by publicly and frankly owning that I know nothing of the matter."

Such would have to be the statement of most moderns, chemists as well as others, who think of alchemy as the beginning, in most unscientific form, of the science of chemistry by means of a search for an elixir of life and immortality, a

universal solvent, or a noble metal. Such aims, coupled with the limited knowledge then available, attracted charlatans as well as the curious, and on the sincere imposed a sacrificial way of life not unlike that of modern scientists, whose primary purpose is to know and understand.

As the philosophic virtues of alchemy are probably not as easily recognized as its material goals, it is good to know that an American, Ethan Allen Hitchcock, deserves credit for such recognition previously given to Jung, whose interest in alchemy developed from his work in psychology. Hitchcock had found an alchemical manuscript while browsing in a second-hand bookstore, and gradually collected a large library on the subject, most of which found its way to the Library of Congress as the result of a sale at the bookstore where the collection had begun. In 1857 in Boston, Hitchcock published his *Remarks upon Alchemy and Alchemists* (2), now extremely rare. In it is stated on page 117 "The work of the alchemist was one of contemplation and not a work of the

*Sister St. John Nepomucene, S.N.D. de N., is chairman of the Department of Chemistry at Trinity College. Last fall she presented a paper at the national meeting of the American Chemical Society, on alchemical manuscripts in libraries of the Washington area. Believing this to be an attractive subject the editor persuaded her to prepare for this journal a less technical paper than the one she had read in Atlantic City. She took up the task with great enthusiasm, and submitted an extensive, thoroughly documented manuscript, only part of which can be published here. Readers who wish to delve into the origin and significance of alchemy should consult Sister St. John directly and see her bibliography.—Ed.

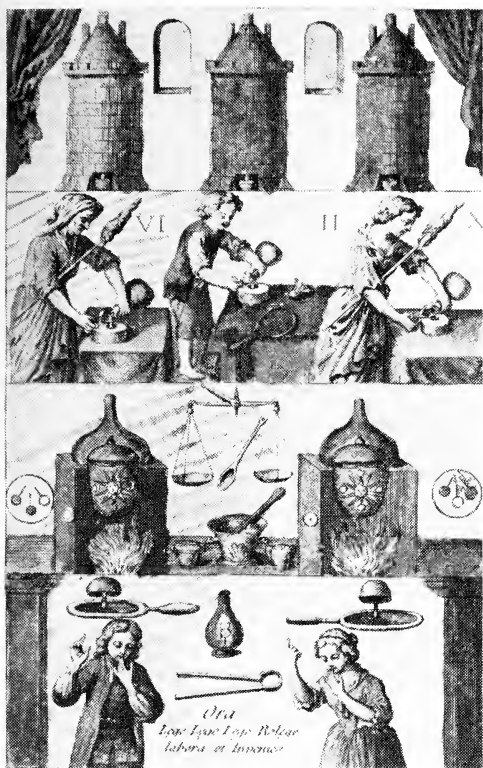


Figure 1. From the *Liber Mutus*, showing the alchemist and his wife, part of the opus magnum or great work, and the characteristic sentence.

hands. The alembic, furnace, cucurbit, retort, philosophical egg, etc. etc. in which the work of fermentation, distillation, extraction of essences and spirits and the preparation of salts is said to have taken place was Man,—y o u r s e l f, friendly reader;—and if you will take yourself into your own study and be candid and honest, acknowledging no other guide or authority but Truth, you may easily discover something of hermetic philosophy; and if at the beginning there should be fear and trembling, the end may be a more than compensating peace.”

The devotion of the alchemist is shown in Figure 1, from the *Liber Mutus* now in the Library of Congress. He stands prayerfully in a laboratory clearly divided into the parts indicated in the names, labor and oratory. The picture bears the Latin imperatives, “Ora, lege, lege, lege, relege,

labora et invenies” (pray, read, read, read, reread, work and you shall find). One may paraphrase some pages of the work attributed generally, but possibly inaccurately, to Albertus Magnus—*Libellus de Alchimia*—by advising for alchemists silence, discretion, an isolated dwelling, patience, perseverance, and assiduity. Others warned them to be rid of anger, jealousy, hatred, and avarice—in itself a great work!

Manuscripts in the Washington Area

From consultation of William J. Wilson's masterly catalog of alchemical manuscripts in the United States and Canada (*Osiris* 6, 1939) and other sources, it is believed that 13 alchemical manuscripts are now in the Washington area. Three date from the fifteenth century, one from the late sixteenth, one from the seventeenth, and the rest from the eighteenth. Two are in English, four in French, four in German, one in Italian, and two in Latin.

Folger Library. Perhaps the most generally interesting is the manuscript at the Folger Shakespeare Library, written in quite a clear hand in English. Measuring only 12 x 19 cm., it is a recipe for aquavitae—which it is presumably unnecessary to identify as whiskey. Shakespeare's six or seven references to aquavitae explain the presence of the manuscript at the Folger. Although completely reproduced elsewhere, it seems worth quoting in full:

“To make aquavitae . . .

Take a strong ale or strong wyne, or the lees of strong wyne and ale together a gallon or 2 as yu please, and take half a pound or more of good liquoriss and as much annise seedes; scrape off the barke from the liquorice, and cutt it into thin slices, and punne the annise seede grosse, and steep altogether close covered 12 hours; then distill itt wth a limbick or serpentyne, and of every gallon of the liquor yw may draw a quarte of reasonable good Aquavitae, that is, of 2 gallons 2 quarts but see that

yor fyre be temperate, and that the head of yor limbeck be kept cold continually with fresh water, and that the bottome of your limbecke be fast luted with rye dough, that no ayre issue out. The best ale to make Aquavitae of is to be made of wheate malte, and the next cleane barley malte, and best wyne for that purpose is sacke."

National Library of Medicine. Another recipe for aquavitae, mentioned only in passing, is in Bethesda at the National Library of Medicine. Bound in red morocco (modern) lettered in gold is the Manuscript Collection of Medical Tracts and Receipts Latin and English 15th Century, which contains the Medieval Leech Book. On paper, there are 117 folios averaging 13.5 x 22 cm., mounted on and inserted between layers of silk, showing through in worn folios. Only two of these folios refer to alchemy. The Book of Alkamy constituting folios 117a and b.

Medieval English Leech Book No. 2 also is at the National Library of Medicine. Dating from the fifteenth century, it was received from Samuel A. Green of Boston on August 11, 1874. The folios measure 20 x 14.3 cm. and are on badly stained paper. On Folio 20v in the margin, is written in a beautiful, clear hand of presumably later date. "I can't read it." This phrase might almost be taken as the motto of one working with alchemical manuscripts, for if the writing is legible, more often than not the meaning is obscure. Figure 2 (from another work, *Liber Sapientiae*, discussed elsewhere in this article) illustrates this point, although itself relatively clear.

Holy Name College. A manuscript attributed to Ramon Lull, although his work as alchemist or author in the field has long been disbelieved, is listed as one of 92 medieval manuscripts at Holy Name College, Brookland. Although of the fifteenth century, it is bound in modern white vellum and consists of 48 folios, 22 x 14 cm. A beautiful incipit in red and blue is followed by smaller ones in

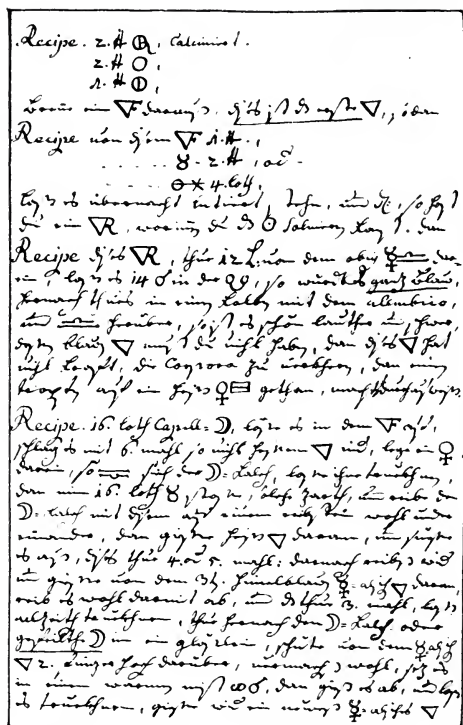


Figure 2. Page from *Liber Sapientiae*, giving recipes and showing use of symbols.

alternating colors with separating and explanatory phrases in red. The whole is beautifully and clearly done, and closely follows the manuscript of John of Rupescissa now at Harvard. Other folios of remedies are bound in the same volume.

Catholic University of America. No. 129 of Catholic University's medieval manuscripts contains alchemical recipes, extracts from earlier authorities, etc. In a beautiful white vellum binding, probably not the original, it has 103 folios and is not rubricated or indented, except at the chapter numbers. The fifteenth century German script is none too clear, and the German is easier to read than the writing.

Library of Congress. The manuscripts of the Library of Congress are in the Manuscript Room and Rare Book Division. In the latter are three manuscripts, one from the collection of General Ethan Allen Hitchcock (1798-1870), the grandson of Ethan Allen of the "Green

Mountain Boys" and the uncle of Ethan Allen Hitchcock, Secretary of the Interior under Theodore Roosevelt. The manuscript is in French, entitled "Concordance—physico—mitho—cabalo—hermetique." Immediately after the title of Part B, there is an interesting bit: "I filled a vessel with dephlogisticated air and another with atmospheric air. I put an animal of the same kind into each. The one breathing atmospheric air at the end of three, four, or five days fell over from weakness and inanition—the one in dephlogisticated air after the same time enjoyed the best health and the greatest strength—this experiment repeated several times and on several different kinds of animals, always gave the same results."

An alchemical compendium in Latin dating from the late sixteenth century, on paper but still in its original limp vellum binding with a flap, also is in the Rare Book Division. There are a diagram in color of a furnace, a 126-line poem, and many references.

In the Manuscript Room the first manuscript opened as if by magic to the dedication to St. Joannes von Nepomuck* and St. Anthony of Padua, of whom the latter was the patron of the author, Joseph Antoni Maickelbeckh of Dillingen, who claims St. John had prompted the canon of his church to procure a Latin codex of Oeduardus Scotus from the library of the Fugger family. This page appears in Figure 3. The manuscript consists of Scotus' Speculum Alchimiae, the Liber Sapientiae, also of Scotus, twenty-three recipes of which sixteen are ascribed to Basil Valentine, and the Universal Tables, as well as the Philosophers' Key reproduced here (Figure 4), which gives the Latin and German names of the elements, reversed, and their symbols. From the Bolton collection, it is interesting not merely for its dedication and repeated references to St. John Nepomuck but even more for the frontispiece in colors—the cover of a book with seals

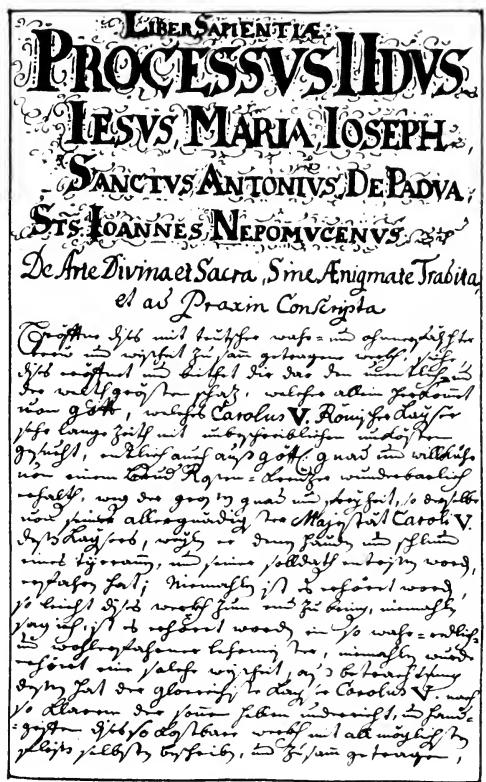


Figure 3. Page from Liber Sapientiae, showing dedication to Jesus, Mary, Joseph, St. Anthony of Padua, and St. John Nepomucene.

in red, white, and yellow and highly symbolic illustrations in five unequal bands. The manuscript itself is in a quite legible German script, generously sprinkled with symbols in red.

The author of the Treatise on the Nature of Metals and The Treatise on Common Metals is unknown. Both treatises are bound together in board, paper-covered and half-morocco. The two treatises are in French in a beautifully clear handwriting, but rather frequently grammatically inexact. Both treatises are theoretical, with no specific recipes, but there are frequent page and chapter references to authorities. There are two circular diagrams, one with symbols of the seven metals and a legend, "Visitabis interiora terrae; Rectificando invenies oleum limpidum, unicam medicinam"—the initial letters forming the acrostic "Vitriolum."

* Patron saint of the author of this article.—Ed.

CLAVIS PHILOSOPHORVM		
Saly	Muina	♁
Nig	Kelis	♁
Allaem 7		
Sly	Murna, Los	♁
Rellig	Muhnega, Arul. assid.	♁
Yell	Mugnulz, Swonias	♁
Nig	Munnats, Relipuj	♁
Rellig	Munis muhnega, Swinucem	♁
Rellig	Mugnuc	♁
Nig	Muref	♁
Almele 4		
Ringl	Sunaclur, Singi	♁
Yell	Sulosa, Reip	♁
Ry	mass, Sunubon, Auga	♁
Nunon	Serec	♁
A		
Nuala	Namula	♁

Figure 4. Philosophers' Key. Names for seven metals and four "elements," in German and Latin reversed, are included.

Another treatise, on the Philosopher's Stone, contains a commentary on that of Sieur Philippe by one Sieur Duclos; Jacques Le Tesson's "Oeuvre du Lyon verd" in dialogue, with no chapter divisions but a long conversation on alchemical matters; and a second dialogue on the conduct of the philosophers. It dates from the eighteenth century and is in the original brown calf binding. The vessels in which to work are described and measurements given; windows by which to see the colors are necessary; but the most important thing is the control of the fire, which if too great destroys and corrupts the thing made, and if too slow extinguishes the spirit. The dissolution requires from forty to fifty days and such processes must be repeated, sometimes twenty times.

Another manuscript, Alchemical Notes and Excerpts, is of late sixteenth century Italian origin. Beautifully rubricated, it

is written in highly abbreviated Latin and innumerable symbols are used. There are colored drawings of alchemical apparatus and nearly 200 Latin hexameters on alchemy; and on folio 70a there are tables of great interest, showing the expenses and profits of the art.

Two other treatises are in German, both in the same writing. In *Miraculum Mundi*, folio 10 has a reference to phlogiston, as well as a poem in cipher on the Philosopher's Stone. According to this manuscript, air in the presence of sunlight on a steel "fire-mirror" will produce a salt that preserves life. The second treatise includes a long introductory allegory concerning Adam and Eve. There is also reference to the Rosy Cross. The manuscript is not rubricated, and the divisions are poorly indicated, many paragraphs extending unbroken over several pages.

The *Liber Mutus* is from the collection of H. Carrington Bolton of the Smithsonian Institution, and was given to the Library of Congress by his widow. The work of one Jacob Saulat Demarets, it was first published by Denis Tollé, a doctor of Rochelle, France, in 1677. The genre of the work is indicated by the fact that he anagrammatized his name to Altus and represented the secrets of the process of transmutation so that only adepts could understand them. The 17 plates are prefaced by an introduction in an extremely clear French hand. The preface indicates that the small furnace can be watched easily for controlling the fire, and that it is portable and can be taken into the alchemist's room where he can stopper it before retiring, to last till morning since it will go for eight or ten hours without touching, if oil is furnished it.

The last manuscript to be mentioned is "Il segreto libro di Artefio, Filosofo antichissimo che tratta dell'arte occulta e della Pietro Filosofale." At first glimpse this appears to be an almost exact translation of part of Pierre Arnould's Latin-French *Trois Traitez*, of which three editions are in the Rare Book Division. The

TROIS TRAITEZ
DE LA PHILOSOPHIE NATV-
RELLE NON ENCORE IMPRIMEZ.

SCA VOIR

LE SECRET LIVRE DV TRES-
ancien Philophe ARTEPHIVS, traitant de l'Art
occulte & transmutation Metallique,
Latin François.

P L V S

LES FIGVRES HIEROGLIPHQYES
de' N I C O L A S F L A M E L ainsi qu'il les a mises en la
quatriesme arche qu'il a bastie au Cimetiere des Inno-
cens à Paris, entrant par la grande porte de la rue S. De-
nys, & prenant la main droite, avec l'explication d'icelles
par iceluy F L A M E L.

ENSEMBLE,

Le vray Livre du doctē S YNESIVS Abbé Grec, tiré de la Bibliothēque
de l'Empereur sur le mesme subject, le tout traduit par P. A R T E P H I V S,
N A V L D sieur de la Cheualerie Postum.

*Si se fata vocant, alias non viribus illis,
Neque etiam duro poteris conuclere ferro.*
Virgil.

A P A R I S,

Chez G V I L L A V M E M A R E T T E R U C Sainct Iacques, au
Gril, pres sainct Benoist.

M. D C. XII.

Avec Privilège du Roy.

Figure 5. Title page of the first printed edition (Paris, 1612) of *The Secret Book of the Most Ancient Philosopher Artephius*.

title-page of the 1612 edition is reproduced here (Figure 5). However, since Artephius, sometimes called Artesius—presumably the poet and alchemist Altughra'i—is thought to have lived in 1128, the manuscript may well be earlier than the book; dating from the writing is not easy, and “non encore imprimés” could imply an earlier date. Little is known of the provenance of the manuscript

beyond its acquisition by the Library in or about 1877, with three other alchemical manuscripts; according to the Library records, it and two French treatises were item 253 in an as-yet-unidentified library or sale.

And so, like the ourobouros—the serpent with its tail in its mouth, the alchemical symbol used by Hitchcock on his bookplate—we shall return to our beginning. If alchemy does not yield readily to understanding, if it does not readily yield gold, time spent reading in the field pays rich dividends to the initiated.

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- (2) Hitchcock, Ethan Allen. Remarks upon Alchemy and the Alchemists, Indicating a Method of Discovering the True Nature of Hermetic Philosophy. 2nd. ed. New York, James Miller, 1857. (The “Preface” is signed “E. A. H. St. Louis, 1857.”)

Acknowledgements

To the curators of rare-book and manuscript divisions, and to the librarians of the Folger Shakespeare Library, the National Library of Medicine, Holy Name College, Catholic University of America, and the Library of Congress, sincerest gratitude is expressed for necessary permissions, patience, and assistance. Particularly is gratitude expressed to Lessing J. Rosenwald.

The illustrations accompanying this article were very kindly supplied by the Library of Congress.



THE BROWNSTONE TOWER



Nowadays much time, effort, and money are being spent to make our population scientifically literate and to attract to the study of pure and applied science a larger proportion of our

young people with the hope that many of them will take up careers in teaching, research, or practice in science or engineering. Various specifications for providing financial support for qualitative and quantitative improvement of our scientific capabilities have come to be known as "programs." and the 12th annual report of the National Science Foundation indicates that every conceivable "program" is flourishing. I shall not be concerned here with the improvement of teaching, research, or facilities, but only with the encouragement of science talent.

Promising students emerge in the secondary schools through demonstrated proficiency in their science courses and may be stimulated by their teachers to greater scientific effort in and out of school—to read beyond the required textbooks, to prepare an exhibit for a science fair, to become active in science clubs or junior academies, to seek scientific employment or experience during summer vacations, to undertake and report upon a scientific project (research) that may or may not include a science fair exhibit, to take advantage of opportunities to see professional scientists at work or to hear them talk about their work, and to compete for scientific scholarships. Such activities should help a good student to decide whether he should point toward science in college or the university; he should not at this stage try to determine what kind of scientist or engineer he should become. If he leaves the secondary school strongly attracted to the pursuit of science because

of his proficiency in it and because it satisfies, he is on his way.

Although an able science teacher can exert a more profound influence on a student than any other person can, the teacher can be assisted by others who want to help. Thus the Washington Academy of Sciences, through its Joint Board on Science Education and its Committee on Encouragement of Science Talent, is organized to offer assistance—professional members of the Academy stand ready to advise students and teachers, to serve as judges at science fairs, to serve as speakers on their specialties, to evaluate student papers, and to talk about career opportunities. Their time for such purposes is limited, of course, but I doubt that they are being used to capacity. The Washington Junior Academy of Sciences, established and guided by the senior Academy, holds an annual paper-reading meeting, which brings together from the Washington area students of like mind who may be able to stimulate one another in science more than they can be affected by any adults except their teachers. Washington is probably not unique in making it possible for its better science students to hold their own meetings, but the practice is certainly not widespread.

In 1958 there emerged in the Army's Office of Ordnance Research, at Duke University, a program for assistance to secondary school science teachers and students not unlike that which had developed diffusely in the Washington Academy. The Army's program became known as the Junior Science and Humanities Symposia. In July 1961 it became an Army-wide program administered by the Army Research Office (Durham). In October of that year I became a member of its Advisory Council, headed by the late C. A. Elvehjem, president of the University of Wisconsin. I was attracted by the inclusion of "humanities" in the title. I soon found that the program was for science first, the Army second, and the humanities third. Whoever reminded the organizers that man cannot live by science alone should be

honored, and there is now on the Council a strong and gracious proponent of the humanities, Harry L. Levy, dean of Hunter College, who will not let them be forgotten.

The JSHS has a small, able staff and an annual appropriation. Its function is to assist interested organizations anywhere in the United States to stage a JSH symposium. Although these symposia vary in arrangements, they are similar in pattern and have the following characteristics:

1. A two- or three-day meeting during which students will have an opportunity to talk to one another.

2. Sponsorship by an Army installation where research is being done and cosponsorship by academic institutions or private companies that are also engaged in research.

3. Cooperation with local or regional academies of science and with the leaders of the school systems from which outstanding students and teachers, in a ratio of about 4 to 1, will be drawn for participation in the symposium.

4. An address by one or more Army officers on an Army research program and talks by civilian professionals.

5. An address that may or may not extol the humanities, but should, if concerned primarily with science, have a philosophical, historical, or artistic flavor.

6. Presentation by selected students of their own research reports.

7. Visits by students and teachers in small groups to the laboratories of of scientists who will explain their work and respond to questions.

8. Conversations among students, teachers, and professional scientists on careers in science.

What does a JSH symposium offer Washington area students and teachers that they do not already have? Nothing, really, except the opening of the Army laboratories to inspection and of access to Army scientific personnel. But a JSH symposium provides a convenient combination of worthwhile experiences, supple-

mentary to those that are available in the Washington area.

Evidently the leaders of our school systems did not think the withdrawal of selected students to attend a symposium was too great an encroachment on their school time, for they approved two JSH symposia for Washington. The first was held on March 29-30, 1962, at the Walter Reed Army Institute of Research; the second on April 15-16, 1963, at Georgetown University, with the Harry Diamond Laboratories on the campus of the National Bureau of Standards serving as the Army's sponsor. I was well pleased with the symposium at Walter Reed and liked particularly the opportunity given to teachers and students to visit a laboratory long enough to find out what goes on in it. I did not think so well of the so-called Curbstone Clinic, where for too short a time students tried prematurely to explore careers in science with the help of professional scientists. When a high school student begins to think seriously about a specialty in science, he worries about curricula, forgetting or not realizing that his first objective in college is to become broadly educated and well-grounded in the fundamentals of science.

The total number of JSH symposia held up to March, 1963, was 37. Most of the support, amounting to \$228,000, was provided by the Army Research Office (Durham), but \$33,000 came from industry!

In 1962 it was decided to hold the first national JSH symposium—at the U.S. Military Academy at West Point. Students selected were to be those who had presented papers at local or regional symposia and thus were to be recognized and rewarded for their accomplishments. On April 3-5, 1963, the great event took place in the inspiring setting of West Point. Because the JSH symposia have not yet been held in certain sections of the country, only 19 states were represented by the 130 students and 36 teachers present. Among them were our Phoebe Knipling,

Jean G. Taylor, and 8 students from the Washington area. The program was excellent, and the experiences these students had, especially in meeting one another, certainly must have justified the cost of the symposium and have far exceeded in benefit to them what they might have derived from their own classes during the same period.

Washington made a great contribution to the humanistic side of this symposium through a philosophical luncheon address by Ralph G. H. Siu of this city, entitled "The Plunge into Darkness." In it he warned would-be scientists against the temptation to worship gadgetry, the Big Science fraternity, and the ritualization of methodology.

Two first-year cadets also stressed the social side of their technical training when they gave illustrated talks on their experiences in a program called "Operation Crossroads Africa." One had gone to Ethiopia, the other to Nigeria with other young Americans to help Africans build a rural school house and a library. Probably their help was really not needed, but the process of working together with people of different language and culture did something to prove to them that "a man's a man for a' that."

On the evening of the first day Edward Teller, whose views on the need for strengthening American science led to the initiation of the JSHS program, spoke not only to the participants in the symposium, but also to a large contingent of cadets.

After the first day of the meeting I had to return to Washington. Having been inspired by what I had seen and heard, I should think that impressionable young students would be affected for life by this unforgettable experience.

In Oklahoma a well-supported state-wide junior symposium is held annually with scientists of national reputation coming into the state to participate. One can safely say that never before in the United States has so much attention been paid to so many budding scientists. Let us hope that these fine young people will not be spoiled

by it and that their idealism and desire for knowledge and truth will prevail over materialism.

Finally, let me propose the only science-promoting "program" that has not yet been funded, because it cannot be; i.e., that every altruistic mature scientist find for himself a young protégé to whom he can be counselor and friend through the school years.

—*Frank L. Campbell*

NCA Laboratories Plan Anniversary Celebration

The Research Laboratories of the National Canners Association will celebrate their golden anniversary in a series of programs scheduled for May 21 and 22, in which officials of the canning industry and the Food and Drug Administration will participate.

The National Canners Association was the first food trade association to create research and technical service laboratories for the benefit of its members, and it was among the first trade groups of any kind to engage in activities of this type. Its laboratories were first organized and staffed in June 1913, when the NCA headquarters were moved to Washington from Bel Air, Md. The Association itself has been in existence since 1907. A second laboratory has been in operation since 1919 in Seattle, Wash., and a third in Berkeley, Calif., since 1926.

The program on May 21 will be conducted for Government representatives and the press, and will include a tour of the Laboratories, where charts and demonstrations will illustrate the types of problems coped with during the earlier years of canning, compared with the modern projects now under study. The tour will be followed by a luncheon at which Food and Drug Commissioner George P. Larrick will be the principal speaker. The final event of this program will be the presentation to Mr. Larrick of a contribution to the Harvey W. Wiley Award Fund.

On May 22 most of the guests will be

scientific and technical people from Government and industry. Oral L. Kline, scientific director of FDA, will be the principal speaker, followed by staff members of the NCA Laboratories. Dr. Kline's topic will be "Research—A Vital Factor in a Food Regulatory Program." C. W. Bohrer, chief bacteriologist of the NCA Washington Laboratory, will describe his recent work with *Staphylococcus enterotoxin*. W. E. Perkins will discuss his work with *Clostridium botulinum* spores. Berkeley chemist J. W. Ralls will discuss his work with natural flavor constituents; and W. A. Mercer, assistant director of the Berkeley Laboratory, will describe some of the techniques in radiochemistry and chromatography that are used by NCA researchers.

WETA Schedules New TV Series

"Science and Engineering Television Journal," a series of 12 one-hour programs on new developments in science and engineering, will be presented beginning Thursday, May 30, by WETA-TV (UHF Channel 26), Washington's educational television station. The programs will be broadcast every Thursday at 7:30 p.m. for 12 weeks.

Purpose of the series of programs is to enable scientists and engineers to view in their homes, reports and discussions usually available only at professional meetings.

The series was produced in cooperation with several engineering and scientific societies, including the American Society of Heating, Refrigerating, and Air-Conditioning Engineers, American Psychological Association, New York Academy of Sciences, American Chemical Society, American Institute of Biological Sciences, Conference Board of the Mathematical

Sciences, Institute of Electrical and Electronics Engineers, American Meteorological Society, and American Society of Civil Engineers.

- Titles of the programs are as follows:
- May 30—The Engineer and Environment
 - June 6—Computer Stimulation of Cognitive Behavior
 - June 13—Vertical Take-Off and Landing Aircraft
 - June 20—Problems in Macromolecular Chemistry
 - June 27—Biology Curriculum Improvements
 - July 4—What Is Mathematics and How Do We Teach It?
 - July 11—Problems in Organic Chemistry
 - July 18—Artificial Intelligence—Present and Future
 - July 25—The Atmospheres of Mars and Venus
 - August 1—Biomaterialogy
 - August 8—The Search for Solid Ground
 - August 15—Civil Engineering Aspects of the World's Fair

WETA-TV, which is on the air daytime and evenings, Monday through Friday, broadcasts quality programs in cultural, public affairs, entertainment, and instructional areas.

The Channel 26 UHF signal can be received by attaching a converter to an ordinary TV set: or in an apartment house equipped with a master UHF antenna, the signal can be received on Channels 3 or 6, on any set connected to the master antenna.

WETA-TV is owned and operated by the Greater Washington Educational Television Association, Inc., which is sponsored by area universities, secondary school systems, and cultural institutions. It is a non-profit group, and solicits financial support from the community for capital and for the evening operation. Its in-school programs are supported by the participating school systems.

Further information can be obtained by calling HUDSON 3-4523.



MAY MEETING

(474th Meeting of the Washington Academy of Sciences)



SPEAKER: Sherman Beychok

Assistant Professor of Biochemistry
College of Physicians and Surgeons
Columbia University

SUBJECT: Conformation of Proteins in Solution:
Optical Rotatory Dispersion Studies

TIME: Thursday, May 16, 1963
8:15 P.M.

PLACE: John Wesley Powell Auditorium,
Cosmos Club
2170 Florida Avenue, N. W.

Abstract of Address—For the past few years, the emphasis in analysis of optical rotatory dispersion of proteins and synthetic polypeptides has been placed on discerning and estimating helix content in these macromolecules. In both these classes, the spatial disposition of the peptide bond exerts a profound effect on the optical rotatory dispersion properties in solution. Dispersion curves of ferrimyoglobin and ferrihemoglobin, as well as the size of one of the characteristic Cotton effects near 2250°A , have been interpreted in terms of the helix content of these proteins, in solution. This kind of analysis is useful for studying secondary structure of proteins in solution, but yields little information about details of tertiary structure. With respect to the latter, a promising approach is to study the optically active absorption bands of bound chromophores whose manner of attachment depends on specific features of tertiary structure. The chromophore may occur naturally, as in heme-proteins, or may be deliberately added. Some results of a study of the interaction of insulin with acridine orange are presented to illustrate induced optical activity in a bound chromophore and the effects of modification of protein structure on the size and magnitude of the Cotton effects.

The Speaker—A native of New York City, Sherman Beychok graduated *magna cum laude* from the College of the City of New York in 1952. In 1957 he received his Ph.D. degree in biochemistry from New York University, working on the physical chemistry of lysozyme. From 1956 to 1960 he was associated with Jacinto Steinhardt as researcher on hemoglobin in the Department of Chemistry at Massachusetts Institute of Technology. During his last year at MIT he was also a lecturer in physical chemistry at Boston University. After a year in the Laboratory of Biophysical Chemistry of the Children's Cancer Research Foundation and Harvard Medical School, he returned to New York, and is now assistant professor of biochemistry at the College of Physicians and Surgeons, Columbia University, where he is working in optical methods for determination of the secondary and tertiary structure of macromolecules.

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.

AGRICULTURE DEPARTMENT

John W. Mitchell has been named leader of a newly-established laboratory for pioneering research on plant growth regulators. The laboratory, located at the Agricultural Research Center, Beltsville, will conduct basic research on how growth regulating compounds and hormones affect plants. It is the 20th pioneering research unit established by the Agricultural Research Service since 1957.

C. H. Hoffman, Entomology Research Division, participated in a panel discussion "To Examine the Use, the Risks, and the Value of Various Methods of Controlling the Most Insidious Garden Enemies," presented at the Garden Club of America meeting held in New York City on March 13.

John H. Martin presented an address, "Potentials for Sorghum Improvement in Africa," at the Third Biennial Grain Sorghum Research and Utilization Conference, held in Amarillo, Tex., on March 12.

John T. Presley attended the International Symposium on Biological Control of Soil-Borne Pathogens, held in Berkeley, Calif., April 8-12.

Joseph R. Spies was the featured speaker on the recent Eighth Annual Arthur Lee Haines Visiting Scientists in Chemistry Program, sponsored by the State University of South Dakota, his alma mater. On April 4 Dr. Spies addressed a banquet meeting on the subject, "The Chemistry and Physiological Properties of Oilseed Allergens." On the following day he spoke before a morning meeting on "Science Education for the Researcher," and before an afternoon session on "Man as Reagent in Allergen Research." The series of programs was

instituted to honor the achievements of Professor Haines, who is now in his 67th year as a science teacher.

GEOLOGICAL SURVEY

Marjorie Hooker was chairman, and **Laura Reichen** a member of the Physical Sciences Panel "Ask the Scientists" at the program held at Georgetown Visitation Preparatory School on March 30. The aim of the program, sponsored by the Committee on Women in Science of the Joint Board of Science Education, is to give local high school girls an opportunity to meet scientists and discuss careers in science.

George Phair is one of the contributors to the "Buddington Volume," a collection of petrologic papers published by the Geological Society of America in honor of Arthur F. Buddington, professor emeritus in the Department of Geology, Princeton University.

GEORGE WASHINGTON UNIVERSITY

Nelson Grisamore, assistant dean (research) of the School of Engineering and Applied Science, gave five lectures during the week of February 18-22, which were broadcast on the WMAL "Lectures in Miniature" series.

HARRIS RESEARCH LABORATORIES

Anthony M. Schwartz gave a talk on "The Measurement of Detergency" before the American Society for Testing Materials meeting in New York on March 11. Dr. Schwartz also presented a paper, "Resistance to Capillary Flow at the Liquid-Solid-Air Interface," at the Kendall Award Symposium honoring **William A. Zisman** at the Los Angeles national meeting of the American Chemical Society. On April 9 he presented a paper on "Friction Relationships in Human Hair" at the Chicago meeting of the Society of Cosmetic Chemists.

John F. Krasny presented a paper entitled, "Warm, Lofty Cotton Fabrics: Some Exploratory Studies," before the 33rd annual meeting of the Textile Research Institute in New York on March 14. **John Menkart** and **Arnold Sookne** also attended the meeting.

Alfred E. Brown participated in a "Career Day" for undergraduates at the Georgetown University Science Center on March 30. His topic was, "Industrial Careers for Scientists." Dr. Brown also participated in the 1963 Junior Science and Humanities Symposium which was held at the GU Science Center on April 16. Approximately 200 high school science students attended this symposium, at which Dr. Brown, representing industry, discussed his views on "The Role of Science from the Viewpoint of Politics, Industry, Government Laboratories, and Universities."

NATIONAL INSTITUTES OF HEALTH

Margaret Pittman, chief of the Laboratory of Bacterial Products, Division of Biologics Standards, received the Superior Service Award at the 12th Annual Department of Health Education and Welfare Honor Awards Ceremony. Dr. Pittman is a former president of the Washington Academy of Sciences.

NAVAL RESEARCH LABORATORY

Richard Tousey received the Draper Medal during the recent 100th annual meeting of the National Academy of Sciences, in recognition of his achievements in solar spectroscopy. Dr. Tousey is the 34th Draper medalist since establishment of the award in 1886.

UNCLASSIFIED

Roy C. Dawson attended the Fifth Annual Conference on Agricultural Meteorology, held in Lakeland, Fla., April 4-5.

DEATHS

Lyman J. Briggs, director emeritus of the National Bureau of Standards, died March 26 at the age of 89. When he retired

in 1945, Dr. Briggs had served the Government for 49 years. He graduated from Michigan State College at 19, and later earned a masters degree in physics from the University of Michigan and the Ph.D. degree from Johns Hopkins University. He began his Government career in 1896, while still a student, as a physicist in the Bureau of Soils of the Department of Agriculture. In 1906 he organized a biophysical laboratory in the Bureau of Plant Industry, and in 1920 he joined the Bureau of Standards. He was appointed acting director by President Hoover in 1932, and confirmed as director in 1933.

CALENDAR OF EVENTS

May 14—American Society of Civil Engineers

Dinner meeting.

6:30 p.m. Powell Auditorium, Cosmos Club.

May 15—American Meteorological Society

Regular meeting.

8:00 p.m., National Academy of Sciences.

May 20—American Society for Metals

National officers' night. Speaker, R. J. Raudebaugh, International Nickel Company, national president of ASM.

6:30 p.m., dinner; 8:00, program. AAUW Building, 2401 Virginia Ave., N.W.

May 20—Society of American Military Engineers

Luncheon meeting.

Noon, Barker Hall, YWCA, 17th and K Sts., N.W.

May 20-23—American Meteorological Society (and others)

1963 International Symposium on Humidity and Moisture Measurement and Control in Science and Industry, sponsored by American Meteorological Society, Instrument Society of America, American Society of Heating, Refrigerating, and Air Conditioning Engineers, National Bureau of Standards, and Weather Bureau.

Sheraton Park Hotel.

May 20—Chemical Engineers Club

Luncheon meeting. Norman C. Laffer, professor of microbiology, University of Maryland, "Industrial Microbiology."

12:15, All States Dining Room, 514 19th St., N.W.

May 21—Anthropological Society of Washington

Gottfried Lang, Catholic University, "Fieldwork in Tanganyika."

8:15 p.m., Room 43, National Museum, 10th St. and Constitution Ave., N.W.

May 21—American Ceramic Society

James Gangler, NASA, "Material problems and the Moon."

6:00 p.m., social hour; 6:45, dinner. Broadmoor Hotel, Connecticut Ave. and Porter St., N.W.

May 23—American Society of Mechanical Engineers

Regular meeting.

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

May 27—D. C. Society of Professional Engineers

Regular meeting.

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

May 28—American Society for Microbiology

Regular meeting.

8:00 p.m., Sternberg Auditorium, Walter Reed.

May 28—American Society of Civil Engineers

Luncheon meeting.

Noon, YWCA, 17th and K Sts., N.W.

ELECTIONS TO FELLOWSHIP

The following persons were elected to fellowship in the Academy at the Board of Managers meeting on April 9:

John E. Gibson, head, Millimeter Wave Astronomy Section, Naval Research Laboratory, "in recognition of his contributions to astrophysics, and in particular his researches on millimeter wavelength radiation of solar system and galactic sources." (Sponsors: Wayne C. Hall, Ed-

ward F. McClain, Jr., Hubert Friedman.)

William R. Hunter, physicist, Naval Research Laboratory, "in recognition of his researches on the optical and photoelectric properties of materials in the extreme ultraviolet." (Sponsors: Wayne C. Hall, Richard Tousey, Hubert Friedman.)

Carl Lamanna, deputy chief and scientific advisor, Life Sciences Division, Army Research Office, "in recognition of his contributions to microbiology, in particular his researches on bacterial toxins and spores, and his co-authorship of 'Basic Bacteriology, Its Biological and Chemical Background.'" (Sponsors: Mary L. Robbins, Howard E. Noyes, Ray C. Dawson.)

Joseph C. R. Licklider, assistant director, Advanced Research Projects Agency, Department of Defense, "in recognition of his contributions to psychology and communication, and in particular his researches on speech perception, pitch perception, and man-computer interaction." (Sponsors: Philip J. Franklin, Charles M. Herzfeld, Maurice Apstein.)

George B. Magin, Jr., radiochemist and radiohydrologist, Atomic Energy Commission, "in recognition of his contributions to knowledge of the chemistry of minerals, in particular his research and his guidance of research by others on the inorganic chemistry of rare earths, mineral synthesis, chemistry of water and its relations to aquifers, and tracer application of radioisotopes." (Sponsors: A. P. Mathers, M. J. Pro, R. L. Schoenemann.)

ELECTIONS TO MEMBERSHIP

The following persons were elected to membership in the Academy at a meeting of the Membership Committee on March 25:

Michael Amrine, science editor, Federation of American Scientists, American Psychological Association, American Statistical Association, and American Orthopsychiatric Association. (Sponsored by John S. Toll.)

Ernest P. Gray, principal staff member (physics), Applied Physics Laboratory, Johns Hopkins University. (Sponsored by Mary L. Robbins.)

W. W. Hammerschmidt, executive secretary, Defense Science Board, Office of the Director of Defense Research and Engineering.

Berton F. Hill, executive secretary, Institute of Laboratory Animal Resources, NAS-NRC. (Sponsored by Frank L. Campbell.)

BOARD OF MANAGERS MEETING NOTES

March Meeting

The Board of Managers held its 554th meeting on March 12 at the National Academy of Sciences, with President Van Evera presiding.

The minutes of the 553rd meeting were approved as previously distributed.

Announcements. Dr. Van Evera announced that on May 14, Editor Detwiler would be the recipient of the Honor Award for 1963 of the Washington Chapter, American Institute of Chemists.

Dr. Van Evera reported on the meeting of the Executive Committee on February 27, calling particular attention to the discussion of a possible joint journal as well as a joint directory for scientific societies of the Washington area. Dr. Van Evera asked the Board members to consider the pros and cons of establishing such a joint enterprise and be prepared to discuss the matter at a subsequent Board meeting.

Membership. Chairman Hobbs presented the names of five candidates for resident fellowship, for First Reading.

Dr. Hobbs requested guidance on interpretation of the term "acceptable" in considering qualifications for membership in the Academy. It was concluded that individuals should be considered "acceptable" if they could demonstrate an interest in science, even if they could not demonstrate professional competence in any branch thereof. The Board felt that it is the expressed general intent of the present

Bylaws to provide in the membership category an opportunity for amateur scientists, teachers of science, members of trade organizations who employ scientists, etc., to become members of the Academy; and that a more precise statement of qualifications for membership may be evolved after some experience with general guidelines like those indicated above.

Dr. Hobbs distributed for comment a tentative "application for membership" form. It was generally considered that the form required excessive information on professional accomplishments, which might deter many amateurs and teachers from seeking membership. Dr. Van Evera asked Dr. Hobbs to meet with the Executive Committee on March 27 to continue discussion of this and other points concerned with membership.

Election of Fellows. Following the Second Reading of their names by Dr. Hobbs, the following persons were elected to fellowship in the Academy: A. D. Alexander, R. C. Parlett, and R. E. Ritts, Jr. (See also April issue, page 100.)

Treasurer. Treasurer Henderson reported the following current balances: Junior Academy, \$2,839.92; Joint Board, \$6,315.07; Senior Academy, \$2,167.88, plus a 91-day bill for \$5,000.

Editor. Editor Detwiler reported that the March issue of the *Journal* would be in the mail on Wednesday, March 13.

Meetings. Chairman Robbins reminded the Board that the Academy's March 21 meeting would be addressed by Raymond J. Seeger of the National Science Foundation, "On the Sociology of Science." She also announced that the speaker for the April 18 meeting would be Ragnar Rollefson, director of the Office of International Scientific Affairs, Department of State, on "Science in the Department of State."

Dr. Robbins also reported the following appointments to the Committee on Meetings: F. T. McClure, P. H. Oehser, B. F. Scribner, and Jacinto Steinhart.

Old Business. Dr. Van Evera announced his conclusion, reached after consideration

of a question raised about the propriety of the Academy having a committee to deal with Congressional affairs, that there are no restrictions in the Academy charter in this respect. Dr. Van Evera has established a Committee on Congressional Activities Affecting Science, and has named the following members: Malcolm W. Henderson (chairman), Frank L. Campbell, and Thorndike Saville.

April Meeting

The Board of Managers held its 555th meeting on April 9 at the National Academy of Sciences, with President-elect Francois Frenkiel presiding in the unavoidable absence of President Van Evera.

The minutes of the 554th meeting were approved as previously distributed.

Membership. Chairman Hobbs presented the names of five candidates for resident fellowship, for First Reading.

Dr. Hobbs announced that the Membership Committee had elected the following four persons to membership in the Academy, as follows: M. Amrine, E. P. Gray, W. W. Hammerschmidt, and B. F. Hill.

Dr. Hobbs submitted for comment a draft application form for membership; the Board approved the form and authorized the Secretary to duplicate a thousand copies. Dr. Hobbs indicated that a draft form for nomination of resident fellows would be presented at the next Board meeting.

Treasurer. Treasurer Henderson reported the following current balances: Junior Academy, \$1,270.83 in checking account, \$2,839.92 in savings account; Joint Board, \$5,110.45; Senior Academy, \$4,044.50 in checking account, plus a 91-day bill for \$5,000.

Dr. Henderson announced that Mrs. Richard Humphreys would soon assume secretarial duties in the Academy office, succeeding Mrs. Galbraith.

Dr. Henderson suggested that the Board consider and discuss at the next meeting the question of bonding the treasurer.

Dr. Henderson reported receipt of a request from the Department of Defense for

permission to reprint certain entomological information appearing in the *Journal*. The Board could see no reason why the Academy should object to the DOD proposal; however, it was agreed that Dr. Henderson would discuss the matter also with the Johnson Reprint Company, which handles the sale of back issues of the *Journal*.

Secretary. Dr. Irving reported that certain Bylaws changes recently approved by the Board (see February *Journal*, page 41) would soon be submitted to the membership for ratification by mail ballot. On the same ballot, the members will be requested to vote on the affiliation of the Washington-Baltimore Section of the Electrochemical Society.

Editor. Editor Detwiler reported that the April issue of the *Journal* was in press, and expressed thanks to Associate Editors Farrow and Campbell for completing the editorial work on this issue during the Editor's absence from the city.

Mr. Detwiler also indicated that he and President Van Evera would meet with officers of the Chemical Society of Washington to discuss the feasibility of combining the directory of that group with the Academy's directory.

Meetings. Chairman Robbins informed the Board that during her projected sojourn in Baghdad and until the end of June, Dr. Steinhart would serve as acting chairman of the Committee.

Dr. Robbins presented the following forecast of future Academy meetings: April 18, Ragnar Rollefson on "Science in the Department of State"; May 16, Sherman Beychok of Columbia University on optical rotatory dispersion studies of proteins in solution; October meeting, John O'Keefe of Goddard Space Flight Center and another speaker to be named, sharing a discussion of some aspects of a flight to the moon; May 1964 meeting, R. B. Kuschner of the Applied Physics Laboratory, demonstrating some aspects of the navigational satellites. Also in 1964, a commemoration of Galileo's 400th birthday may be included in the program.

Dr. Robbins also presented a Meetings Committee proposal that the Academy sponsor an annual symposium particularly appropriate to Washington and not suitable for individual scientific societies. The overall theme might be "Science and Society"; and the symposium could be known, for example, as the Annual Washington Academy of Sciences Symposium on Science and Society. The following subjects were suggested for individual symposia, or for coverage in two or three successive symposia: Socialization of science; impact of science on population trends; science as an economic dislocator; science and communication; and support of science from the standpoint of allocation of natural resources. It was proposed that a special committee for planning and conducting the symposia be appointed.

Dr. Frenkiel indicated that the Executive Committee had reacted favorably to this proposal at its meeting on March 27. At the present meeting, the Board's reaction likewise was generally favorable. It was suggested that Dr. Van Evera might wish to choose a special committee of Academy members to explore the general idea with scientists and perhaps university presidents in the area, before determining how next to proceed.

Election of Fellows. Following the Second Reading of their names by Dr. Hobbs, the following persons were elected to fellowship in the Academy: J. E. Gibson, W. R. Hunter, Carl Lamanna, J. C. R. Licklider, and G. B. Magin, Jr.

New Business. As delegate for the Institute of the Aerospace Sciences, Dr. Frenkiel reported that within the next six months this group will go out of independent existence to become part of the American Institute of Aeronautics and Astronautics. It is possible but not certain that the latter organization will become formally affiliated with the Washington Academy of Sciences.

The Board discussed the feasibility of publishing a single journal serving all scientific societies in the Washington area. The discussion briefly covered such topics as objectives; format (newsletter type of journal, or medium for publication of general scientific papers, or a combination of both); the lack of need for preserving published items that have little permanent value; difficulties in merging the Academy's *Journal* with such an established specialized publication as *The Capital Chemist*; and appeal to advertisers in a joint publication. With this start, it was agreed that the discussion might be continued at subsequent Board meetings.



**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 L. PARADISO
Chemical Society of Washington	LEO SCHUBERT
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	GERHARD M. BRAUER
Institute of the Aerospace Sciences	FRANCOIS N. FRENKIEL
American Meteorological Society	MORRIS TEPPER
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
American Ceramic Society	Delegate not appointed

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

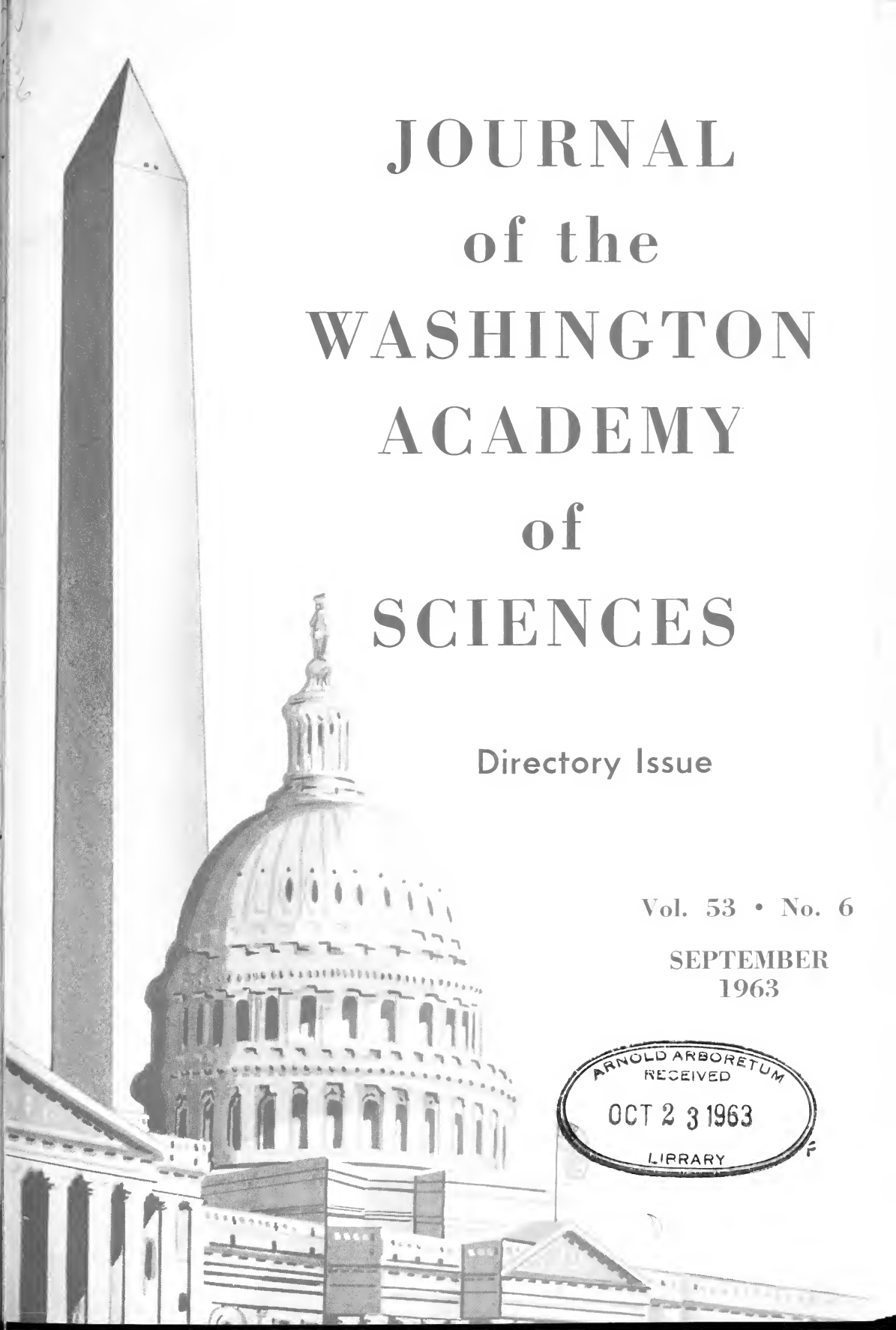
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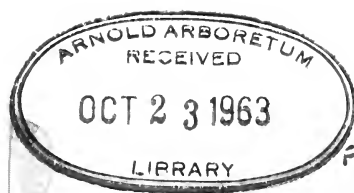


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JOURNAL OF THE WASHINGTON ACADEMY OF SCIENCES

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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.

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Current issues of the Journal (past two calendar years) may still be obtained directly from the Academy office at 1530 P Street, N.W., Washington 5, D.C.

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Washington Academy of Sciences

1963 Directory

of

The Academy and Four of Its Affiliated Societies

Foreword

The present, 38th, issue of the Academy's directory is again this year issued as the September issue of the *Journal*.

As was the case last year, we have attempted to produce an up-to-date listing of the membership at minimum cost to the Academy. Between the classified listing and the Washington telephone book, there should be little difficulty in getting in touch with local members; hence we have not given the addresses of members. Also, the Academy office at 1530 P Street (AD 4-5323) is in a position to supply addresses for all members, whether local or non-resident, upon request.

Again this year, members are classified by three listings—alphabetically, by place of employment, and by membership in local societies affiliated with the Academy. Thus, the directory attempts to answer the basic questions that arise when the name of a scientist is mentioned: Where does he work? and What does he do? The knowledge that John Jones works in the Agricultural Research Service and that he belongs to the Entomological Society is the key to whether we have anything in common with him, and if so, how to seek him out.

We have not indicated places of employment for nonresident members, since this would lead to a very complex coding system; and such codes would scarcely be a reliable guide for written contacts. Nor have we classified emeritus members by place of employment, since most of them, presumably, have retired from gainful employment.

Assignment of codes for place of employment and membership in affiliated societies is based upon results of a postcard questionnaire sent to active, resident fellows and members. Where fellows and 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.

An innovation this year is the inclusion of complete membership rosters for four of the Academy's 29 affiliated societies, both members and nonmembers of the Academy. These four affiliates are the Entomological Society of Washington, the Botanical Society of Washington, the International Association for Dental Research, and the Institute of Food Technologists. In return for their cooperation, the four societies will be provided with copies of the directory at nominal cost. This operation is avowedly a pilot-scale experiment to develop precise figures on the labor and cost of including nonmembers of the Academy, and to determine by experience the usefulness of such listings, to both the Academy and the affiliates. If the service does have general usefulness and the cost is not prohibitive, we shall hope to extend it next year to other Academy affiliates. Certainly it can be envisioned that a consolidated directory of the Academy and all its affiliates would provide a valuable guide to a preponderance of the scientists in the Washington area.

Explanation of Listings

Academy Fellows and Members

The alphabetical listing purports to include all fellows and members on the Academy rolls as of July 1, 1963, whether resident or nonresident, and whether active (dues-paying) or emeritus (retired).

Employment.—The first column of code symbols after the name is a semi-mnemonic cross-reference to place of employment, as shown in the first classified listing. In the employment code, 1 refers to Government agencies (and 1A to Agriculture, 1C to Commerce, etc.; and 1CNBS refers to the National Bureau of Standards in the Department of Commerce); 2 refers to educational institutions, both higher (2H) and secondary (2S) (2HUMD is the University of Maryland); 3A refers to associations and 3I to private institutions; 4 refers to consultants, physicians, and other self-employed persons; 5 refers to business concerns (5HARE is the Harris Research Laboratories, for example); 6 refers to foreign and international groups (embassies, UN organizations, etc.); 7 refers to retired persons who are still dues-paying fellows; and 8 refers to persons whose places of employment, if any, are presently not known.

Places of employment are given only for resident active fellows and members.

Affiliation.—The second column of code symbols refers to the person's membership in one or more of the societies affiliated with the Academy, as given in the following list, which includes also the year of the societies' affiliation with the Academy:

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)
- 5 American Ceramic Society, Baltimore-Washington Section (1962)

A systematic effort was made to include affiliations for all resident active fellows and members. In the case of nonresidents and emeriti, affiliations are given where known, but the listings are not comprehensive.

Two recent society mergers should be noted, since they will affect the future classification of affiliates. The Institute of the Aerospace Sciences (Code X) has merged with the American Rocket Society (not an Academy affiliate) to become the American Institute of Aeronautics and Astronautics. And the American Institute of Electrical Engineers (Code N) has merged with the Institute of Radio Engineers (Code S) to become the Institute of Electrical and Electronics Engineers. Since it is not clear that these mergers have been completely effected at the local level, we have

not recognized the changes in the present directory, but shall doubtless do so in the next edition.

Academy Status.—The third column of symbols refers to membership status in the Academy. AF refers to a fellow of the Academy, and AM to an Academy member. RA refers to a resident active fellow or member; NA refers to a nonresident active fellow or member (living more than 50 miles from the White House); and RE and NE refer respectively to resident and nonresident emeritus fellows.

Nonmembers of the Academy

In the case of four Academy affiliates (Codes F, K, W, and 4), all members of the affiliates are listed in the directory, whether or not they belong to the Academy. Those who do not belong to the Academy are designated by a two-letter code in the third column, instead of a four-letter code (e.g., RA instead of AFRA). The symbols RA, NA, RE, and NE refer to status in the affiliate concerned, rather than in the Academy.

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 21 in chronological order of affiliation. Some of these 29 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 consists of three general classes: members, fellows, and patrons.

At present the membership is composed principally of resident active fellows who by reason of scientific attainment are deemed eligible. Nominations for fellowship, endorsed by at least two fellows 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. The new category, "member," is open, upon application, to any interested person who is approved by the Committee on Membership.

As of July 1, 1963, the total membership of the Academy was approximately 1180.

Organization for 1963

Officers

<i>President</i>	BENJAMIN D. VAN EVERA	George Washington University (FE 8-0250 X 681; home CL 6-3298)
<i>President-Elect</i>	FRANCOIS N. FRENKIEL	David Taylor Model Basin (EM 5-2600 X292; home WO 6-2344)
<i>Secretary</i>	GEORGE W. IRVING, JR.	Department of Agriculture (DU 8-5134; home OL 2-8564)
<i>Treasurer</i>	MALCOLM C. HENDERSON	Catholic University (LA 9-6000 X313; home CO 5-1252)

Managers

<i>Term through</i> 1963	ALPHONSE F. FORZIATI	Advanced Research Projects Agency DOD (OX 7-8663; home JU 8-9617)
1963	LEO SCHUBERT	American University (WO 6-6800 X 267; 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)
1965	JOHN K. TAYLOR	National Bureau of Standards (EM 2-4040 X7855; home WA 7-4659)
1965	MARY L. ROBBINS	George Washington University (FE 3-9000 X510; home OL 2-5410)

Committee Chairmen

Executive Committee	BENJAMIN D. VAN EVERA	George Washington University (FE 8-0250 X681; home CL 6-3298)
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(The Executive Committee consists of the president, president-elect, secretary, treasurer and John K. Taylor and Russell B. Stevens for the Board of Managers.)

Meetings	MARY L. ROBBINS	George Washington University (FE 3-9000 X510; home OL 2-5410)
Membership	ROBERT B. HOBBS	National Bureau of Standards (EM 2-4040 X478; home OL 4-6042)
Awards for Scientific Achievement	ROBERT W. BERLINER	National Institutes of Health (496 X2116; home 652-7572)

Grants-in-Aid of Research	ARCHIBALD T. MCPHERSON	Office of Technical Services, USDC (EM 2-4040 X7218; home WH 2-4065)
Policy and Planning	To be appointed.	
Encouragement of Science Talent	REV. FRANCIS J. HEYDEN, S.J.	Georgetown University (FE 7-3300 X577)
Science Education	JOHN K. TAYLOR	National Bureau of Standards (EM 2-4040 X 7855; 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)
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	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	1927	Alexander Wetmore	1946	Hugh L. Dryden
1899-		1928	Robert B. Sosman	1947	Waldo L. Schmitt
1910	Charles D. Walcott	1929	Ales Hrdlicka	1948	Frederick D. Rossini
1911	Frank W. Clarke	1930	William Bowie	1949	F. H. H. Roberts, Jr.
1912	Frederick V. Coville	1931	Nathan Cobb	1950	Francis B. Silsbee
1913	Otto H. Tittmann	1932	Leason H. Adams	1951	Nathan R. Smith
1914	David White	1933	Robert F. Griggs	1952	Walter Ramberg
1915	Robert S. Woodward	1934	Louis B. Tuckerman	1953	Frank M. Setzler
1916	Leland O. Howard	1935	George W. McCoy	1954	Francis M. Defandorf
1917	William H. Holmes	1936	Oscar E. Meinzer	1955	Margaret Pittman
1918	Lyman J. Briggs	1937	Charles Thom	1956	Ralph E. Gibson,
1919	Frederick L. Ransome	1938	Paul E. Howe	1957	William M. Rubey
1920	Carl L. Alsberg	1939	Charles E. Chambliss	1958	Archibald T. McPherson
1921	Alfred H. Brooks	1940	Eugene C. Crittenden	1959	Frank L. Campbell
1922	William J. Humphreys	1941	Austin H. Clark	1960	Lawrence A. Wood
1923	Thomas W. Vaughan	1942	Harvey L. Curtis	1961	Philip H. Abelson
1924	Arthur L. Day	1943	Leland W. Parr	1962	Benjamin D. Van Evera
1925	Vernon Kellogg	1944	Clement L. Garner		
1926	George K. Burgess	1945	John E. Graf		

Bylaws

The Bylaws of the Academy, as last amended in December 1962, appear in the February 1963 issue of the Journal, pages 51-55. Various new amendments to Article IV (Officers), approved by the Board of Managers at its meeting of January 8, 1963

and appearing on pages 44-45 of the February Journal, are currently before the membership for ratification by mail ballot. A new, up-to-date version of the Bylaws will appear in the Journal in the near future.



Alphabetical List of Members

ABBOT, CHARLES G		AFRE	BAKER, EDWARD W	1ARRP	F	RA
ABELSON, PHILIP H	3IGEL BEHQ3	AFRA	BAKER, HOWARD	1ARFR	F	RA
ABRAMS, ALBERT M	1D-IP	W RA	BAKER, W L	8CLUN	F	RA
ABRAMS, ESTELLE	2HHOU	W RA	BAMFORD, RONALD	2HUMD	K	AFRA
ACHTER, MEYER R	1DNRL	V AFRA	BARBEAU, MARIUS			AFNA
ACKERMAN, WILLIAM L	1ARFR	K RA	BARBROW, LOUIS E	1CNBS	BN	AFRA
ADAIR, CHARLES R	1ARFR	K RA	BARCLAY, ARTHUR S	1ARFR	K	RA
ADAMS, CAROLINE A	2SARC	K RA	BARKER, HENRY D	1ARFR	K	RA
ADAMS, ELLIOT Q		AFNE	BARKER, ROY J	1ARFR	EFGZ	AFRA
ADAMS, JEAN R		RA	BARNES, R PERCY	2HHOU	E	AFRA
ADAMS, LEASON H	1AX	F AFNE	BARNHART, CLYDE S		F	AFNA
ADLER, VICTOR E	1ARFR	F RA	BARON, LOUIS S	1DAWR	QU	AFRA
AKERS, ROBERT P	1HNIH	G AFRA	BARRE, H W		K	NE
ALBERTS, HUGO	8CLUN	K RA	BARRETT, MARGARET D	1HNIH	U	AFRA
ALDRICH, JOHN W	1IFWS	D AFRA	BARRETT, MORRIS K	1HNIH	U	AFRA
ALEXANDER, AARON D	1DAWR	QU AFRA	BARRY, CORNELIUS	2HUMD	F	RA
ALEXANDER, ALLEN L	1DNRL	E AFRA	BARSS, HOWARD P		K	AFNE
ALEXANDER, LYLE T	1ARFR	E AFRA	BARTLETT, RICHARD P JR	1AMRP	4	RA
ALEXANDER, SAMUEL N	1CNBS	BNS AFRA	BARTRAM, M THOMAS	1HFDA	4	RA
ALFORD, HAROLD G	1ARRP	F RA	BASS, ARNOLD M	1CNBS	B	AFRA
ALFORD, JOHN A	1ARNI	4 RA	BATCHER, OLIVE M	1ARNI	4	RA
ALLEN, HAROLD B	1IFWS	4 RA	BATEMAN, ALAN M			AFNE
ALLEN, HARRY C JR	1CNBS	BEG AFRA	BATES, P H			AFNE
ALLEN, WILLIAM	1CMAA	O AFRA	BATES, ROGER G	1CNBS	E	AFRA
ALLISON, FRANKLIN E	7RETD	EGO AFRA	BATTISTONE, G C	1DAWR	W	RA
ALT, FRANZ L	1CNBS	AFRA	BAUER, HUGO	1HNIH	E	AFRA
ALTER, HARVEY	5HARE	E AFRA	BEACH, LOUIS A	1DNRL	BG3	AFRA
AMES, LAWRENCE M	1DAEX	K AFRA	BEACHAM, LOWRIE M	1HFDA	4	RA
AMIRIKIAN, ARSHAM	1DNBY	RT AFRA	BEAL, JAMES A	1AFOR	F	RA
AMRINE, MICHAEL	4CONS	AMRA	BEAN, HOWARD S	4CONS	O	AFRA
ANASTOS, GEORGE	2HUMD	GP AFRA	BEARCE, HENRY W			AFNE
ANDERSEN, ALICE M	1AMRP	K RA	BECKER, EDWIN D	1HNIH	E	AFRA
ANDERSON, DONALD M	1ARFR	F RA	BECKETT, CHARLES W	1CNBS	E	AFRA
ANDERSON, EVELYN		AFNA	BEE, GERALD R	3ANCA	4	RA
ANDERSON, MYRON S	7RETD	E AFRA	BEHREND, EDWIN H			AFRE
ANDERSON, WENDELL L	1DNRL	E AFRA	BEIJ, K HILDING			AFNE
ANDERSON, WILLIAM H	1ARFR	FZ AFRA	BEKKEDAHL, NORMAN	1CNBS	BEG	AFRA
ANDREWS, HOWARD L	1HNIH	AFRA	BELKIN, MORRIS	1HNIH		AFRA
ANDREWS, JOHN S	1ARFR	P AFRA	BELL, JAMES W	3ANCA	4	RA
ANDREWS, T G	2HUMD	AFRA	BELOIAN, ARAM	1ARNI	4	RA
APP, BERNARD A	1ARFR	F RA	BELSHEIM, ROBERT	1DNRL	BGO	AFRA
APPEL, WILLIAM D	3AATC	E AFRA	BENDER, ALVA H	8CLUN	F	RA
APPLEMAN, CHARLES O		AFRE	BENDER, EDWARD K	8CLUN	F	RA
APSTEIN, MAURICE	1DAHD	S AFRA	BENDER, MAURICE	1HPHS	E4	AFRA
ARBUCKLE, W S	2HUMD	4 RA	BENDER, ROBERT W	5GIFO	4	RA
AREFIAN, DANIEL	2HHOU	W RA	BENEDICT, WILLIAM S	2HJHU		AFRA
ARMSTRONG, CHARLES		AFRE	BENJAMIN, CHESTER R	1ARFR	DGK	AFRA
ARMSTRONG, GEORGE T	1CNBS	BEG AFRA	BENNETT, JOHN A	1CNBS	GV	AFRA
ARNETT, ROSS H	2HCUA	F RA	BENNETT, MARTIN	4CONS	E	AFRA
ARNOLD, FRANCIS A JR	1HNIH	W RA	BENNETT, ROBERT R	1IGES	H	AFRA
ARTZ, LENA		K RE	BENNETT, WILLARD H			AFNA
ASLAKSON, CARL I	4CONS	RT AFRA	BERCH, JULIAN	5HARE	E	AMRA
ASTIN, ALLEN V	1CNBS	BSX AFRA	BERKNER, L V			AFNA
AUSLOOS, PIERRE J	1CNBS	E AFRA	BERL, WALTER G	3IAPL	BE	AFRA
AUTRY, HOMER V	8CLUN	F RA	BERLINER, ROBERT W	1HNIH	BU	AFRA
AXILROD, BENJAMIN M	1CNBS	B AFRA	BERMAN, MORRIE D	1ARNI	4	RA
			BERNIER, JOSEPH L	1D-IP	W	RA
			BERNTON, HARRY S	4PHYS	I	AFRA
BABERS, FRANK H		AFNA	BHASKAR, SURINDAR N	1DAWR	W	RA
BAER, PAUL N	1HNIH	W RA	BHUSSRY, B R	2HGEU	W	RA
BAILEY, ROBERT H		4 NA	BIBERSTEIN, FRANK A JR	2HCUA	BT	AFRA
BAILEY, WILLIAM J	2HUMD	E AFRA	BICKLEY, WILLIAM E	2HUMD	FZ	AFRA
BAKER, ARTHUR A	1IGES	H AFRA	BIEN, CORABEL		K	RE

BILLINGS, SAMUEL C	1ARRP F	RA	BUNN, RALPH W	3AES A FZ	AFRA
BIRCKNER, VICTOR		AFRE	BURAS, EDMUND M JR	5HARE E	AFRA
BIRD, H R		AFNA	BURGERS, J M	2HUMD BX	AFRA
BIRKS, LAVERNE S	1DNRL	AFRA	BURINGTON, RICHARD S	1DNBW BG	AFRA
BISHOPP, F C		AFNE	BURK, DEAN	1HNIH EU	AFRA
BISELL, T L	2HUMD F	RA	BURKE, BERNARD F	3ICIW	AFRA
BLACK, RICHARD B	1DNOR G	AFRA	BURKE, FRANK J	8CLUN F	RA
BLAIR, WILLIAM R		AFNE	BURKE, FREDERIC G	4PHYS I	AFRA
BLAKE, DORIS H		F	BURKEY, LLOYD A		AFRE
BLANC, MILTON L		AFNA	BURKS, BARNARD D	1ARFR F	RA
BLICKENSTAFF, CARL C	1ARFR F	RA	BURNETT, GEORGE W	1DAWR W	RA
BLOOM, MORTIMER C	1DNRL BE	AFRA	BURNETT, HARRY C	1CNBS GV	AFRA
BLUM, WILLIAM		AFRE	BURNS, CLAIRE L	1CNBS W	RA
BLUNT, ROBERT F	1CNBS	AFRA	BURSTEIN, ELIAS		AFNA
BODENSTEIN, WILLIAM G	1ARFR F	RA	BURSTONE, M S	1HNIH W	RA
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BOGLE, ROBERT W		AFNA	BUSBEBY, RUTH L	1ARFR F	RA
BOHRER, WALLACE C	3ANCA 4	RA	BUTLER, CHARLES	11FWS 4	RA
BOLTON, ELLIS T	3IDTM	AFRA	BUTLER, WARREN L	1AMMR B	AFRA
BOND, HOWARD W	1HNIH E	AFRA	BYERLY, PERRY		AFNA
BONDELID, ROLLON O	1DNRL	AFRA	BYERLY, THEODORE C	1ACSE U	AFRA
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BORTHWICK, HARRY A	1ARFR DKG	AFRA	BYRNE, ROBERT J	1HNIH GQ	AFRA
BOSWELL, VICTOR R	1ARFR	AFRA			
BOUTWELL, JOHN M		GH			
BOWEN, RAEFEL L	1CNBS W	RA	CABALLERO, EDUARDO		AFNA
BOWER, VINCENT E	1CNBS	AFRA	CALDWELL, FRANK R	1CNBS BG	AFRA
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BOYD, EARL N	1ACSE 4	RA	CAMALIER, WILLARD C	4OENT W	RA
BOYD, FRANCIS R	3IGEL H	AFRA	CAMPAIGNE, HOWARD H	1D-X	AFRA
BOYD, HELEN C	1ANAL K	RA	CAMPBELL, FRANK L	3INAS BDEFZ	AFRA
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BRAATEN, NORMAN F	1CCGS BMR	AFRA	CANTWELL, GEORGE	1ARFR F	RA
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BRAM, RALPH A	2HUMD F	RA	CAREY, FRANCIS E	5ASPR	AFRA
BRANDLY, PAUL J	1ARRP 4	RA	CAREY, RICHARD T	1AMRP 4	RA
BRANHAM, SARA E		AFRE	CARHART, HOMER W	1DNRL EG	AFRA
BRANSON, HERMAN	2HHOU	AFRA	CARMICHAEL, LEONARD	1XSMI	AFRA
BRAUER, GERHARD M	1CNBS EW	AFRA	CARRINGTON, TUCKER	1CNBS BE	AFRA
BRECKENRIDGE, F C	1CNBS B	AFRA	CARROLL, DOROTHY	1IGES GH	AFRA
BRECKENRIDGE, ROBERT G		AFNA	CARROLL, THOMAS J	5BERA B	AFRA
BREIT, GREGORY		AFNA	CARROLL, WILLIAM R	1HNIH E	AFRA
BRENNER, ABNER	1CNBS EG	AFRA	CARRON, MAXWELL K	1IGES EH	AFRA
BREWER, CARL R	1HNIH Q	AFRA	CARTER, HUGH	1HPHS	AFRA
BREWER, KEITH A	1DNNO BEG	AFRA	CARTWRIGHT, O L	1XSMI F	RA
BRICKWEDDE, F G		AFNE	CASH, EDITH K		K
BRIERLEY, PHILIP	1ARFR K	RA	CASH, LILLIAN		K
BRIGHAM, IRVING H	8CLUN F	RA	CASSEL, JAMES M	1CNBS E	AFRA
BRODIE, BERNARD B	1HNIH EU	AFRA	CAUL, HAROLD J	1CNBS EVW	AFRA
BROGDON, JENNIE L	1ARNI 4	RA	CHALKLEY, HAROLD W		AFRE
BROMBACHER, W G	7RETD B	AFRA	CHAMBERLAYNE, EARL C	6WOHE 4	RA
BROOKMAN, BERNARD	1HNIH F	RA	CHAPIN, EDWARD A		AFNE
BROOKS, DONALD B	1D-S	AFRA	CHAPIN, EDWARD J	1DNRL GV	AFRA
BROOKS, HERBERT B		AFRE	CHAPLIN, HARVEY R JR	1DNDT	AFRA
BROWN, ALFRED E	5HARE BEG	AFRA	CHAPLINE, W R		K
BROWN, B F	1DNRL V	AFRA	CHAPMAN, VELMA J	1ARNI 4	RA
BROWN, EDGAR		AFRE	CHARTER, W V	8CLUN W	RA
BROWN, JOSHUA R C	2HUMD G	AFRA	CHASE, AGNES		K
BROWN, RUSSELL G	2HUMD K	AFRA	CHASE, FLORENCE M		K
BROWN, THOMAS M	2HGWA IQ	AFRA	CHEEK, CONRAD H	1DNRL E	AFRA
BROWN, WALTER E	1CNBS W	RA	CHILDS, VIRGINIA M	2HHOU K	RA
BUCK, RAYMOND W	1ARFR K	RA	CHRISTENSON, LEROY D	1ARFR FGZ	AFRA
BUCKLEY, FLOYD W	1CNBS E	AFRA	CHURCH, LLOYD E	1D-IP W	RA
BUHRER, EDNA M	7RETD P	AFRA	CHURCHILL, ETHAN D	8CLUN K	RA
BULLOCK, HOWARD R	1AX F	RA	CLAFFEY, PAUL J	2HCUA T	AFRA

CLAIRE, CHARLES N	1CCGS BM	AFRA	DAHMS, REYNOLD G	1ARFR F	RA
CLARK, FRANCIS E		AFNA	DALZELL, CARSON	1XAEC OV3	AFRA
CLARK, G M	1IFWS F	RA	DANE, CARLE H	1IGES H	AFRA
CLARK, GEORGE E JR	5ARCO	AFRA	DARROW, BERTHA S	8CLUN K	RA
CLARK, J ALLEN		RE	DARROW, G M		RE
CLARK, KENNETH G	1ARFR Q	AFRA	DARROW, ROBERT A	1DAFD K	RA
CLARK, WILLIAM A	3IATC Q	AMRA	DARWENT, BASIL DE B	2HCUA BE	AFRA
CLARKE, J F	1XSMI F	RA	DAUER, CARL C	1HPHS	AFRA
CLAUSEN, CURTIS P		AFNE	DAVIDSON, JOHN A	2HCOU F	RA
CLEAVER, OSCAR P	1DAER NR	AFRA	DAVIDSON, ROBERT A	2HCUA K	RA
CLEMENT, J REID JR	1DNRL	AFRA	DAVIS, DON R	1XSMI F	RA
COBLENTZ, W W		AFRE	DAVIS, MARION M	1CNBS EG	AFRA
COCHRAN, DORIS M	1XSMI G	AFRA	DAVIS, PHILIP J	1CNBS	AFRA
COCHRAN, LLOYD C	1ARFR K	RA	DAVIS, R F	2HUMD	AFRA
COE, FRED O	4PHYS GI	AFRA	DAVIS, RAYMOND		BE
COE, GERALD E	1ARFR K	RA	DAVIS, WATSON	3ISCS BHM	AFRA
COE, MAYNE R		AFNE	DAVISSON, JAMES W	1DNRL B	AFRA
COFFMAN, FRANKLIN A	1ARFR K	RA	DAWSON, CLARENCE E	4DENT W	RA
COHN, ROBERT	1DNHS B	AFRA	DAWSON, ELSIE H	1ARNI 4	RA
COLBRY, VERA	1AMRP K	RA	DAWSON, PAUL R		AFNE
COLE, HOWARD I		AFNE	DAWSON, REED		AFNA
COLE, KENNETH S	1HNIH	AFRA	DAWSON, ROY C	6FAOR Q	AFRA
COLEMAN, JOHN S	3INAS 2	AFRA	DAWSON, WILSON F	8CLUN F	RA
COLLINS, HENRY B	1XSMI C	AFRA	DE CAMP, ROGER A	3ANCA 4	RA
COMPTON, CHARLES C	5SHCH F	RA	DE FERIET, J KAMPE		AFNA
COMPTON, DALE W		AFNA	DE LAUNAY, JULES		AFNA
CONGER, PAUL S	1XSMI	AFRA	DE PACKH, DAVID	1DNRL	AFRA
CONKLE, HERBERT J	1ARRP F	RA	DE PUE, LELAND A	1DNRL GV	AFRA
COOK, HAROLD T	1AMMR BK4	AFRA	DEAN, HORACE S		K
COOK, J WILLIAM	1HFDA 4	RA	DEBORD, GEORGE G		AFNE
COOK, RICHARD K	1CNBS B2	AFRA	DEIGNAN, HERBERT G	1XSMI	AFRA
COOK, ROBERT C	5PORB CGK	AFRA	DEIGNAN, STELLA	1XSMI	AFRA
COOKE, WYTHE C		AFRE	DEITZ, VICTOR R	1DNRL E	AFRA
COOLEY, J S		RE	DEMAREE, J B		K
COOLIDGE, HAROLD J	3INAS G	AFRA	DENNY, CLEVE B	3ANCA 4	RA
COOLIDGE, WILLIAM D		AFNA	DERMEN, HAIG	1ARFR K	AFRA
COONS, GEORGE H		AFRE	DETWILER, SAMUEL B	7RETD KL	AFRA
COOPER, G ARTHUR	1XSMI H	AFRA	DETWILER, SAMUEL B JR	1ARNI E	AFRA
COOPER, JAMES F	1ARFR F	RA	DEWS, SAM C	1DAX F	RA
COOPER, STEWART R	2HHOU E	AFRA	DIAMOND, PAULINE	2SMOC	AFRA
COOTER, IRVIN L	1CNBS BN	AFRA	DICKSON, GEORGE	1CNBS GW	AFRA
CORNFIELD, JEROME	1HNIH	AFRA	DIEHL, WALTER S	4CONS X	AFRA
CORNYN, JOHN	1D-IP W	RA	DIEHL, WILLIAM W		K
CORRELL, DONOVAN S		AFNA	DIEHL, G H	2HJHU F	RA
CORY, ERNEST N		AFRE	DIENER, THEODOR O	1ARFR K	RA
COTTAM, CLARENCE		AFNA	DIGGES, THOMAS G		V
COULSON, JACK E	1ARNI EU	AFRA	DILLER, J D	1AFOR K	RA
COULSON, JACK R	1ARFR F	RA	DOCTOR, NORMAN J	1DAHD S	AFRA
COWAN, RICHARD S	1XSMI K	RA	DOETSCH, RAYMOND N	2HUMD Q	AFRA
COWIE, DEAN B	3IDTM	AFRA	DOLECEK, RICHARD L	1DNRL BG	AFRA
CRAFT, CHARLES C		AFNA	DONOVAN, JOSEPHINE R	8CLUN K	RA
CRAFTON, PAUL A		AFRA	DORN, HAROLD F	1HNIH	AFRA
CRAGOE, CARL S	2HGWU GNOX	AFRE	DOSS, MILDRED A	2HUMD P	AFRA
CRAVEN, JOHN P	1DNBP B2	AFRA	DOUGLAS, CHARLES A	1CNBS BG	AFRA
CREITZ, CARROLL E	1CNBS E	AFRA	DOUGLAS, THOMAS B	1CNBS E	AFRA
CRESSMAN, GEORGE P	1XNMC	AFRA	DOWNEN, PHILIP B	1ARFR F	RA
CRISS, WILLIAM H	3ADIS 4	RA	DOWNING, LEWIS K	2HHOU T	AFRA
CROOKS, DONALD M	1ARFR K	RA	DOWNS, ROBERT J	1ARFR K	RA
CROWTHER, HAROLD E	1IFWS 4	RA	DRAEGER, HAROLD R		AFNE
CUATRECASAS, JOSE	1XSMI K	RA	DRAKE, CARL J	1XSMI F	RA
CULBERTSON, JOSEPH O	1ARFR K	RA	DRECHSLER, CHARLES	1ARFR K	AFRA
CULLINAN, FRANK P	1ARFR K	AFRA	DRUMMETER, LOUIS F JR	1DNRL	AFRA
CURRAN, HAROLD R	1ARNI GQ	AFRA	DRYDEN, HUGH L	1XNAS BG0X	AFRA
CURRIER, LOUIS W	7RETD H	AFRA	DU SHANE, GRAHAM		AFNA
CURTIS, ROGER W	1DAHD	AFRA	DUCKWORTH, W DONALD	1XSMI F	RA
CURTISS, LEON F		AFNE	DUERDSEN, JACOB A	7RETD BG	AFRA
CUSHMAN, HELENE G	1ANAL F	RA	DUNCAN, HELEN M	1IGES H	AFRA
CUTTITTA, FRANK	1IGES EGH	AFRA	DUNCAN, ROBERT C		AFRE
			DUNNING, KENNETH L	1DNRL B	AFRA
DAFT, FLOYD S	7RETD EU	AFRA	DURBIN, CHARLES G	1HFDA GP	AFRA

DUTILLY, ARTHEME A	2HCUA K	AFRA	FITZGERALD, ROBERT J	1HNIH W	RA
DUTKY, SAMSON R	1ARFR F	RA	FIVAZ, ALFRED E	1CBDS L	AFRA
DWYER, MARY C	1DNSO 4	RA	FLEMING, HAROLD	2HHOU W	RA
			FLETCHER, HEWITT G	1HNIH EG	AFRA
			FLINT, OLIVER S	1XSMI F	RA
EARLE, WILTON R	1HNIH U	AFRA	FLORIN, ROLAND E	1CNBS E	AFRA
ECKERT, W J		AFNA	FLUNO, JOHN A	1ARFR F	RA
ECKHARDT, E A		AFNE	FOLK, JOHN E	1HNIH W	RA
EDDY, BERNICE E	1HNIH GQU	AFRA	FONER, SAMUEL N	3IAPL B	AFRA
EDDY, NATHAN B	1HNIH G	AFRA	FOOTE, PAUL D	3INAS B	AFRA
EDMONDSON, LOCKE F	1ARNI 4	RA	FOOTE, RICHARD H	1ARFR F	RA
EDMUNDS, LAFE R	1XNSF F	AFRA	FORD, T FOSTER	1DNRL E	AFRA
EDSON, JAMES B	1XNAS	AFRA	FORZIATI, ALPHONSE F	1D-S EW	AFRA
EGLI, PAUL H	1DNRL E	AFRA	FORZIATI, FLORENCE H	1ARNI E	AFRA
EGOLF, DONALD R	1ARFR K	AFRA	FOSTER, AUREL O	1ARFR P	AFRA
EHEART, JAMES F	1ARNI 4	RA	FOSTER, JAMES R	2HUMD F	RA
EHEART, MARY S	2HUMD 4	RA	FOURNIER, ROBERT O	1IGES H	AFRA
EHRMAN, JOACHIM B	1DNRL G	AFRA	FOURT, LYMAN	5SHARE E	AFRA
EIDUSON, HYMAN P	1HFDA 4	RA	FOWELLS, HARRY A	1AFOR L	AFRA
EISENBERG, WILLIAM	1HFDA K	RA	FOX, ADRIAN C	8CLUN K	RA
EISENHART, CHURCHILL	1CNBS B	AFRA	FOX, MATTIE R	1HFDA EGU	AFRA
EISENSTEIN, JULIAN C	1CNBS	AFRA	FOX, ROBERT B	1DNRL EG	AFRA
ELBOURN, ROBERT D	1CNBS BNS	AFRA	FRACKER, STANLEY B	7RETD F	RA
ELDRIDGE, BRUCE F	1DAWR F	RA	FRAME, ELIZABETH G	1HNIH EU	AFRA
ELKINS, EDGAR R JR	3ANCA 4	RA	FRANCK, JAMES		AFNE
ELLINGER, GEORGE A	1CNBS GV	AFRA	FRANK, BERNARD		AFNA
ELLIOTT, CHARLOTTE	K	AFNE	FRANK, KARL	1HNIH U	AFRA
ELLIOTT, F E		AFNA	FRANKLIN, PHILIP J	1D-S ENS	AFRA
ELLIS, NED R	1ARFR EGU	AFRA	FRANKLIN, TEMPIE R	2SARC	AFRA
EMERSON, K C	8CLUN F	RA	FRAPS, RICHARD M	1ARFR BU	AFRA
EMERSON, W B		AFRE	FREAR, SCOTT E	2HUMD 4	RA
EMERY, ALDEN H	3AACS EG	AFRA	FREDERIKSE, H P	8CLUN	AFRA
EMMART, EMILY W	1HNIH GQU	AFRA	FREEMAN, MONROE E	1XSMI EU	AFRA
EMMONS, CHESTER W	1HNIH K	RA	FREEMAN, OLIVER H	K	NE
EMSWELLER, SAMUEL L	1ARFR K	AFRA	FRENCHETTE, ARTHUR R	1DNMS W	RA
ENDICOTT, KENNETH M	1HNIH	AFRA	FRENKIEL, FRANCOIS N	1DNDR BXY	AFRA
ENGLAND, WALTER C	5ENLA 4	RA	FRIEDMAN, ABRAHAM S		AFNA
ENNIS, WILLIAM B JR	1ARFR	AFRA	FRIEND, BERTA	1ARNI 4	RA
ERIKSON, EDWIN B	4DENT W	RA	FRIESS, SEYMOUR L	1DNMR E	AFRA
ERNEST, JANE V	1AMMR 4	RA	FRUSH, HARRIET L	1CNBS E	AFRA
ESTERMANN, IMMANUEL		AFNA	FULKERSON, JOHN F	1ACSE K	RA
ETZEL, HOWARD W	1XNSF G	AFRA	FULLER, HENRY S	1DAWR DF	AFRA
EVANS, ALICE C		AFRE	FULLMER, HAROLD M	1HNIH W	RA
EVANS, W DUANE	1LBLS	AFRA	FULLMER, IRVIN H	1CNBS BGO	AFRA
EWERS, JOHN C	1XSMI	AFRA	FULTON, H R	K	RE
EYDE, RICHARD H	1XSMI K	RA	FULTON, ROBERT A	1ARFR EZ	AFRA
EZEKIEL, WALTER N	1DNX K	RA	FURUKAWA, GEORGE T	1CNBS BEG	AFRA
FABER, JOHN E	2HUMD Q	AFRA	GABRIELSON, IRA N	3IWMI	AFRA
FAHEY, JOSEPH J	1IGES EGH	AFRA	GADDIS, ADAM M	1ARNI 4	RA
FALES, JOHN H	1ARFR F	RA	GAFAFER, WILLIAM M	W	AFNA
FALLON, ROBERT J	5MELP BEG	AFRA	GALLOWAY, RAYMOND A	2HUMD K	RA
FARR, MARIE L	1ARFR K	RA	GALTISOFF, PAUL S		AFNE
FARR, MARION M	1ARFR P	AFRA	GAMMONS, JOHN G	8CLUN F	RA
FARROW, RICHARD P	3ANCA E4	AFRA	GAMOW, GEORGE		AFNA
FAUST, GEORGE T	1IGES H	AFRA	GARDNER, IRVINE C	7RETD B	AFRA
FAUST, WILLIAM R	1DNRL	AFRA	GARNER, CLEMENT L		AFRE
FENN, LEONARD S	1AMRP 4	RA	GARNER, RICHARD G	1ACSE 4	RA
FERGUSON, HENRY G		AFRE	GARRETT, WALLACE T	2HUMD F	RA
FERGUSON, LLOYD N	2HHOU E	AFRA	GARSTENS, HELEN L	2HUMD	AFRA
FERGUSON, ROBERT E	1CNBS	AFRA	GARVIN, DAVID	1CNBS	AFRA
FERRELL, RICHARD A	2HUMD G	AFRA	GARY, ROBERT	1CNBS	AFRA
FIELD, WILLIAM D	1XSMI	AFRA	GATES, G E		AFNA
FIELDNER, ARNO C	7RETD EGM	AFRA	GATES, JANE	1AMMR 4	RA
FIELDS, MELVIN D	1XGSA 4	RA	GAUCH, HUGH	2HUMD K	RA
FINLEY, HAROLD E	2HHOU D	AFRA	GAZIN, CHARLES L	1XSMI DH	AFRA
FIOCK, ERNEST F		AFNA	GEIL, GLENN W	1CNBS V	AFRA
FISCHBACH, HENRY	1HFDA 4	RA	GELLER, ROMAN F	7RETD BG5	AFRA
FISK, BERT	1DNRL	AFRA	GELTMAN, SYDNEY		AFNA

GERBERG, EUGENE J	5INCR	F	RA	HALLER, HERBERT L	1ARFR	EFGZ	AFRA
GEYGER, WILLIAM A	1DNOL	N	AFRA	HALSTEAD, BRUCE W			AFNA
GHAFFARI, ABOLGHASSEM	1CNBS	B	AFRA	HAMANN, JOHN A	1AMMR	4	RA
GIBBS, ROBERT J	1ARNI	4	RA	HAMBLETON, EDSON J	1ARRP	DFG	AFRA
GIBSON, JOHN E	1DNRL		AFRA	HAMBLETON, JAMES I	7RETD	F	AFRA
GIBSON, KASSON S			AFRE	HAMER, WALTER J	1CNBS	EN	AFRA
GIBSON, RALPH E	3IAPL	BEX	AFRA	HAMMERSCHMIDT, W W	1D-S	B	AMRA
GILBERT, ENGEL L	1ARRP	F	RA	HAMMOND, H DAVID	2HHOU	K	AMRA
GILLMAN, JOSEPH L JR	4CONS	EMOV	AFRA	HAMPP, EDWARD G	1CNHJ	QW	AFRA
GILPIN, GLADYS L	1ARNI	4	RA	HAND, CADET H JR			AFNA
GINNINGS, DEFOE C	1CNBS	E	AFRA	HANSBROUGH, RAYMOND	1AFOR	K	RA
GINTHER, ROBERT J	1DNRL		AFRA	HANSEN, IRA B	2HGWU	DG	AFRA
GISH, OLIVER H			AFNE	HANSEN, LOUIS S	1D-IP	W	RA
GLASGOW, AUGUSTUS R JR	1CNBS	EG	AFRA	HANSEN, MORRIS H	1CBUC		AFRA
GLASS, JEWELL J	1IGES		AFRA	HARDENBURG, ROBERT E	1ANMR		AFRA
GLASSER, ROBERT G	1DNRL		AFRA	HARDER, E C			AFNA
GODEK, THEODORE D	8CLUN	F	RA	HARDING, WALLACE G	2HUMD	F	RA
GODFREY, THEODORE B	1DAHD		AFRA	HARNED, R W	8CLUN	F	RA
GOLDBERG, MICHAEL	7RETD	B	AFRA	HARRIS, FOREST K	1CNBS		AFRA
GOLDSWORTHY, M C		K	NE	HARRIS, MILTON	5HARE	E	AFRA
GOLL, F L		K	RE	HARRISON, FLOYD P	2HUMD	F	RA
GOLUMBIC, CALVIN	1AMMR	E4	AFRA	HARRISON, W N	1CNBS		AFRA
GONET, FRANK	1XUST	E	AFRA	HART, ROBERT W	3IAPL		AFRA
GOODWIN, JOHN T JR	3ICIR	4	RA	HARTLEY, WILLIAM	6AUSO	K	RA
GOODWIN, WILLIAM M	1XVET	W	RA	HARVALIK, Z V	1DAER	E	AFRA
GOOS, ROGER D	1HNTH	K	RA	HARWOOD, PAUL D			AFNA
GORDON, CHARLES L	1CNBS	BEG	AFRA	HASELTINE, NATE	5WAPO		AFRA
GORDON, RUTH E			AFNA	HASKINS, CARYL P	3ICIW	FR	AFRA
GOTH, ROBERT W	1ARFR	K	RA	HASS, GEORG H	1DAER		AFRA
GOULD, IRA A			AFNA	HAUPTMAN, HERBERT	1DNRL	BG	AFRA
GRAF, JOHN E	7RETD	DFG	AFRA	HAUT, IRVIN C	2HUMD		AFRA
GRAHAM, C E	4CONS	4	RA	HAVILAND, ELIZABETH	2HUMD	F	RA
GRAHAM, EDWARD H	1ASCS		AFRA	HAWTHORNE, EDWARD W	2HHOU		AFRA
GRANT, ULYSSES S III	7RETD	GJMRT	AFRA	HAYDEN, IDA	2HHOU	W	RA
GRASSL, CARL O			AFNA	HAYES, DORIS W	1AFOR	K	RA
GRATON, LOUIS C			AFNA	HAYES, R LEWIS	2HHOU	W	RA
GRAUMANN, HUGO O	1ARFR	K	RA	HAZLETON, LLOYD W	5HALA	EU	AFRA
GRAYATT, ANNIE R	1ARFR	K	RA	HEERMAN, RUBEN M	1ACSE	K	RA
GRAYATT, G FLIPPO	7RETD	KL	AFRA	HEGGESTAD, HOWARD E	1ARFR	K	RA
GRAY, ERNEST P	3IAPL	B	AMRA	HEIMPEL, A M	1ARFR	F	RA
GREEN, MELVILLE S	1CNBS	B	AFRA	HEINZE, PETER H	1ANMR	EGK4	AFRA
GREENE, JOHN C	1HNHJ	W	RA	HELBACKA, NORMAN V	2HUMD	4	RA
GREENLEAF, CARLOS A	3ANCA	4	RA	HELLER, ISIDOR			AFNA
GREENOUGH, M L	1CNBS	G	AFRA	HENDERSON, E P	1XSMI	H	AFRA
GREENSPAN, MARTIN	1CNBS	BG2	AFRA	HENDERSON, MALCOLM C	2HCUA	B23	AFRA
GRIFFING, VIRGINIA	2HCUA	BE	AFRA	HENLEY, ROBERT R			AFRE
GRIFFITHS, NORMAN H	2HHOU	W	RA	HENNEBERRY, THOMAS J	1ARFR	F	AFRA
GRINNELL, CHARLES N	3ANCA	4	RA	HENRY, JOSEPH L	2HHOU	W	RA
GRISAMORE, NELSON T	2HGWU	BGNS	AFRA	HENRY, THOMAS R	7RETD		AFRA
GROSVENOR, GILBERT	3INGS	GJ	AFRA	HERMAN, CARLTON M	1IFWS	GPU	AFRA
GUARINO, P A	1DAHD	S	AFRA	HERMAN, ROBERT C			AFNA
GUNDERSON, FRANK L	4CONS	4	RA	HERRING, JON L	1ARFR	F	RA
GURNEY, ASHLEY B	1ARFR	DFG	AFRA	HERSCHMAN, HARRY K	1CX		AFRA
				HERSEY, MAYO D			AFNA
				HERZ, NORMAN			AFNA
HACKSKAYLO, EDWARD	1AFOR	GKL	AFRA	HERZFELD, CHARLES M	1D-S	B	AFRA
HAEUSSLER, GILBERT J	1ARFR	F	RA	HERZFELD, KARL F	2HCUA	B2	AFRA
HAGEN, JOHN P			AFNA	HERZFELD, REGINA F	2HCUA	C	AFRA
HAGEN, THOMAS L	1HPHS	W	RA	HESS, WALTER C		W	AFRE
HAGUE, JOHN L	1CNBS	EG	AFRA	HEYDEN, FRANCIS J	2HGEU	BG	AFRA
HAHN, ELISABETH H	3ANCA	4	RA	HIATT, CASPAR W	1HNHJ	EGQT	AFRA
HAHN, FRED E	1DAWR		AFRA	HICKLEY, THOMAS J	1CCGS	S2	AFRA
HAINES, KENNETH A	1ARAO	FGZ	AFRA	HICKOX, GEORGE H	1DAER	GQRT	AFRA
HAKALA, REINO W			AFNA	HICKS, VICTOR			AFNA
HALE, MASON E JR	1XSMI	K	RA	HIDNERT, PETER			AFRE
HALL, DAVID G	1ARAO	F	RA	HIGGINS, ELMER			AFRE
HALL, E RAYMOND			AFNA	HIGGINS, JOSEPH J	1ARFR	K	RA
HALL, R CLIFFORD			AFRE	HILBERT, GUIDO E	1ARAO	4	RA
HALL, STANLEY A	1ARFR	EZ	AFRA	HILDEBRAND, EARL M	1ARFR	K	RA
HALL, WAYNE C	1DNRL	SGN	AFRA	HILL, BERTON F	3INAS		AMRA

HILL, FREEMAN K	3IAPL BX	AFRA	JAMES, L H		AFNE
HILL, SAMUEL O	1ARFR F	RA	JAMES, MAURICE T		AFNA
HILLIG, FRED	5DRDE 4	RA	JAY, GEORGE E JR	5MIAS G	AFRA
HILTON, JAMES L	1ARFR	AFRA	JEN, C K	3IAPL B	AFRA
HINER, RICHARD L	1ARFR 4	RA	JENKINS, ANNA E	K	AFNE
HINMAN, WILBUR S JR	4CONS S	AFRA	JENKINS, DALE W	1XNAS F	RA
HIRST, JOHN M	1DNMC F	RA	JENNESS, DIAMOND		AFNE
HIVON, KATHARINE J	1ARNI 4	RA	JESSUP, RALPH S	7RETD BG	AFRA
HOBBES, ROBERT B	1CNBS BEG	AFRA	JOHANNESSEN, ROLF B	1CNBS E	AFRA
HOCHWALD, FRITZ	8CLUN K	RA	JOHNSON, A G	K	RE
HODGE, W H	1XNSF K	RA	JOHNSON, BERTRAND L		AFRE
HODGES, RONALD W	1ARFR F	RA	JOHNSON, D R	1SAID F	RA
HOERING, THOMAS C	3IGEL EH	AFRA	JOHNSON, DANIEL P	1CNBS B	AFRA
HOFFMAN, JAMES I		AFNA	JOHNSON, FALBA	K	NE
HOFFMAN, JOHN D	1CNBS E	AFRA	JOHNSON, KEITH C	2SDCP	AFRA
HOFFMAN, RICHARD E	8CLUN F	RA	JOHNSON, PAUL E	3INAS 4	AFRA
HOFFMANN, CLARENCE H	1ARFR FLZ	AFRA	JOHNSON, PHYLLIS T		AFNA
HOGGE, HAROLD J		AFNA	JOHNSTON, FRANCIS E	2HGWU B	AFRA
HOLLIES, NORMAN R S	5SHARE E	AFRA	JOHNSTON, FREDERICK A	1ARRP K	RA
HOLLINGSHEAD, ROBERT S		AFRE	JONES, HENRY A		AFNA
HOLMGREN, HARRY D	2HUMD	AFRA	JONES, JACK C	2HUMD F	AFRA
HOLSHOUSER, WILLIAM L	1XCAB GV	AFRA	JONES, SLOAN E	1ARFR F	RA
HOLSTON, JOHN A	1IFWS 4	RA	JORDAN, LUZERNE G	1HNIH W	RA
HOLWAY, R T	1D-PC F	RA	JOSEPH, STANLEY E	2HUMD F	RA
HOOKER, MARJORIE	1IGES H	AFRA	JOYCE, JAMES W	1SX BG	AFRA
HOOPER, JOHN I	1DNRL BG	AFRA	JUDD, DEANE B	1CNBS B	AFRA
HOOPER, SAM R	1ARNI 4	RA	JUDD, NEIL M		AFRE
HOOPER, THOMAS B	1CNBS E	AFRA	JUDSON, LEWIS V	7RETD BG	AFRA
HOOPER, WILLIAM J	3ICIR 4	RA	JUHN, MARY	7RETD U	AFRA
HOPP, HENRY	L	AFNA	JUSTICE, OREN L	1AMMR K	RA
HORNSTEIN, IRWIN	1ARNI 4	RA	JUSTIN, A CHRISTINE	1DN50 4	RA
HORTON, BILLY M	1DAHD	AFRA			
HOSTETTER, J C		AFNE			
HOTTLE, GEORGE A	1HNIH GQU	AFRA	KAGARISE, RONALD E	1DNRL G	AFRA
HOUGH, FLOYD W	GRT	AFNA	KAHN, ARNOLD H	1CNBS	AFRA
HOWARD, FRANK L	1CNBS E	AFRA	KALCKAR, HERMAN M	2HUJU	AFRA
HOWARD, GEORGE W	1DAER RT	AFRA	KALMBACK, KENNETH H	8CLUN F	RA
HOWE, PAUL E	4CONS E	AFRA	KALMUS, HENRY P	1DAHD S	AFRA
HOWELL, ARDEN J	1HNIH W	RA	KANAGY, JOSEPH R	1CNBS E	AFRA
HUBBARD, DONALD	1CNBS EG	AFRA	KANE, EDWARD A	1ARFR E	AFRA
HUGH, RUDOLPH	8CLUN	AMRA	KAPLAN, HARRY	4DENT W	RA
HUGHES, JOHN H	1HPHS F	RA	KARLE, ISABELLA	1DNRL G	AFRA
HULL, WILLIAM B	1DNMS F	RA	KARLE, JEROME	1DNRL BE	AFRA
HUMPHREYS, CURTIS J		AFNA	KARR, PHILLIP R		AFNA
HUNDLEY, JAMES M	1HPHS	AFRA	KARRER, ANNIE M H		AFRE
HUNT, HOWARD L	8CLUN F	RA	KARRER, SEBASTIAN	7RETD BE	AFRA
HUNT, N REX	K	NE	KAUFMAN, H PAUL	4CONS MR	AFRA
HUNTER, GEORGE W III		AFNE	KECK, DAVID K	1XNSF K	RA
HUNTER, RICHARD S	5HUAS G	AFRA	KEEGAN, HARRY J	1CNBS EG	AFRA
HUNTER, WILLIAM R	1DNRL B	AFRA	KEGELES, GERSON		AFNA
HUNTOON, ROBERT D	1CNBS BS	AFRA	KELLUM, LEWIS B		AFNA
HUTCHINS, LEE M	K	AFNA	KENK, ROMAN	1XLIC G	AFRA
HUTTON, GEORGE L	1DNBY FG	AFRA	KENNARD, RALPH B	7RETD BG	AFRA
HWANG, SHUH-WEI	3IATC K	RA	KENNARD, WILLIAM C	K	NA
HYLAND, HOWARD L	1ARFR K	RA	KENNEDY, E R	2HCUA GQ	AFRA
			KENNEDY, JAMES J	4DENT W	RA
			KENNEY, ARTHUR W	8CLUN	AFRA
		AFNA	KENWORTHY, FRANCIS T	1ARRP K	RA
IMAI, ISAO	3IACI K	RA	KEPHART, L W	K	RE
IMLE, E P	4CONS B5	AFRA	KERESZTESY, JOHN C	1HNIH E	AFRA
IRVING, HERBERT	1ARNI E4	AFRA	KERR, ELIZABETH B	8CLUN K	RA
IRWIN, GEORGE R	1DNRL B	AFRA	KERR, ROSE G	1IHEC 4	RA
ISBELL, HORACE S	1CNBS E	AFRA	KERR, THOMAS	1ARFR K	RA
			KESSLER, KARL G	1CNBS BG	AFRA
			KEULEGAN, GARBIS H		AFNA
JACKSON, HARTLEY H T		AFRE	KEYES, PAUL H	1HNIH W	RA
JACKSON, JULIUS L	1CNBS B	AFRA	KIES, JOSEPH A	1DNRL BGV	AFRA
JACOB, KENNETH D	4CONS E	AFRA	KIESS, CARL C	7RETD G	AFRA
JACOBS, WALTER W		AFNA	KIGUEL, ENRIQUE B	2HGUE W	RA
JACOBS, WOODROW C	1XNOD Y	AFRA	KILLIAN, THOMAS J		AFNA

KILLIP, ELLSWORTH P		AFNE	LE CLERG, ERWIN L	1ARFR K	AFRA
KILTZ, BURTON F	1DAEC K	RA	LEDER, LEWIS B		AFNA
KING, PETER	1DNRL BE	AFRA	LEE, RICHARD H	1DNMR	AFRA
KING, RAYMOND L	2HUMD 4	RA	LEFEBVRE, CAMILLE L	1ACSE K	RA
KINGSOLVER, JOHN	1XSMI F	RA	LEIGHTY, CLYDE E		AFRE
KINNEY, J P		AFNE	LEIKIND, MORRIS C	1HNIH	AFRA
KLEIN, RALPH	1CNBS BEG	AFRA	LEINER, ALAN L		AFNA
KLINE, GORDON M	1CNBS E	AFRA	LENTZ, PAUL L	1ARFR K	RA
KLINE, ORAL L	1HFDA 4	RA	LEONARD, EMERY C		AFRE
KLUTE, CHARLES H	1DAHD BE	AFRA	LEONARD, MORTIMER D	7RETD FGZ	AFRA
KNAPP, DAVID G	1CCGS G	AFRA	LEUKEL, ROBERT W		RE
KNIGHT, ROBERT J		NA	LEVERTON, RUTH M	1ARNI	AFRA
KNIPLING, EDWARD F	1ARFR FZ	AFRA	LEVY, SAMUEL		AFNA
KNIPLING, PHOEBE H	2SARC	AFRA	LEY, HERBERT L JR		AFNA
KNOBLOCK, EDWARD C	1DAWR EU	AFRA	LI, HUI-LIN		AFNA
KNOPF, ELEANORA B		AFNE	LICKLIDER, JOSEPH C	1D-S	AFRA
KNOWLES, ZELDA	8CLUN F	RA	LIDDEL, URNER	1XNAS BS3	AFRA
KNOWLTON, KATHRYN	7RETD EU	AFRA	LIDE, DAVID R JR	1CNBS	AFRA
KOHLER, HANS W	1DAHD GS	AFRA	LIEBERMAN, MORRIS	1AMMR E	AFRA
KOLB, ALAN C	1DNRL	AFRA	LIEBSON, SIDNEY H		AFNA
KOPPANYI, THEODORE	2HGEU	AFRA	LIKINS, ROBERT C	1HNIH W	AFRA
KORAB, HARRY E	3AABC 4	RA	LILLY, JOHN C		AFNA
KORNETSKY, AARON	5GIFO 4	RA	LINDQUIST, ARTHUR W		AFNA
KOSTKOWSKI, HENRY J	1CNBS B	AFRA	LING, LEE		AFNA
KOTTER, F RALPH	1CNBS NS	AFRA	LINK, CONRAD B	2HUMD K	RA
KOTULA, ANTHONY W	1AMMR 4	RA	LINNENBOM, VICTOR J	1DNRL E	AFRA
KRAMER, AMIHUJ	2HUMD 4	RA	LIPPINCOTT, ELLIS R	2HUMD E	AFRA
KRAMER, JAMES P	1ARFR F	RA	LIPSCOMB, BERNARD R	1ARFR K	RA
KRASNY, JOHN F	5SHARE	AFRA	LITOVITZ, THEODORE A	2HCUA B2	AFRA
KRAUS, C A		AFNA	LITTLE, ELBERT L JR	1AFOR KL	AFRA
KRAUSS, ROBERT W	2HUMD K	AFRA	LITTLE, RUBY R	1ARNI K4	RA
KREITLOW, KERMIT W	1ARFR K	AFRA	LLOYD, GEORGE W	1ARRP F	RA
KRESHOVER, SEYMORE J	1HNIH W	RA	LOCKHART, LUTHER B JR	1DNRL E	AFRA
KRESTENSEN, ELROY R	2HUMD F	RA	LOEGERING, WILLIAM Q	1ARFR K	RA
KROGH, HAROLD W	4DENT W	RA	LOFQUIST, ETSUKO O	7RETD U	AFRA
KROMBEIN, KARL V	1ARFR F	RA	LOGAN, HUGH L	1CNBS V	AFRA
KRUGER, GUSTAV O	2HGEU W	RA	LOHR, ANNIE		RE
KRUGER, JEROME	1CNBS E	AFRA	LOPEZ, ANTHONY	4	NA
KULIK, MARTIN M	1AMRP K	RA	LORING, BLAKE M	4CONS V	AFRA
KULLBACK, SOLOMON	2HGWU S	AFRA	LOTHROP, S K		AFNA
KULLERUD, GUNNAR	3IGEL G	AFRA	LOVE, S KENNETH	1IGES EGH	AFRA
KULWICH, ROMAN	1HNIH 4	RA	LOY, HENRY W	1HFDA 4	RA
KUMPULA, JOHN W	1CNBS W	RA	LUDFORD, GEOFFREY S		AFNA
KURTZ, FLOYD E	1ARNI E	AFRA	LUGENBILL, PHILIP JR	1ARFR F	RA
KURZWEG, HERMAN H	1XNAS BX	AFRA	LUMSDEN, DAVID V	1ARFR K	RA
KUSHNER, LAWRENCE M	1CNBS V	AFRA	LUTZ, JACOB M	1AMMR K4	AFRA
KYLE, CURTIS H		RE	LUTZ, ROGER A	4	NA
			LYMAN, F EARLE	1HNIH W	RA
			LYMAN, JOHN	1XNSF EY	AFRA
			LYNCH, DANIEL F	4DENT W	RA
			LYNN, W GARDNER	2HCUA B	AFRA
LAKI, KOLOMAN	1HNIH DEG	AFRA			
LAKIN, HUBERT W		AFNA			
LAMANNA, CARL	1DARO QU	AFRA			
LAMB, FRANK W		AFNA			
LAMBERT, EDMUND B	1ARFR GK	AFRA	MA, ROBERTA	1ARFR K	RA
LAMBERT, WALTER D		AFNE	MACLAY, W DAYTON	1ARNI 4	RA
LANCHESTER, HORACE P	1ARFR F	RA	MADORSKY, SAMUEL L	7RETD E	AFRA
LANDIS, PAUL E	1DAHD S	AFRA	MAGIN, GEORGE B JR	1XACE EH3	AFRA
LANDSBERG, H E	1CWEB Y	AFRA	MAGNESS, J R		RE
LANE, JOHN E	1HNIH F	RA	MAGNUSSON, HARRIS W	3INFI 4	RA
LANG, WALTER B		AFRE	MAHAN, ARCHIE I	3IAPL B	AFRA
LANGFORD, GEORGE S	2HUMD FZ	AFRA	MAHONEY, CHARLES H	3ANCA 4	RA
LAPHAM, EVAN G		AFNA	MAKSYMUIK, BOHDAN	1AFOR F	RA
LAPP, C J	3INAS BG	AFRA	MALLACK, JERRY	2HUMD F	RA
LAPP, RALPH E	4X B	AFRA	MANDEL, H GEORGE	2HGWU EU	AFRA
LARRIMER, WALTER H	3INAS GLZ	AFRA	MANDEL, JOHN	1CNBS E	AFRA
LARSEN, RACHEL H	1HNIH W	RA	MANN, DAVID E	1CNBS E	AFRA
LASHOF, THEODORE W	1CNBS BG	AFRA	MARCUS, MARVIN		AFNA
LASTER, HOWARD J	2HUMD B	AFRA	MARGETIS, PETER M	1DAWR W	RA
LATTA, RANDALL		AFNE	MARSHALL, LOUISE H	1HNIH	AFRA
LAUDANI, HAMILTON	1AMRP F	RA	MARSHALL, WADE H	1HNIH B	AFRA

MARTIN, GEORGE W		AFNE	MEARS, ATHERTON H		AFRE
MARTIN, JOHN H	7RETD GK	AFRA	MEARS, FLORENCE M	2HGWU	AFRA
MARTIN, MARGARET E	1ARNI 4	RA	MEBS, RUSSELL W	1CNBS V	AFRA
MARTIN, MONROE H	2HUMD	AFRA	MEGGERS, WILLIAM F	7RETD B	AFRA
MARTON, L L		AFNA	MEINESS, F A		AFNE
MARVIN, ROBERT S	1CNBS BEG	AFRA	MENDLOWITZ, HAROLD	1CNBS	AFRA
MARYOTT, ARTHUR A	1CNBS E	AFRA	MENKART, JOHN H	5SHARE E	AFRA
MARZKE, OSCAR T		AFNA	MERCURI, ARTHUR J	1AMMR 4	RA
MASON, EDWARD A	2HUMD BE	AFRA	MERRIAM, CARROLL F		AFNA
MASON, HORATIO C	1ARFR F	RA	MERZ, ALBERT R		AFRE
MASON, MARTIN A	2HGWU MOT	AFRA	MEYER, FREDERICK G	1ARFR K	RA
MASSEY, JOSEPH T	3IAPL BS	AFRA	MEYERHOFF, HOWARD A		AFNA
MATCHETT, JOHN R	1ARNI 4	RA	MEYERSON, MELVIN R	1CNBS	AFRA
MATHERS, ALEX P	1TIRS E	AFRA	MEYROWITZ, ROBERT	1IGES E	AFRA
MATHEWS, OSCAR	K	RE	MICHAEL, ALBERT S	1ARFR F	RA
MATLACK, MARION B	1ARFR E	AFRA	MIDDLETON, HOWARD E		AFNE
MATOSSI, FRANK		AFNA	MIDER, G BURROUGHS	1HNIH	AFRA
MATTHEWS, RUTH H	1ARNI 4	RA	MILLAR, ZELMA A	5HOSH 4	RA
MATTICK, JOSEPH F	2HUMD 4	RA	MILLER, ALVIN H	K	NA
MAUSS, BESSE D	7RETD	AFRA	MILLER, CARL F	1XSMI CG	AFRA
MAXWELL, LOUIS R	1DNOL B	AFRA	MILLER, CLEM O	1HNIH E	AFRA
MAY, CURTIS	1ARFR K	RA	MILLER, DAVID J	1HFDA 4	RA
MAY, DONALD C JR	1DNBW BG	AFRA	MILLER, J CHARLES	1IGES H	AFRA
MAY, EUGENE	K	RE	MILLER, LULA A	2SDCP K	RA
MAY, IRVING	1IGES EGH	AFRA	MILLER, PAUL R	1ARFR K	AFRA
MAYER, CORNELL H	1DNRL S	AFRA	MILLER, ROMAN R	1DNRL E	AFRA
MAYOR, JOHN R	3AAAS	AFRA	MINARD, DAVID		AFNA
MAZUR, JACOB	1CNBS B	AFRA	MINARD, JAMES P	1IGES	AFRA
MC BRIDE, GORDON W	5UNCA E4	AFRA	MISER, HUGH D		AFRE
MC CABE, LOUIS C	5RERS CER	AFRA	MITCHELL, J MURRAY JR	1CWEB GY	AFRA
MC CANN, HAROLD G	1HNIH W	RA	MITCHELL, JOHN W	1ARFR	AFRA
MC CLAIN, EDWARD F JR	1DNRL BS	AFRA	MITCHELL, ROBERT T	1IFWS F	RA
MC CLELLAN, WILBUR D	1ARFR GK	AFRA	MITTLEMAN, DON	1CNBS B	AFRA
MC CLURE, FLOYD A	1XSMI K	RA	MIZELL, LOUIS R	5SHARE E	AFRA
MC CLURE, FRANK J	1HNIH EUW	AFRA	MOHLER, FRED L	7RETD BG	AFRA
MC CLURE, FRANK T	3IAPL BE	AFRA	MOLLARI, MARIO		AFRE
MC COMB, CHARLES W	2HUMD F	RA	MONCHICK, LOUIS	3IAPL	AFRA
MC CULLOUGH, NORMAN B	1HNIH GIQ	AFRA	MONTROLL, ELLIOTT W	2HUMD	AFRA
MC DONALD, EDWINA	1DNDO 4	RA	MOORE, ARTHUR D	1AFOR F	RA
MC DONALD, EMMA J	1CNBS E	AFRA	MOORE, GEORGE A	1CNBS GV	AFRA
MC ELHINNEY, JOHN	1DNRL B	AFRA	MOORE, HARVEY C	2HAMU	AFRA
MC FADDEN, MAX	1XSMI F	RA	MORGAN, DELBERT T	2HUMD K	RA
MC GOVRAN, EDWARD R	1ACSE F	RA	MORGAN, OMAR D JR	2HUMD K	RA
MC GRATH, HILDE M	1ARFR K	RA	MORGAN, RAYMOND	2HUMD	AFRA
MC GREW, JOHN R	1ARFR K	RA	MORRIS, JOSEPH B	2HHOU E	AFRA
MC GUIRE, THOMAS R		AFNA	MORRIS, KELSO B	2HHOU E	AFRA
MC ILWRAITH, T F		AFNA	MORRISON, BENJAMIN Y		AFNA
MC INTOSH, ALLEN	7RETD GP	AFRA	MORRISON, HAROLD	F	AFRE
MC KAY, HAZEL H	1AFOR K	RA	MORRISON, JOSEPH P	1XSMI D	AFRA
MC KAY, JOHN W	1ARFR K	RA	MORTON, CONRAD V	1XSMI K	RA
MC KEE, SAMUEL A	7RETD	AFRA	MOSTOFI, F K	1D-IP G	AFRA
MC KELVEY, VINCENT E	1IGES H	AFRA	MUEHLHAUSE, CARL O	1CNBS B3	AFRA
MC KENZIE, LAWSON M		AFNA	MUESEBECK, CARL F	F	AFRE
MC KINNEY, HAROLD H	K	AFRE	MUNSON, S C	2HGWU F	RA
MC KNIGHT, EDWIN T	1IGES H	AFRA	MURPHY, LEONARD M	1CCGS B	AFRA
MC LEAN, RUTH A	1ARNI 4	RA	MURRAY, WILLIAM S	1DNX F	RA
MC MILLEN, J HOWARD	1XNSF B	AFRA	MURRILL, ROBERT D	1HNIH F	RA
MC MINIMY, MARGARET	2HUMD 4	RA	MYERS, ALFRED T		AFNA
MC MULLEN, DONALD B	1DAWR	AFRA	MYERS, RALPH D	2HUMD B	AFRA
MC MURDIE, HOWARD F	1CNBS 5	AFRA			
MC MURTREY, JAMES E JR	1ARFR K	AFRA			
MC NALLY, EDMUND H	1ARFR 4	RA	NACE, RAYMOND L	1IGES H	AFRA
MC NEIL, ETHEL C	1ARNI 4	RA	NAESER, CHARLES R	2HGWU EGH	AFRA
MC NESBY, JAMES R	1CNBS B	AFRA	NAMIAS, JEROME	1CWEB Y	AFRA
MC NISH, ALVIN G	1CNBS B	AFRA	NANCE, NELLIE	K	NE
MC PHEE, HUGH C		AFRE	NEAL, T J	1DAWR F	RA
MC PHERSON, ARCHIBALD	1CNBS BEG	AFRA	NELSEN, ROBERT J	4DENT W	RA
MC WHORTER, FRANK P		AFNE	NELSON, R H	3AESA FGZ	AFRA
MEAD, STERLING V	4DENT W	RA	NEMES, J L	2HGEU W	RA
MEADE, BUFORD K	1CCGS	AFRA	NEUENDORFFER, J A	3IFRI G	AFRA

REINHART, FRANK W	4CONS	EG	AFRA	SAILER, REECE I		AFNA	
REINHART, FRED M			AFNA	SALKOVITZ, EDWARD I	1DNOR	B AFNA	
REITEMEIER, ROBERT F	1XAEC		AFRA	SALMON, S C		K RE	
RENKIN, EUGENE M	2HGWU		AFRA	SALWIN, HAROLD	1HFDA	4 RA	
REYNOLDS, HOWARD	1ARNI	Q4	AFRA	SAN ANTONIO, JAMES P	1ARFR	K RA	
REYNOLDS, ORR E	1D-S	W	AFRA	SANDERSON, JOHN A	1DNRL	B AFRA	
RHOADS, AUSTIN T	3ANCA	4	RA	SANDOZ, GEORGE	1DNRL		AFRA
RHODES, IDA	1CNBS		AFRA	SANFORD, RAYMOND L			AFRE
RICE, DONALD-A	1CCGS	R	AFRA	SARLES, MERRITT P	2HCUA	PZ	AFRA
RICE, FRANCIS O			AFNA	SAUNDERS, JAMES B	1CNBS	G	AFRA
RICE, STUART A	5SURE		AFRA	SAVILLE, THORNDIKE JR	1DAEB	GT	AFRA
RICKER, PERCY L			K AFRE	SCHAEFFER, CLAUDE E			AFNA
RIDDLE, OSCAR			AFNE	SCHAFFER, JACOB M	1CBDS	4	RA
RIOCH, DAVID M	1DAWR	G	AFRA	SCHAFFER, ROBERT	1CNBS	E	AFRA
RITT, PAUL E	2MELP	S5	AFRA	SCHALLER, WALDEMAR T			AFRE
RITTS, ROY E JR	5HGEU	IQU	AFRA	SCHAMP, HOMER W JR	2HUMD	B	AFRA
RIVELLO, ROBERT M	2HUMD	OX	AFRA	SCHAREN, ALBERT L	1ARFR	K	RA
RIVLIN, RONALD S			AFNA	SCHECHTER, MILTON S	1ARFR	EZ	AFRA
ROBBINS, MARY L	2HGWU	GQU	AFRA	SCHEEH, MILTON D	1CNBS	BE	AFRA
ROBERT, ALICE L	1ARFR	K	RA	SCHIAFFINO, S STEPHEN	1HFDA	4	RA
ROBERTS, ELLIOTT B	7RETD	B	AFRA	SCHIEFER, HERBERT F	1CNBS		AFRA
ROBERTS, FRANK H	1XSMI	C	AFRA	SCHINDLER, ADOLPH F	1ARFR	K	RA
ROBERTS, RICHARD B	3IDTM		AFRA	SCHINDLER, ALBERT I	1DNRL	B	AFRA
ROBERTSON, A F	1CNBS	G	AFRA	SCHLATTER, F P			K RE
ROBERTSON, MYRNA J	7RETD	P	AFRA	SCHLOSSER, GEORGIA C	1ARNI	4	RA
ROBERTSON, RANDAL M	1XNSF	BGL	AFRA	SCHMITT, HERMAN P	3ANAF	4	RA
ROBINSON, HENRY E	1CNBS		AFRA	SCHMITT, WALDO L	1XSMI	D	AFRA
ROCK, GEORGE D	2HCUA		AFRA	SCHOEN, JAMES F	1ARRP	K	RA
RODENHISER, HERMAN A	1ARFR	K	RA	SCHOEN, LOUIS J	1CNBS		AFRA
RODNEY, WILLIAM S	1XNSF	B	AFRA	SCHOENBORN, HENRY W	2HUMD		AFRA
RODRIGUEZ, RAUL	1DAER	GR	AFRA	SCHOENEMAN, ROBERT L	1TIRS		AFRA
ROE, ROBERT S	1HFDA	4	RA	SCHOENING, HARRY W	7RETD	GQ	AFRA
ROEDDER, EDWIN	1IGES	BH	AFRA	SCHOOLEY, ALLEN H			AFNA
ROESER, WILLIAM F	1CNBS	BGR	AFRA	SCHOONOVER, IRL C	1CNBS	BEW5	AFRA
ROGERS, LORE A			AFNE	SCHRECKER, ANTHONY W	1HNIH	E	AFRA
ROGOSA, MORRISON	1HNIH	W	RA	SCHREINER, OSWALD			AFNE
ROLLER, JANE W	1AFOR	K	RA	SCHREMP, EDWARD J	1DNRL		AFRA
ROLLER, PAUL S	5LIPR	BEG	AFRA	SCHUBAUER, GALEN B	1CNBS	B	AFRA
ROLLOW, J DOUGLAS	5CAPC	F	RA	SCHUBERT, BERNICE G			K AFNA
ROMNEY, CARL F	1DFX	H	AFRA	SCHUBERT, LEO	2HAMU	BE	AFRA
ROSE, JOHN C	2HGEU	U	AFRA	SCHULMAN, JAMES H	1DNRL	B	AFRA
ROSENBLATT, DAVID	1CNBS	B	AFRA	SCHULTZ, EUGENE S	1ARFR	K	AFRA
ROSENTHAL, SANFORD M	1HNIH		AFRA	SCHWARTZ, ANTHONY M	5HARE	E	AFRA
ROSS, CLARENCE S			AFRE	SCHWARTZ, BENJAMIN			AFRE
ROSS, CULBERTSON W	1DAEB		AFRA	SCOFIELD, CARL S	7RETD	K	AFRA
ROSS, SHERMAN	3AAPS		AFRA	SCOFIELD, FRANCIS	3ANPV	E	AMRA
ROSSINI, FREDERICK D			AFNA	SCOFIELD, HENRY	1DNMC	W	RA
ROTH, FRANK L	1CNBS	G	AFRA	SCOTT, ARNOLD H	1CNBS	BGN	AFRA
ROTHSCHILD, LOUIS JR	5FOCN	4	RA	SCOTT, DAVID B	1HNIH	W	AFRA
ROTKIN, ISRAEL	1DAHD	BNS	AFRA	SCOTT, DONALD H	1ARFR	K	RA
ROVELSTAD, GORDON H	1DNMC	W	RA	SCOTT, L E	2HUMD	4	RA
ROWE, WALLACE P	1HNIH		AFRA	SCOVILLE, HERBERT JR	1XCIA		AFRA
ROZEBOOM, L E	2HJHU	F	RA	SCRIBNER, BOURDON F	1CNBS	E	AFRA
RUBBY, WILLIAM W			AFNA	SEEGER, RAYMOND J	1XNSF	B	AFRA
RUBIN, MEYER	1IGES	4	AFRA	SERVICE, JERRY H			AFNE
RUBIN, ROBERT J	1CNBS	B	AFRA	SETZLER, FRANK M			AFRE
RUBIN, VERA C	2HGEU	B	AFRA	SHALOWITZ, AARON L	1CCGS	R	AFRA
RUDD, VELVA E	1XSMI	DK	AFRA	SHAMEY, JENNIE	1ARNI	4	RA
RUHOFF, F A	1XSMI	F	RA	SHANAHAN, A J	1XNSF	Q	AFRA
RUMBAUGH, LYNN H	5REAN	B	AFRA	SHANNON, JAMES A	1HNIH		AFRA
RUSSELL, ALBERT L	1HNIH	W	RA	SHAPIRO, GUSTAVE	1CNBS	NS	AFRA
RUSSELL, LOUISE M	1ARFR	DFG	AFRA	SHAPIRO, LEONARD	1IGES	E	AFRA
RYALL, A LLOYD	1AMMR	4	AFRA	SHAPIRO, MAURICE M	1DNRL	B	AFRA
RYERSON, KNOWLES A			AFNA	SHAPLEY, A H			AFNA
				SHAPOVALOV, MICHAEL			AFNE
				SHAW, JOSEPH C			AFNA
SABROSKY, CURTIS W	1ARFR	F	RA	SHEA, KEVIN G	1XAEC	4	RA
SAENZ, ALBERT W	1DNRL		AFRA	SHEAR, MURRAY J	1HNIH	BG	AFRA
SAGER, THERON	7RETD		AFRA	SHELTON, EMMA	1HNIH		AFRA
SAGER, WILLIAM F	2HGWU	E	AFRA	SHELTON, L R JR	1HFDA	4	RA

SHEN, SHAN-FU		AFNA	SOUDER, WILMER	4CONS	EW	AFRA
SHEPARD, HAROLD H	1AASC	FZ	SPANGLER, PAUL J	1ARFR	F	RA
SHERESHEFSKY, J LEON	2HHOU	E	SPARHAWK, WILLIAM N			AFNE
SHERMAN, RALPH W	1ARRP	F	SPECHT, HEINZ			AFNA
SHETLER, STANWYN G	1XSMI	K	SPEER, JOHN F	3AAIC	4	RA
SHIMER, H W			SPENCE, ROBERT J	2HUMD	4	RA
SHIMKIN, DEMITRI B			SPENCER, J T	1XNSF	G	AFRA
SHINN, LEO A			SPENCER, LEWIS V			AFNA
SHIOTA, TETSUO	1HNH	W	SPENCER, ROSCOE R			AFNE
SHORB, DOYS A	1ARFR	P	SPETZMAN, LLOYD A	1IGES	K	RA
SHORB, MARY S	2HUMD	Q	SPICER, H CECIL	1IGES	H	AFRA
SHRIVER, DAVID	2HUMD	F	SPICER, JOSEPH R	1ARNI	EU	AFRA
SHRIVER, REBECCA F	3ANCA	4	SPILMAN, THEODORE J	1ARFR	F	RA
SHROPSHIRE, WALTER	1XSMI	K	SPOONER, CHARLES S JR	5AUCO	G	AFRA
SHULER, KURT E	1CNBS	B	SPRAGUE, GEORGE F	1ARFR		AFRA
SIEGLER, EDOUARD H		F	ST GEORGE, RAYMOND A	1AFOR	DFLZ	AFRA
SIEGLER, EUGENE A		K	STADTMAN, E R	1HNH		AFRA
SIEVERS, ARTHUR F		K	STAIR, RALPH	1CNBS	GS	AFRA
SILBERSCHMIDT, KARL M			STAKMAN, E C			AFNA
SILBERWEIT, MARIA	2HHOU	W	STANFORD, JOHN W	1CNBS	W	RA
SILSBEE, FRANCIS B	7RETD	BGN	STANTON, T R			RE
SILVERMAN, SHIRLEIGH	1DNOR	B	STARCKE, HELLE	8CLUN	F	RA
SIMHA, ROBERT			STAUSS, HENRY E	1XNAS	V	AFRA
SIMMONS, LANSING G	1CCGS	RT	STEARN, JOSEPH L	1CCGS		AFRA
SIMMS, BENNETT T	7RETD	G	STEELE, ERNEST K	1AMRP	4	RA
SIMPSON, JACKSON E	1ARNI	4	STEERE, RUSSELL L	1ARFR	K	AFRA
SIMPSON, ROBERT H	1CWEB	Y	STEFANSSON, VILHJALMUR			AFNE
SINGLETERRY, CURTIS R	1DNRL	E	STEGUN, IRENE A	1CNBS		AFRA
SIPLE, PAUL A			STEINBERG, R A		K	RE
SITTERLY, BANCROFT W	2HAMU	B	STEINER, ROBERT F	1DNMR	BE	AFRA
SITTERLY, CHARLOTTE M	1CNBS	BG	STEINHARDT, JACINTO	2HGUE	E	AFRA
SKINNER, HENRY T	1ARFR	K	STEINHAEJER, ALLEN L	2HUMD	F	RA
SLACK, LEWIS	3INAS	B	STEPHAN, ROBERT M	1HNH	QUW	AFRA
SLADEK, JAROMIL V	1HFDA	E	STEPHENS, ROBERT E	1CNBS	B	AFRA
SLAWSKY, MILTON M	1DFOS	GMX	STEPHENSON, L W			AFNE
SLAWSKY, ZAKA I	1DNOL	B	STERN, KURT H	1CNBS	E	AFRA
SLOCUM, GLENN G	1HFDA	Q4	STERN, WILLIAM L	1XSMI	K	RA
SMALL, HAROLD E	8CLUN	F	STERNBERG, RICHARD	3AABC	4	RA
SMALL, JAMES B	1CCGS	BMR	STETTEN, DEWITT JR			AFNA
SMART, J SAMUEL			STEVENS, HENRY	1ARNI	E	AFRA
SMITH, ALBERT C	1XSMI	K	STEVENS, ROLLIN E			AFNA
SMITH, AUGUSTINE V P	2SDCP	K	STEVENS, RUSSELL B	2HGWU	K	AFRA
SMITH, C EARLE JR	1ARFR	K	STEVENSON, FREDERICK J	4CONS	G	AFRA
SMITH, CHARLES M			STEVENSON, JOHN A		K	AFRE
SMITH, EDGAR R			STEWART, DEWEY	1ARFR	GK	AFRA
SMITH, FALCONER	1HNH	BU	STEWART, ILEEN E	1XNSF		AFRA
SMITH, FLOYD F	1ARFR	FZ	STEWART, ROBERT N	1ARFR	K	RA
SMITH, FRANCIS A			STEWART, SARAH E	1HNH	IQU	AFRA
SMITH, HENRY L JR			STEWART, T DALE	1XSMI	Q	AFRA
SMITH, HORACE L JR		4	STEYSKAL, GEORGE C	1ARFR	F	RA
SMITH, JACK C	1CNBS		STIEBELING, HAZEL K	7RETD	E	AFRA
SMITH, LYMAN B	1XSMI	K	STIEHLER, ROBERT D	1CNBS	BEGO	AFRA
SMITH, MARLON R	1ARFR	F	STILL, JOSEPH W			AFNA
SMITH, NATHAN R		K	STILLER, BERTRAM	1DNRL	BG	AFRA
SMITH, PAUL A	5RACO	BGHTX	STIMSON, HAROLD F	7RETD	BG	AFRA
SMITH, PAUL L	1DNRL	BS	STIRLING, MATHEW W	7RETD	CG	AFRA
SMITH, SIDNEY T	1DNRL	S	STOKES, ILEY E	1ARFR	K	RA
SMITH, WILLIE W	1HNH	U	STONE, A M	3IAPL	B	AFRA
SNAVELY, BENJAMIN L	1DNOL	G2	STONE, ALAN	1ARFR	F	RA
SNAY, HANS G	1DNOL	G2	STRASBERG, MURRAY	1DNDT	2	AFRA
SNOKE, HUBERT R	7RETD		STRAUB, HARALD W	1DAHD		AFRA
SNYDER, DONALD G	1IFWS	4	STRINGFIELD, VICTOR T	1IGES	GH	AFRA
SNYDER, THOMAS E		F	STUART, NEIL W	1ARFR	K	AFRA
SODERSTROM, THOMAS R	1XSMI	K	SULLIVAN, WILLIAM N JR	1ARFR	F	RA
SOLLERS-RIEDEL, HELEN	1ARRP	F	SULZBACHER, WILLIAM L	1ARNI	4	RA
SOLLNER, KARL	1HNH	E	SUMMERS, DONALD		4	NA
SOMERS, IRA I	3ANCA	4	SUTCLIFFE, WALTER D			AFRE
SOMMER, HELMUT	1DAHD	S	SVENSON, H K	1IGES	K	RA
SOOKNE, ARNOLD M	5SHARE	E	SWALLEN, J R	1XSMI	K	RA
SORDELLI, A			SWANSON, HENRY A	4DENT	W	RA

SWEENEY, JAMES P	1ARNI 4	RA	TREXLER, JAMES H	1DNRL BGS	AFRA
SWEENEY, WILLIAM T	1CNBS EVW	AFRA	TROMBA, FRANCIS G	1ARFR P	AFRA
SWICK, CLARENCE H		AFRE	TRUEBLOOD, CHARLES K	3AAPS	AFRA
SWIFT, CLIFTON E	1ARNI 4	RA	TRUEDELL, PAGE E	1DNPI H	AFRA
SWINDELLS, JAMES F	1CNBS B	AFRA	TRYON, MAX	1CNBS E	AFRA
SWINGLE, CHARLES F		AFNE	TULANE, VICTOR J		AFNA
			TUNELL, GEORGE		AFNA
TALBERT, PRESTON T	2HHOU E	AFRA	TURNER, JAMES H	1ARFR P	AFRA
TALBOTT, F LEO	2HCUA BG	AFRA	TURPIN, JEAN M	5SNUR K	RA
TALIAFERRO, W H		AFNA	TURRELL, GEORGE C	2HHOU	AFRA
TAPKE, VICTOR F		RE	TUVE, M A	3IDTM B	AFRA
TASAKI, ICHIKI	1HNIH	AFRA	TWIGG, BERNARD A	2HUMD 4	RA
TATE, DOUGLAS R	1CNBS BG	AFRA			
TAUSSKY, OLGA		AFNA	UHLER, FRANCIS M	1IFWS	AFRA
TAYLOR, ALBERT L	1ARFR KP	AFRA	UHRING, JOSEPH	1ARFR K	RA
TAYLOR, GEORGE C JR	1IGES H	AFRA	ULLRICH, DONALD E	5SHCH F	RA
TAYLOR, JAMES H		AFRE	UMPLEBY, JOSEPH B		AFNE
TAYLOR, JOHN K	1CNBS BEG	AFRA			
TAYLOR, LAURISTON S	1CNBS	AFRA			
TAYLOR, MARIE C	2HHOU K	RA	VACHER, HERBERT C	7RETD GV	AFRA
TAYLOR, MODDIE D	2HHOU E	AFRA	VAN DERSAL, WILLIAM R	1ASCS	AFRA
TAYLOR, RAYMOND L	3AAAS	AFRA	VAN EVERA, BENJAMIN D	2HGWU EG	AFRA
TAYLOR, ROBERT T	1DNX F	RA	VAN REEN, ROBERT	1DNMR W	RA
TCHEN, CHAN-MOU	1CNBS B	AFRA	VAN TASSELL, E R	2HCUA F	RA
TEELE, RAY P	1CNBS BG	AFRA	VANCE, ARLO M	1ARFR F	RA
TELFORD, IRA R	2HGWU U	AFRA	VANDERSLICE, J T	2HUMD BE	AFRA
TEMPLE, C E	K	NE	VAUGHN, M W	4	NA
TEPPER, MORRIS	1XNAS XY	AFRA	VAZQUEZ, ALBERTO W	1HFDA F	RA
TERRELL, EDWARD E	1ARFR K	RA	VEITCH, FLETCHER P JR	2HUMD EU	AFRA
THALER, WILLIAM J	2HGEU 2	AFRA	VELDEE, M V		AFNE
THAYER, THOMAS P	1IGES H	AFRA	VESTINE, E H		AFNA
THOM, HERBERT C S	1CWEB Y	AFRA	VIGNESS, IRWIN	1DNRL BH2	AFRA
THOMAS, CHARLES A	1ARFR K	RA	VINAL, GEORGE W		AFNE
THOMAS, H REX	1ARFR K	RA	VINCENT, R H	1DFX F	RA
THOMAS, JAMES L	4CONS	AFRA	VINTI, JOHN P	1CNBS BG	AFRA
THOMAS, PAUL D	1CCGS V	AFRA	VOGT, GEORGE B	1ARFR F	RA
THOMPSON, JACK C	1CWEB Y	AFRA	VOLWILER, ERNEST H		AFNA
THOMPSON, JOHN I	5JITH 4	RA	VON BRAND, THEODOR C	1HNIH PU	AFRA
THOMPSON, JOHN V	8CLUN F	RA	VORIS, LEROY	3INAS	AFRA
THOMPSON, PHILIP D		AFNA	VOSS, GILBERT L		AFNA
THOMSON, JAMES E	1AMMR 4	RA	VOZZO, JOHN A	1AFOR K	RA
THURMAN, ERNESTINE B	1HNIH FG	AFRA			
TILDEN, EVELYN B		AFNE			
TILLSON, ALBERT H	1HFDA K	RA	WACHTMAN, J B JR	1CNBS BG5	AFRA
TILLYER, E D		AFNA	WADA, WALTER W	1DNRL	AFRA
TIPSON, R STUART	1CNBS E	AFRA	WADDEL, RAMOND C	1XNAS	AFRA
TITSLER, RALPH P	1ARNI Q4	AFRA	WADEY, WALTER G	5WATA	AFRA
TITUS, HARRY M		AFNA	WADLEY, F M	7RETD F	RA
TODD, EDWARD L	1ARFR F	RA	WALKER, EARNEST A	1ARRP K	RA
TODD, FRANK E	1ARFR FZ	AFRA	WALKER, EGBERT H	7RETD K	AFRA
TODD, MARGARET R	1IGED GH	AFRA	WALKER, ROBERT L	1ARFR F	RA
TOEPFER, EDWARD W	1ARNI 4	RA	WALKER, WILLIAM C	4	NA
TOLDBY, VERNER	4	NA	WALKLEY, LUELLE M	1ARFR F	RA
TOLL, JOHN S	2HUMD B	AFRA	WALL, LEO A	1CNBS BE	AFRA
TOLLE, CHESTER D	1HFDA 4	RA	WALLS, EDGAR P	K	RE
TOOL, ARTHUR Q	7RETD	AFRA	WALTER, HOMER E	1ARNI 4	RA
TOOLE, EBEN H	K	RE	WALTHER, CARL H	2HGWU GT	AFRA
TOOLE, VIVIAN K	1ARFR K	RA	WALTON, GEORGE P		AFRE
TORGESON, JOHN L	1CNBS EG	AFRA	WALTON, MARGARET	1AX F	RA
TORRESON, OSCAR W	7RETD BG	AFRA	WALTON, WILLIAM W	1CNBS E	AFRA
TOULMIN, PRIESTLEY III	1IGES 4	AFRA	WARD, HENRY P	7RETD E	AFRA
TOUSEY, RICHARD	1DNRL B	AFRA	WARD, JUSTUS C	1ARRP	AFRA
TOWNSEND, JOHN R	4CONS B	AFRA	WARD, THOMAS G	5MTAS GQU	AFRA
TRAGER, GEORGE L		AFNA	WARGA, MARY E	3AOSA BEG	AFRA
TRAUB, ROBERT	2HUMD DFP	AFRA	WARNER, ROSE E	1XSMI F	RA
TRAVIS, CLARENCE W	1XDCG F	AMRA	WASHER, F E	1CNBS	AFRA
TREADWELL, CARLETON R	2HGWU EU	AFRA	WATERMAN, ALAN T	7RETD	AFRA
TRENT, HORACE M	1DNRL B2	AFRA	WATERMAN, PETER	1DNRL GS	AFRA
TRESSLER, WILLIS L		AFRE	WATSON, ALICE J	1ARFR K	RA

WATSTEIN, DAVID	1CNBS	AFRA	WOLFLE, DAEL	3AAAS	AFRA
WATTS, CHESTER B	7RETD BG	AFRA	WOLICKI, ELIGIUS A	1DNRL	AFRA
WAY, KATHARINE	3INAS B	AFRA	WOMACK, MADELYN	1ARNI EU	AFRA
WEAVER, E R	7RETD CE	AFRA	WOOD, CHARLES B	4	NA
WEAVER, LESLIE O	2HUMD K	RA	WOOD, JESSIE I	K	RE
WEBB, BYRON H	1ARNI 4	RA	WOOD, LAWRENCE A	1CNBS EP	AFRA
WEBB, J E	7RETD F	RA	WOOD, REUBEN E	2HGWU E	AFRA
WEBB, RAYMON E	1ARFR K	RA	WOOD, W B	7RETD F	RA
WEBB, ROBERT W	1AMMR BK	AFRA	WOOD, WILLIAM H	5HOSH 4	RA
WEBBER, ROBERT T		AFNA	WOODBURY, C G	K	RE
WEBER, EUGENE W	1DAEX MRT	AFRA	WOODS, G FORREST	2HUMD E	AFRA
WEIDA, FRANK		AFRE	WOODS, MARK W	1HNIH KU	AFRA
WEIDLEIN, E R		AFNE	WORKMAN, WILLIAM G	7RETD G	AFRA
WEIGEL, C A	7RETD F	RA	WORTHLEY, HARLAN N		AFNE
WEIHE, WERNER K	1DAER GS	AFRA	WRATHER, W E	1IGES H	AFRA
WEIL, GEORGE L	4CON S 3	AFRA	WRENCH, JOHN W JR	1DNNDT G	AFRA
WEINBERG, HAROLD P	5VAEN V	AFRA	WRIGHT, ROBERT	K	RE
WEINTRAUB, ROBERT L	2HGWU E	AFRA	WULF, OLIVER B		AFNA
WEIR, C EDITH	1ARNI 4	RA	WURDACK, JOHN J	1XSMI K	RA
WEIR, CHARLES E	1CNBS	AFRA	WYMAN, LEROY L	1CNBS GV	AFRA
WEISMAN, DONALD M	1ARFR F	RA			
WEISS, FRANCIS J	1XLIC BEGKQ	AFRA	YAPLEE, BENJAMIN S	1DNRL S	AFRA
WEISS, FRANCIS J	1XLIC 34	AFRA	YATES, LUCILLE W	1ARRP F	RA
WEISS, FREEMAN A		AFRE	YEAGER, J FRANKLIN	1HNIH	AFRA
WEISS, RICHARD A	1DARO GS	AFRA	YEATMAN, JOHN N	1ANMR 4	RA
WEISSBERG, SAMUEL	1CNBS BE	AFRA	YEOMANS, ALFRED H	1ARFR	AFRA
WEISSLER, ALFRED	1DFOS BE2	AFRA	YIP, GEORGE	1HFDA 4	RA
WEISSMAN, STANLEY	2HUMD B	AFRA	YOCUM, L EDWIN	K	AFNE
WELD, CLARK J	K	RE	YODER, HATTEN S JR	3IGEL EH	AFRA
WELD, L H	F	RE	YOU DEN, WILLIAM J	1CNBS BE	AFRA
WELLMAN, FREDERICK L		AFNE	YOUNG, DAVID A JR		AFNA
WELLS, HARRY W	1SX	AFRA	YOUNG, ROBERT T JR	1DAHD GS	AFRA
WENDT, LORINA	8CLUN K	RA	YUILL, JOSEPH S	1AFOR FGLZ	AFRA
WENSCH, GLEN W	1XAEC GV3	AFRA			
WESTENBERG, ARTHUR A	3IAPL E	AFRA	ZAUMEYER, WILLIAM J	1ARFR K	RA
WESTER, HORACE V	1INCP K	RA	ZELEN, MARVIN	1HNIH	AFRA
WESTER, ROBERT E	1ARFR K	RA	ZELENY, LAWRENCE	1AMRP EG	AFRA
WETMORE, ALEXANDER	1XSMI DG	AFRA	ZEN, E-AN	1IGES H	AFRA
WEXLER, ARNOLD	1CNBS B	AFRA	ZIES, EMANUEL G		AFRE
WEYL, F JOACHIM	1DNOR B	AFRA	ZIPKIN, ISADORE	1HNIH W	RA
WHEELER, NANCY H	8CLUN F	RA	ZISMAN, WILLIAM A	1DNRL E	AFRA
WHEELER, WILLIS H	1ARRP K	RA	ZMUDA, ALFRED J	3IAPL B	AFRA
WHERRY, EDGAR T		AFNE	ZOCH, RICHMOND T	7RETD Y	AFRA
WHITE, CHARLES E	2HUMD E	AFRA	ZWANZIG, ROBERT W	1CNBS BG	AFRA
WHITE, ORLAND E		AFNE	ZWEMER, RAYMUND L	3AFEB	AFRA
WHITE, RICHARD O	1ARRP F	RA			
WHITMAN, MERRILL J	1XAEC V3	AFRA			
WHITTAKER, COLIN W	1ARFR EG	AFRA			
WHITTEN, CHARLES A	1CCGS BGR	AFRA			
WICHERS, EDWARD	3INAS E	AFRA			
WILCOX, MARGUERITE	K	RE			
WILDHACK, W A	1CNBS BGX	AFRA			
WILEY, ROBERT C	2HUMD 4	RA			
WILKINS, GEORGE R	5CONC 4	RA			
WILLIAMS, DONALD H	3ADIS G4	AMRA			
WILLIAMS, FLOYD J	2HUMD K	RA			
WILLIAMS, LLEWELYN	1ARFR K	RA			
WILLIER, LILLIAN E	1SAID K	RA			
WILSON, BRUCE L	1CNBS BG	AFRA			
WILSON, KATHERINE	8CLUN K	RA			
WILSON, R E		AFNA			
WILSON, WILLIAM K	1CNBS E	AFRA			
WINT, T CECIL	4CON S N3	AFRA			
WINTERS, HAROLD F	1ARFR K	RA			
WIRTH, WILLIS W	1ARFR F	RA			
WITHROW, ALICE P	1XNSF	AFRA			
WITKOP, BERNHARD	1HNIH E	AFRA			
WOKE, PAUL A	1HNIH F	RA			
WOLBARSH, MYRON L	1DNMR F	RA			
WOLF, VIRGINIA S	1ARFR F	RA			

Classification by Place of Employment

1	GOVERNMENT			COLBRY, VERA	K	RA
1A	DEPT OF AGRICULTURE			FENN, LEONARD S	4	RA
				KULIK, MARTIN M	K	RA
1AASC	AGR STAB & CONS SERVICE			LAUDANI, HAMILTON	F	RA
	SHEPARD, HAROLD H	FZ	AFRA	NICKERSON, DOROTHY	G	AFRA
				STEELE, ERNEST K	4	RA
				ZELENY, LAWRENCE	EG	AFRA
1ACSE	COOP STATE EXPT STA SERVICE					
	BOYD, EARL N	4	RA	1ANAL	NAT AGR LIBRARY	
	BYERLY, THEODORE C	U	AFRA		BOYD, HELEN C	K RA
	FULKERSON, JOHN F	K	RA		CUSHMAN, HELENE G	F RA
	GARNER, RICHARD G	4	RA	1AR	AGRI RESEARCH SERVICE	
	HEERMAN, RUBEN M	K	RA	1ARAO	AGRI RES SER, OFF ADMR	
	LEFEBVRE, CAMILLE L	K	RA		HAINES, KENNETH A	FGZ AFRA
	MC GVRAN, EDWARD R	F	RA		HALL, DAVID G	F RA
1AFOR	FOREST SERVICE				HILBERT, GUIDO E	4 RA
	BEAL, JAMES A	F	RA	1ARFR	FARM RESEARCH	
	BONGBERG, JACK W	F	RA		ACKERMAN, WILLIAM L	K RA
	DILLER, J D	K	RA		ADAIR, CHARLES R	K RA
	FOWELLS, HARRY A	L	AFRA		ADLER, VICTOR E	F RA
	HACSKAYLO, EDWARD	GKL	AFRA		ALEXANDER, LYLE T	E AFRA
	HANSBROUGH, RAYMOND	K	RA		ANDERSON, DONALD M	F RA
	HAYES, DORIS W	K	RA		ANDERSON, WILLIAM H	FZ AFRA
	LITTLE, ELBERT L JR	KL	AFRA		ANDREWS, JOHN S	P AFRA
	MAKSYMIUK, BOHDAN	F	RA		APP, BERNARD A	F RA
	MC KAY, HAZEL H	K	RA		BAKER, HOWARD	F RA
	MOORE, ARTHUR D	F	RA		BARCLAY, ARTHUR S	K RA
	PALMER, JOHN G	K	RA		BARKER, HENRY D	K RA
	PARKER, KENNETH W	KL	AFRA		BARKER, ROY J	EFGZ AFRA
	ROLLER, JANE W	K	RA		BENJAMIN, CHESTER R	DGK AFRA
	ST GEORGE, RAYMOND A	DFLZ	AFRA		BLICKENSTAFF, CARL C	F RA
	VOZZO, JOHN A	K	RA		BODENSTEIN, WILLIAM G	F RA
	YUILL, JOSEPH S	FGLZ	AFRA		BORTHWICK, HARRY A	DGK AFRA
1AM	AGRI MARKETING SERVICE				BOSWELL, VICTOR R	AFRA
1AMMR	MARKETING RESEARCH				BRIERLEY, PHILIP	K RA
	BUTLER, WARREN L	B	AFRA		BUCK, RAYMOND W	K RA
	COOK, HAROLD T	BK4	AFRA		BURKS, BARNARD D	F RA
	ERNEST, JANE V	4	RA		BUSBY, RUTH L	F RA
	GATES, JANE	4	RA		CANTWELL, GEORGE	F RA
	GOLUMBIC, CALVIN	E4	AFRA		CAPPS, HAHN W	F RA
	HAMANN, JOHN A	4	RA		CHRISTENSON, LEROY D	FGZ AFRA
	HARDENBURG, ROBERT E	4	AFRA		CLARK, KENNETH G	E AFRA
	HEINZE, PETER H	EGK4	AFRA		COCHRAN, LLOYD C	K RA
	JUSTICE, OREN L	K	RA		COE, GERALD E	K RA
	KOTULA, ANTHONY W	4	RA		COFFMAN, FRANKLIN A	K RA
	LIEBERMAN, MORRIS	E	AFRA		COOPER, JAMES F	F RA
	LUTZ, JACOB M	K4	AFRA		COULSON, JACK R	F RA
	MERCURI, ARTHUR J	4	RA		CROOKS, DONALD M	K RA
	NORRIS, KARL H	4	AFRA		CULBERTSON, JOSEPH O	K RA
	PENTZER, WILBUR T	B	AFRA		CULLINAN, FRANK P	K AFRA
	RYALL, A LLOYD	4	AFRA		DAHMS, REYNOLD G	F RA
	THOMSON, JAMES E	4	RA		DERMEN, HAIG	K AFRA
	WEBB, ROBERT W	BK	AFRA		DIENER, THEODOR O	K RA
	YEATMAN, JOHN N	4	RA		DOWDEN, PHILIP B	F RA
1AMRP	MARKETING REGULATORY PROGRAMS				DOWNS, ROBERT J	K RA
	ANDERSEN, ALICE M	K	RA		DRECHSLER, CHARLES	K AFRA
	BARTLETT, RICHARD P JR	4	RA		DUTKY, SAMSON R	F RA
	BURTON, DAVID L	4	RA		EGOLF, DONALD R	K AFRA
	CAREY, RICHARD T	4	RA		ELLIS, NED R	EGU AFRA
					EMSWELLER, SAMUEL L	K AFRA

ENNIS, WILLIAM B JR		AFRA		RAINWATER, CLYDE F	F	RA
FALES, JOHN H	F	RA		REED, LUCIUS B	F	RA
FARR, MARIE L	K	RA		ROBERT, ALICE L	K	RA
FARR, MARION M	P	AFRA		RODENHISER, HERMAN A	K	RA
FLUNO, JOHN A	F	RA		RUSSELL, LOUISE M	DFG	AFRA
FOOTE, RICHARD H	F	RA		SABROSKY, CURTIS W	F	RA
FOSTER, AUREL O	P	AFRA		SAN ANTONIO, JAMES P	K	RA
FRAPS, RICHARD M	BU	AFRA		SCHAREN, ALBERT L	K	RA
FULTON, ROBERT A	EZ	AFRA		SCHECHTER, MILTON S	EZ	AFRA
GOTH, ROBERT W	K	RA		SCHINDLER, ADOLPH F	K	RA
GRAUMANN, HUGO O	K	RA		SCHULTZ, EUGENE S	K	AFRA
GRAVATT, ANNIE R	K	RA		SCOTT, DONALD H	K	RA
GURNEY, ASHLEY B	DFG	AFRA		SHORB, DOYS A	P	AFRA
HAEUSSLER, GILBERT J	F	RA		SKINNER, HENRY T	K	RA
HALL, STANLEY A	EZ	AFRA		SMITH, C EARLE JR	K	RA
HALLER, HERBERT L	EFGZ	AFRA		SMITH, FLOYD F	FZ	AFRA
HEGGESTAD, HOWARD E	K	RA		SMITH, MARLON R	F	RA
HEIMPEL, A M	F	RA		SPANGLER, PAUL J	F	RA
HENNEBERRY, THOMAS J	F	AFRA		SPILMAN, THEODORE J	F	RA
HERRING, JON L	F	RA		SPRAGUE, GEORGE F		AFRA
HIGGINS, JOSEPH J	K	RA		STEERE, RUSSELL L	K	AFRA
HILDEBRAND, EARL M	K	RA		STEWART, DEWEY	GK	AFRA
HILL, SAMUEL O	F	RA		STEWART, ROBERT N	K	RA
HILTON, JAMES L		AFRA		STEYSKAL, GEORGE C	F	RA
HINER, RICHARD L	4	RA		STOKES, ILEY E	K	RA
HODGES, RONALD W	F	RA		STONE, ALAN	F	RA
HOFFMANN, CLARENCE H	FLZ	AFRA		STUART, NEIL W	K	AFRA
HYLAND, HOWARD L	K	RA		SULLIVAN, WILLIAM N JR	F	RA
JONES, SLOAN E	F	RA		TAYLOR, ALBERT L	KP	AFRA
KANE, EDWARD A	E	AFRA		TERRELL, EDWARD E	K	RA
KERR, THOMAS	K	RA		THOMAS, CHARLES A	K	RA
KNIPLING, EDWARD F	FZ	AFRA		THOMAS, H REX	K	RA
KRAMER, JAMES P	F	RA		TODD, EDWARD L	F	RA
KREITLOW, KERMIT W	K	AFRA		TODD, FRANK E	FZ	AFRA
KROMBEIN, KARL V	F	RA		TOOLE, VIVIAN K	K	RA
LAMBERT, EDMUND B	GK	AFRA		TROMBA, FRANCIS G	P	AFRA
LANCHESTER, HORACE P	F	RA		TURNER, JAMES H	P	AFRA
LE CLERG, ERWIN L	K	AFRA		UHRING, JOSEPH	K	RA
LENTZ, PAUL L	K	RA		VANCE, ARLO M	F	RA
LIPSCOMB, BERNARD R	K	RA		VOGT, GEORGE B	F	RA
LOEGERING, WILLIAM Q	K	RA		WALKER, ROBERT L	F	RA
LUGENBILL, PHILIP JR	F	RA		WALKLEY, LUELLA M	F	RA
LUMSDEN, DAVID V	K	RA		WATSON, ALICE J	K	RA
MA, ROBERTA	K	RA		WEBB, RAYMON E	K	RA
MASON, HORATIO C	F	RA		WEISMAN, DONALD M	F	RA
MATLACK, MARION B	E	AFRA		WESTER, ROBERT E	K	RA
MAY, CURTIS	K	RA		WHITTAKER, COLIN W	EG	AFRA
MC CLELLAN, WILBUR D	GK	AFRA		WILLIAMS, LLEWELYN	K	RA
MC GRATH, HILDE M	K	RA		WINTERS, HAROLD F	K	RA
MC GREW, JOHN R	K	RA		WIRTH, WILLIS W	F	RA
MC KAY, JOHN W	K	RA		WOLF, VIRGINIA S	F	RA
MC MURTREY, JAMES E JR	K	AFRA		YEOMANS, ALFRED H		AFRA
MC NALLY, EDMUND H	4	RA		ZAUMEYER, WILLIAM J	K	RA
MEYER, FREDERICK G	K	RA				
MICHAEL, ALBERT S	F	RA				
MILLER, PAUL R	K	AFRA				
MITCHELL, JOHN W		AFRA				
NIIMOTO, DOROTHY H	K	RA				
O BRIEN, MURIEL	K	RA				
OAKES, ALBERT J JR	K	RA				
OMAN, PAUL W	F	RA				
ORELLANA, RODRIGO G	K	RA				
PAPAVIZAS, GEORGE C	K	RA				
PARKER, MARION W	K	AFRA				
PERDUE, ROBERT E JR	K	RA				
PIRINGER, ALBERT A	K	RA				
POLLOCK, BRUCE M	GK	AFRA				
PRESLEY, JOHN T		AFRA				
PRICE, SAMUEL	K	RA				
PULTZ, LEON M	K	RA				

IARNI NUTR CONSUMER & IND USE RES

ALFORD, JOHN A	4	RA
BATCHER, OLIVE M	4	RA
BELOIAN, ARAM	4	RA
BERMAN, MORRIE D	4	RA
BROGDON, JENNIE L	4	RA
CHAPMAN, VELMA J	4	RA
COULSON, JACK E	EU	AFRA
CURRAN, HAROLD R	GQ	AFRA
DAWSON, ELSIE H	4	RA
DETWILER, SAMUEL B JR	E	AFRA
EDMONDSON, LOCKE F	4	RA
EHEART, JAMES F	4	RA
FORZIATI, FLORENCE H	E	AFRA
FRIEND, BERTA	4	RA
GADDIS, ADAM M	4	RA

GIBBS, ROBERT J	4	RA			
GILPIN, GLADYS L	4	RA			
HIVON, KATHARINE J	4	RA			
HOOVER, SAM R	4	RA			
HORNSTEIN, IRWIN	4	RA			
IRVING, GEORGE W JR	E4	AFRA			
KURTZ, FLOYD E	E	AFRA			
LEVERTON, RUTH M		AFRA			
LITTLE, RUBY R	K4	RA			
MACLAY, W DAYTON	4	RA			
MARTIN, MARGARET E	4	RA			
MATCHETT, JOHN R	4	RA			
MATTHEWS, RUTH H	4	RA			
MC LEAN, RUTH A	4	RA			
MC NEIL, ETHEL C	4	RA			
PATTERSON, WILBUR I	4	RA			
PECOT, REBECCA	4	RA			
POMMER, ALFRED M	EGH	AFRA			
REDSTROM, RUTH A	4	RA			
REYNOLDS, HOWARD	Q4	AFRA			
SCHLOSSER, GEORGIA C	4	RA			
SHAMEY, JENNIE	4	RA			
SIMPSON, JACKSON E	4	RA			
SPIES, JOSEPH R	EU	AFRA			
STEVENS, HENRY	E	AFRA			
SULZBACHER, WILLIAM L	4	RA			
SWEENEY, JAMES P	4	RA			
SWIFT, CLIFTON E	4	RA			
TITSLER, RALPH P	Q4	AFRA			
TOEPFER, EDWARD W	4	RA			
WALTER, HOMER E	4	RA			
WEBB, BYRON H	4	RA			
WEIR, C EDITH	4	RA			
WOMACK, MADELYN	EU	AFRA			
1ARRP ARS REGULATORY PROGRAMS					
ALFORD, HAROLD G	F	RA			
BAKER, EDWARD W	F	RA			
BILLINGS, SAMUEL C	F	RA			
BRANDLY, PAUL J	4	RA			
CALLAGHAN, GEORGE F	F	RA			
CALLAWAY, MINNIE B	F	RA			
CONKLE, HERBERT J	F	RA			
GILBERT, ENGEL L	F	RA			
HAMBLETON, EDSON J	DFG	AFRA			
JOHNSTON, FREDERICK A	K	RA			
KENWORTHY, FRANCIS T	K	RA			
LLOYD, GEORGE W	F	RA			
O NEILL, KELLIE	F	RA			
OAKLEY, RICHARD G	F	RA			
PELTIER, PAUL X	F	RA			
POPHAM, WILLIAM L	F	RA			
REAGAN, EUGENE P	F	RA			
SCHOEN, JAMES F	K	RA			
SHERMAN, RALPH W	F	RA			
SOLLERS-RIEDEL, HELEN	F	RA			
WALKER, EARNEST A	K	RA			
WARD, JUSTUS C		AFRA			
WHEELER, WILLIS H	K	RA			
WHITE, RICHARD O	F	RA			
YATES, LUCILLE W	F	RA			
1ASCS SOIL CONSERVATION SERVICE					
GRAHAM, EDWARD H		AFRA			
VAN DERSAL, WILLIAM R		AFRA			
1AX DEPT OF AGRI MISC					
ADAMS, JEAN R	F	RA			
BULLOCK, HOWARD R	F	RA			
WALTON, MARGARET	F	RA			
1C DEPARTMENT OF COMMERCE					
1CBDS BUSINESS & DEF SERVICES ADMN					
FIVAZ, ALFRED E	L	AFRA			
SCHAFFER, JACOB M	4	RA			
1CBUC BUREAU OF THE CENSUS					
HANSEN, MORRIS H		AFRA			
1CCGS COAST & GEODETIC SURVEY					
BRAATEN, NORMAN F	BMR	AFRA			
CARDER, DEAN S	BHR	AFRA			
CLAIRE, CHARLES N	BM	AFRA			
HICKLEY, THOMAS J	S2	AFRA			
KNAPP, DAVID G	G	AFRA			
MEADE, BUFORD K		AFRA			
MURPHY, LEONARD M	B	AFRA			
POLING, AUSTIN C	S	AFRA			
RICE, DONALD A	R	AFRA			
SHALOWITZ, AARON L	R	AFRA			
SIMMONS, LANSING G	RT	AFRA			
SMALL, JAMES B	BMR	AFRA			
STEARNS, JOSEPH L		AFRA			
THOMAS, PAUL D	V	AFRA			
WHITTEN, CHARLES A	BGR	AFRA			
1CMAA MARITIME ADMINISTRATION					
ALLEN, WILLIAM	O	AFRA			
1CNBS NAT BUREAU OF STANDARDS					
ALEXANDER, SAMUEL N	BNS	AFRA			
ALLEN, HARRY C JR	BEG	AFRA			
ALT, FRANZ L		AFRA			
ARMSTRONG, GEORGE T	BEG	AFRA			
ASTIN, ALLEN V	BSX	AFRA			
AUSLOOS, PIERRE J	E	AFRA			
AXILROD, BENJAMIN M	B	AFRA			
BARBROW, LOUIS E	BN	AFRA			
BASS, ARNOLD M	B	AFRA			
BATES, ROGER G	E	AFRA			
BECKETT, CHARLES W	E	AFRA			
BEKKEDAHL, NORMAN	BEG	AFRA			
BENNETT, JOHN A	GV	AFRA			
BLUNT, ROBERT F		AFRA			
BOWEN, RAEFEL L	W	RA			
BOWER, VINCENT E		AFRA			
BRAUER, GERHARD M	EW	AFRA			
BRECKENRIDGE, F C	B	AFRA			
BRENNER, ABNER	EG	AFRA			
BROWN, WALTER E	W	RA			
BUCKLEY, FLOYD W	E	AFRA			
BURNETT, HARRY C	GV	AFRA			
BURNS, CLAIRE L	W	RA			
CALDWELL, FRANK R	BG	AFRA			
CANNON, EDWARD W		AFRA			
CARRINGTON, TUCKER	BE	AFRA			
CASSEL, JAMES M	E	AFRA			
CAUL, HAROLD J	EVW	AFRA			
COOK, RICHARD K	B2	AFRA			
COOTER, IRVIN L	BN	AFRA			
CREITZ, CARROLL E	E	AFRA			
DAVIS, MARION M	EG	AFRA			
DAVIS, PHILIP J		AFRA			
DICKSON, GEORGE	GW	AFRA			
DOUGLAS, CHARLES A	BG	AFRA			
DOUGLAS, THOMAS B	E	AFRA			
EISENHART, CHURCHILL	B	AFRA			
EISENSTEIN, JULIAN C		AFRA			
ELBOURN, ROBERT D	BNS	AFRA			
ELLINGER, GEORGE A	GV	AFRA			

FERGUSON, ROBERT E		AFRA	PLYLER, EARL K	BE	AFRA
FLORIN, ROLAND E	E	AFRA	PROSEN, EDWARD J	E	AFRA
FRUSH, HARRIET L	E	AFRA	RHODES, IDA		AFRA
FULLMER, IRVIN H	BGO	AFRA	ROBERTSON, A F	G	AFRA
FURUKAWA, GEORGE T	BEG	AFRA	ROBINSON, HENRY E		AFRA
GARVIN, DAVID		AFRA	ROESER, WILLIAM F	BGR	AFRA
GARY, ROBERT		AFRA	ROSENBLATT, DAVID	B	AFRA
GEIL, GLENN W	V	AFRA	ROTH, FRANK L	G	AFRA
GHAFFARI, ABOLGHASSEM	B	AFRA	RUBIN, ROBERT J	B	AFRA
GINNINGS, DEFOE C	E	AFRA	SAUNDERS, JAMES B	G	AFRA
GLASGOW, AUGUSTUS R JR	EG	AFRA	SCHAFFER, ROBERT	E	AFRA
GORDON, CHARLES L	BEG	AFRA	SCHEER, MILTON D	BE	AFRA
GREEN, MELVILLE S	B	AFRA	SCHIEFER, HERBERT F		AFRA
GREENOUGH, M L	G	AFRA	SCHOEN, LOUIS J		AFRA
GREENSPAN, MARTIN	BG2	AFRA	SCHOONOVER, IRL C	BEW5	AFRA
HAGUE, JOHN L	EG	AFRA	SCHUBAUER, GALEN B	B	AFRA
HAMER, WALTER J	EN	AFRA	SCOTT, ARNOLD H	BGN	AFRA
HARRIS, FOREST K		AFRA	SCRIBNER, BOURDON F	E	AFRA
HARRISON, W N		AFRA	SHAPIRO, GUSTAVE	NS	AFRA
HOBBS, ROBERT B	BEG	AFRA	SHULER, KURT E	B	AFRA
HOFFMAN, JOHN D	E	AFRA	SITTERLY, CHARLOTTE M	BG	AFRA
HOOVER, THOMAS B	E	AFRA	SMITH, JACK C		AFRA
HOWARD, FRANK L	E	AFRA	STAIR, RALPH	GS	AFRA
HUBBARD, DONALD	EG	AFRA	STANFORD, JOHN W	W	RA
HUNTOON, ROBERT D	BS	AFRA	STEGUN, IRENE A		AFRA
ISBELL, HORACE S	E	AFRA	STEPHENS, ROBERT E	B	AFRA
JACKSON, JULIUS L	B	AFRA	STERN, KURT H	E	AFRA
JOHANNESSEN, ROLF B	E	AFRA	STIEHLER, ROBERT D	BEGO	AFRA
JOHNSON, DANIEL P	B	AFRA	SWEENEY, WILLIAM T	EVW	AFRA
JUDD, DEANE B	B	AFRA	SWINDELLS, JAMES F	B	AFRA
KAHN, ARNOLD H		AFRA	TATE, DOUGLAS R	BG	AFRA
KANAGY, JOSEPH R	E	AFRA	TAYLOR, JOHN K	BEG	AFRA
KEEGAN, HARRY J	EG	AFRA	TAYLOR, LAURISTON S		AFRA
KESSLER, KARL G	BG	AFRA	TCHEN, CHAN-MOU	B	AFRA
KLEIN, RALPH	BEG	AFRA	TEELE, RAY P	BG	AFRA
KLINE, GORDON M	E	AFRA	TIPSON, R STUART	E	AFRA
KOSTKOWSKI, HENRY J	B	AFRA	TORGESEN, JOHN L	EG	AFRA
KOTTER, F RALPH	NS	AFRA	TRYON, MAX	E	AFRA
KRUGER, JEROME	E	AFRA	VINTI, JOHN P	BG	AFRA
KUMPULA, JOHN W	W	RA	WACHTMAN, J B JR	BG5	AFRA
KUSHNER, LAWRENCE M	V	AFRA	WALL, LEO A	BE	AFRA
LASHOF, THEODORE W	BG	AFRA	WALTON, WILLIAM W	E	AFRA
LIDE, DAVID R JR		AFRA	WASHER, F E		AFRA
LOGAN, HUGH L	V	AFRA	WATSTEIN, DAVID		AFRA
MANDEL, JOHN	E	AFRA	WEIR, CHARLES E		AFRA
MANN, DAVID E	E	AFRA	WEISSBERG, SAMUEL	BE	AFRA
MARVIN, ROBERT S	BEG	AFRA	WEXLER, ARNOLD	B	AFRA
MARYOTT, ARTHUR A	E	AFRA	WILDHACK, W A	BGX	AFRA
MAZUR, JACOB	B	AFRA	WILSON, BRUCE L	BG	AFRA
MC DONALD, EMMA J	E	AFRA	WILSON, WILLIAM K	E	AFRA
MC MURDIE, HOWARD F	5	AFRA	WOOD, LAWRENCE A	EP	AFRA
MC NESBY, JAMES R	B	AFRA	WYMAN, LEROY L	GV	AFRA
MC NISH, ALVIN G	B	AFRA	YOU DEN, WILLIAM J	BE	AFRA
MC PHERSON, ARCHIBALD	BEG	AFRA	ZWANZIG, ROBERT W	BG	AFRA
MEBS, RUSSELL W	V	AFRA			
MENDLOWITZ, HAROLD		AFRA	1CWEB WEATHER BUREAU		
MEYERSON, MELVIN R		AFRA	LANDSBERG, H E	Y	AFRA
MITTLEMAN, DON	B	AFRA	MITCHELL, J MURRAY JR	GY	AFRA
MOORE, GEORGE A	GV	AFRA	NAMIAS, JEROME	Y	AFRA
MUEHLHAUSE, CARL O	B3	AFRA	OSMUN, J W	Y	AFRA
NEWMAN, MORRIS		AFRA	PUTNINS, PAUL H	GY	AFRA
NEWMAN, SANFORD B		AFRA	REICHELDERFER, FRANCIS		AFRA
NEWTON, CLARENCE J		AFRA	SIMPSON, ROBERT H	Y	AFRA
OKABE, HIDEO	E	AFRA	THOM, HERBERT C S	Y	AFRA
OREM, THEODORE H	V	AFRA	THOMPSON, JACK C	Y	AFRA
PAFFENBARGER, GEORGE C	W	AFRA			
PAGE, CHESTER H	BGNS	AFRA	1CX DEPT OF COMMERCE MISC		
PEISER, H STEFFEN	BE	AFRA	HERSCHMAN, HARRY K		AFRA
PELL, WILLIAM H		AFRA			
PITTS, JOSEPH W	V5	AFRA	1D DEPARTMENT OF DEFENSE		

1D-IP ARMED FORCES INST PATHOLOGY				ALEXANDER, AARON D	QU	AFRA
ABRAMS, ALBERT M	W	RA		BARON, LOUIS S	QU	AFRA
BERNIER, JOSEPH L	W	RA		BATTISTONE, G C	W	RA
CHURCH, LLOYD E	W	RA		BHASKAR, SURINDAR N	W	RA
CORNYN, JOHN	W	RA		BOZEMAN, MARILYN F	QU	AFRA
HANSEN, LOUIS S	W	RA		BURNETT, GEORGE W	W	RA
MOSTOFI, F K	G	AFRA		ELDRIDGE, BRUCE F	F	RA
1D-PC ARMED FORCES PEST CONTROL BD				FULLER, HENRY S	DF	AFRA
HOLWAY, R T	F	RA		HAHN, FRED E		AFRA
1D-S OFFICE OF THE SECRETARY				KNOBLOCK, EDWARD C	EU	AFRA
BROOKS, DONALD B		AFRA		MARGETIS, PETER M	W	RA
FORZIATI, ALPHONSE F	EW	AFRA		MC MULLEN, DONALD B		AFRA
FRANKLIN, PHILIP J	ENS	AFRA		NEAL, T J	F	RA
HAMMERSCHMIDT, W W	B	AMRA		RIOCH, DAVID M	G	AFRA
HERZFELD, CHARLES M	B	AFRA		1DAX ARMY MISC		
LICKLIDER, JOSEPH C		AFRA		DEWS, SAM C	F	RA
REYNOLDS, ORR E	W	AFRA		NEWSON, HAROLD D	F	RA
1D-X DEPT OF DEFENSE MISC				1DF DEPT OF THE AIR FORCE		
CAMPAIGNE, HOWARD H		AFRA		1DFOS OFFICE OF SCIENTIFIC RES		
1DA DEPARTMENT OF THE ARMY				SLAWSKY, MILTON M	GMX	AFRA
1DAEB CORPS ENG BEACH EROSION BD				WEISSLER, ALFRED	BE2	AFRA
CALDWELL, JOSEPH M	T	AFRA		1DFX AIR FORCE MISCELLANEOUS		
ROSS, CULBERTSON W		AFRA		ROMNEY, CARL F	H	AFRA
SAVILLE, THORNDIKE JR	GT	AFRA		VINCENT, R H	F	RA
1DAEC OFF OF THE CHIEF OF ENGINEERS				1DN DEPARTMENT OF THE NAVY		
KILTZ, BURTON F	K	RA		1DNBS BUREAU OF SHIPS		
REED, WILLIAM D	FGRZ	AFRA		REAM, DONALD F		AFRA
1DAER ENGINEER RES & DEV	LAB			1DNBW BUREAU OF NAVAL WEAPONS		
CLEAVER, OSCAR P	NR	AFRA		BURINGTON, RICHARD S	BG	AFRA
HARVALIK, Z V	E	AFRA		MAY, DONALD C JR	BG	AFRA
HASS, GEORG H		AFRA		1DNBY BUREAU OF YARDS & DOCKS		
HICKOX, GEORGE H	GQRT	AFRA		AMIRIKIAN, ARSHAM	RT	AFRA
HOWARD, GEORGE W	RT	AFRA		HUTTON, GEORGE L	FG	AFRA
RODRIGUEZ, RAUL	GR	AFRA		1DNBT DAVID TAYLOR MODEL BASIN		
WEIHE, WERNER K	GS	AFRA		CHAPLIN, HARVEY R JR		AFRA
1DAEX CORPS OF ENGINEERS MISC				FRENKIEL, FRANCOIS N	BXY	AFRA
AMES, LAWRENCE M	K	AFRA		OSTEN, EDWARD J	B	AMRA
WEBER, EUGENE W	MRT	AFRA		POLACHEK, HARRY	B	AFRA
1DAFD BIOLOGICAL LAB FT. DETRICK				STRASBERG, MURRAY	2	AFRA
DARROW, ROBERT A	K	RA		WRENCH, JOHN W JR	G	AFRA
1DAHD HARRY DIAMOND LABS				1DNHS U S NAVAL HOSPITAL		
APSTEIN, MAURICE	S	AFRA		COHN, ROBERT	B	AFRA
CURTIS, ROGER W		AFRA		1DNMC NAVAL MEDICAL CENTER		
DOCTOR, NORMAN J	S	AFRA		HIRST, JOHN M	F	RA
GODFREY, THEODORE B		AFRA		ROVELSTAD, GORDON H	W	RA
GUARINO, P A	S	AFRA		SCOFIELD, HENRY	W	RA
HORTON, BILLY M		AFRA		1DNMR NAVAL MEDICAL RESEARCH INST		
KALMUS, HENRY P	S	AFRA		FRIESS, SEYMOUR L	E	AFRA
KLUTE, CHARLES H	BE	AFRA		LEE, RICHARD H		AFRA
KOHLER, HANS W	GS	AFRA		OSTROM, C A	W	RA
LANDIS, PAUL E	S	AFRA		STEINER, ROBERT F	BE	AFRA
ROTKIN, ISRAEL	BNS	AFRA		VAN REEN, ROBERT	W	RA
SOMMER, HELMUT	S	AFRA		WOLBARSHT, MYRON L	F	RA
STRAUB, HARALD W		AFRA		1DNMS BUREAU MEDICINE & SURGERY		
YOUNG, ROBERT T JR	GS	AFRA		FRENCHETTE, ARTHUR R	W	RA
1DARO ARMY RESEARCH OFFICE				HULL, WILLIAM B	F	RA
LAMANNA, CARL	QU	AFRA		1DNNO OFFICE CHIEF NAVAL OPERATIONS		
WEISS, RICHARD A	GS	AFRA				
1DAWR WALTER REED MEDICAL CENTER						

BREWER, KEITH A	BEG	AFRA	SANDERSON, JOHN A	B	AFRA
1DNOL NAVAL ORDNANCE LAB			SANDOZ, GEORGE		AFRA
CALLEN, EARL R	B	AFRA	SCHINDLER, ALBERT I	B	AFRA
GEYGER, WILLIAM A	N	AFRA	SCHREMP, EDWARD J		AFRA
MAXWELL, LOUIS R	B	AFRA	SCHULMAN, JAMES H	B	AFRA
SLAWSKY, ZAKA I	B	AFRA	SHAPIRO, MAURICE M	B	AFRA
SNAVELY, BENJAMIN L	G2	AFRA	SINGLETERRY, CURTIS R	E	AFRA
SNAY, HANS G	G2	AFRA	SMITH, PAUL L	BS	AFRA
1DNOR OFFICE OF NAVAL RESEARCH			SMITH, SIDNEY T	S	AFRA
BLACK, RICHARD B	G	AFRA	STILLER, BERTRAM	BG	AFRA
SALKOVITZ, EDWARD I	B	AFRA	TOUSEY, RICHARD	B	AFRA
SILVERMAN, SHIRLEIGH	B	AFRA	TRENT, HORACE M	B2	AFRA
WEYL, F JOACHIM	B	AFRA	TREXLER, JAMES H	BG5	AFRA
1DNPI PHOTO INTERPRETATION CENTER			VIGNESS, IRWIN	BH2	AFRA
TRUESDELL, PAGE E	H	AFRA	WADA, WALTER W		AFRA
1DNRL NAVAL RESEARCH LAB			WATERMAN, PETER	GS	AFRA
ACHTER, MEYER R	V	AFRA	WOLICKI, ELIGIUS A		AFRA
ALEXANDER, ALLEN L	E	AFRA	YAPLEE, BENJAMIN S	S	AFRA
ANDERSON, WENDELL L	E	AFRA	ZISMAN, WILLIAM A	E	AFRA
BEACH, LOUIS A	BG3	AFRA	1DN50 NAVAL SUBSISTENCE OFFICE		
BELSHEIM, ROBERT	BGO	AFRA	DWYER, MARY C	4	RA
BIRKS, LAVERNE S		AFRA	JUSTIN, A CHRISTINE	4	RA
BLOOM, MORTIMER C	BE	AFRA	MC DONALD, EDWINA	4	RA
BONDELID, ROLLON O		AFRA	1DN5P SPECIAL PROJECTS OFFICE		
BROWN, B F	V	AFRA	CRAVEN, JOHN P	B2	AFRA
CARHART, HOMER W	EG	AFRA	1DNX DEPT OF NAVY MISC		
CHAPIN, EDWARD J	GV	AFRA	EZEKIEL, WALTER N	K	RA
CHEEK, CONRAD H	E	AFRA	MURRAY, WILLIAM S	F	RA
CLEMENT, J REID JR		AFRA	TAYLOR, ROBERT T	F	RA
DAVISSON, JAMES W	B	AFRA	1H DEPT OF HEALTH EDUCATION & WELFARE		
DE PACKH, DAVID		AFRA	1HFDA FOOD AND DRUG ADMN		
DE PUE, LELAND A	GV	AFRA	BARTRAM, M THOMAS	4	RA
DEITZ, VICTOR R	E	AFRA	BEACHAM, LOWRIE M	4	RA
DOLECEK, RICHARD L	BG	AFRA	COOK, J WILLIAM	4	RA
DRUMMETER, LOUIS F JR		AFRA	DURBIN, CHARLES G	GP	AFRA
DUNNING, KENNETH L	B	AFRA	EIDUSON, HYMAN P	4	RA
EGLI, PAUL H	E	AFRA	EISENBERG, WILLIAM	K	RA
EHRMAN, JOACHIM B	G	AFRA	FISCHBACH, HENRY	4	RA
FAUST, WILLIAM R		AFRA	FOX, MATTIE R	EGU	AFRA
FISK, BERT		AFRA	KLINE, ORAL L	4	RA
FORD, T FOSTER	E	AFRA	LOY, HENRY W	4	RA
FOX, ROBERT B	EG	AFRA	MILLER, DAVID J	4	RA
GIBSON, JOHN E		AFRA	OSBORN, ROBERT A	4	RA
GINTHER, ROBERT J		AFRA	PROCHAZKA, MILLO W	4	RA
GLASSER, ROBERT G		AFRA	ROE, ROBERT S	4	RA
HALL, WAYNE C	SGN	AFRA	SALWIN, HAROLD	4	RA
HAUPTMAN, HERBERT	BG	AFRA	SCHIAFFINO, S STEPHEN	4	RA
HOOVER, JOHN I	BG	AFRA	SHELTON, L R JR	4	RA
HUNTER, WILLIAM R	B	AFRA	SLADEK, JAROMIL V	E	AFRA
IRWIN, GEORGE R	B	AFRA	SLOCUM, GLENN G	Q4	AFRA
KAGARISE, RONALD E	G	AFRA	TILLSON, ALBERT H	K	RA
KARLE, ISABELLA	G	AFRA	TOLLE, CHESTER D	4	RA
KARLE, JEROME	BE	AFRA	VAZQUEZ, ALBERTO W	F	RA
KIES, JOSEPH A	BGV	AFRA	YIP, GEORGE	4	RA
KING, PETER	BE	AFRA	1HNIH NATIONAL INSTS OF HEALTH		
KOLB, ALAN C		AFRA	AKERS, ROBERT P	G	AFRA
LINNENBOM, VICTOR J	E	AFRA	ANDREWS, HOWARD L		AFRA
LOCKHART, LUTHER B JR	E	AFRA	ARNOLD, FRANCIS A JR	W	RA
MAYER, CORNELL H	S	AFRA	BAER, PAUL N	W	RA
MC CLAIN, EDWARD F JR	BS	AFRA	BARRETT, MARGARET D	U	AFRA
MC ELHINNEY, JOHN	B	AFRA	BARRETT, MORRIS K	U	AFRA
MILLER, ROMAN R	E	AFRA	BAUER, HUGO	E	AFRA
PAGE, ROBERT M	S	AFRA	BECKER, EDWIN D	E	AFRA
PELLINI, WILLIAM S	V	AFRA	BELKIN, MORRIS		AFRA
RADO, GEORGE T	B	AFRA			
SAENZ, ALBERT W		AFRA			

BERLINER, ROBERT W	BU	AFRA	SOLLNER, KARL	E	AFRA
BOETTCHER, RICHARD E	F	RA	STADTMAN, E R		AFRA
BOND, HOWARD W	E	AFRA	STEPHAN, ROBERT M	QUW	AFRA
BOWMAN, PAUL W	DK	AFRA	STEWART, SARAH E	IQU	AFRA
BREWER, CARL R	Q	AFRA	TASAKI, ICHIJI		AFRA
BRODIE, BERNARD B	EU	AFRA	THURMAN, ERNESTINE B	FG	AFRA
BROOKMAN, BERNARD	F	RA	VON BRAND, THEODOR C	PU	AFRA
BURK, DEAN	EU	AFRA	WITKOP, BERNHARD	E	AFRA
BURSTONE, M S	W	RA	WOKE, PAUL A	F	RA
BYRNE, ROBERT J	GQ	AFRA	WOODS, MARK W	KU	AFRA
CARROLL, WILLIAM R	E	AFRA	YEAGER, J FRANKLIN		AFRA
COLE, KENNETH S		AFRA	ZELEN, MARVIN		AFRA
CORNFIELD, JEROME		AFRA	ZIPKIN, ISADORE	W	RA
DORN, HAROLD F		AFRA			
EARLE, WILTON R	U	AFRA	1HOED OFFICE OF EDUCATION		
EDDY, BERNICE E	GQU	AFRA	OBOURN, ELLSWORTH S	B	AFRA
EDDY, NATHAN B	G	AFRA			
EMMART, EMILY W	GQU	AFRA	1HPHS PUBLIC HEALTH SERVICE		
EMMONS, CHESTER W	K	RA	BENDER, MAURICE	E4	AFRA
ENDICOTT, KENNETH M		AFRA	BRADLEY, G H	F	RA
FITZGERALD, ROBERT J	W	RA	CARTER, HUGH		AFRA
FLETCHER, HEWITT G	EG	AFRA	DAUER, CARL C		AFRA
FOLK, JOHN E	W	RA	HAGEN, THOMAS L	W	RA
FRAME, ELIZABETH G	EU	AFRA	HUGHES, JOHN H	F	RA
FRANK, KARL	U	AFRA	HUNDLEY, JAMES M		AFRA
FULLMER, HAROLD M	W	RA			
GOOS, ROGER D	K	RA	11 DEPT OF THE INTERIOR		
GREENE, JOHN C	W	RA			
HAMPP, EDWARD G	QW	AFRA	1IFWS FISH & WILDLIFE SERVICE		
HIATT, CASPAR W	EGQT	AFRA	ALDRICH, JOHN W	D	AFRA
HOTTLE, GEORGE A	GQU	AFRA	ALLEN, HAROLD B	4	RA
HOWELL, ARDEN J	W	RA	BUTLER, CHARLES	4	RA
JORDAN, LUZERNE G	W	RA	CLARK, G M	F	RA
KERESZTESY, JOHN C	E	AFRA	CROWTHER, HAROLD E	4	RA
KEYES, PAUL H	W	RA	HERMAN, CARLTON M	GPU	AFRA
KRESHOVER, SEYMORE J	W	RA	HOLSTON, JOHN A	4	RA
KULWICH, ROMAN	4	RA	MITCHELL, ROBERT T	F	RA
LAKI, KOLOMAN	DEG	AFRA	SNYDER, DONALD G	4	RA
LANE, JOHN E	F	RA	UHLER, FRANCIS M		AFRA
LARSEN, RACHEL H	W	RA			
LEIKIND, MORRIS C		AFRA	1IGED GEOLOGIC DIVISION		
LIKINS, ROBERT C	W	AFRA	TODD, MARGARET R	GH	AFRA
LYMAN, F EARLE	W	RA			
MARSHALL, LOUISE H		AFRA	1IGES GEOLOGICAL SURVEY		
MARSHALL, WADE H	B	AFRA	BAKER, ARTHUR A	H	AFRA
MC CANN, HAROLD G	W	RA	BENNETT, ROBERT R	H	AFRA
MC CLURE, FRANK J	EUW	AFRA	CARROLL, DOROTHY	GH	AFRA
MC CULLOUGH, NORMAN B	GIQ	AFRA	CARRON, MAXWELL K	EH	AFRA
MIDER, G BURROUGHS		AFRA	CUTTITTA, FRANK	EGH	AFRA
MILLER, CLEM O	E	AFRA	DANE, CARLE H	H	AFRA
MURRILL, ROBERT D	F	RA	DUNCAN, HELEN M	H	AFRA
NIRENBERG, MARSHALL W		AFRA	FAHEY, JOSEPH J	EGH	AFRA
NYLEN, MARIE U	W	RA	FAUST, GEORGE T	H	AFRA
OMATA, ROBERT R	W	RA	FOURNIER, ROBERT O	H	AFRA
PARK, HELEN D		AFRA	GLASS, JEWELL J		AFRA
PIEZ, KARL A	W	RA	HOOKE, MARJORIE	H	AFRA
PITTMAN, MARGARET	QU	AFRA	LOVE, S KENNETH	EGH	AFRA
RALL, DAVID P	U	AFRA	MAY, IRVING	EGH	AFRA
ROGOSA, MORRISON	W	RA	MC KELVEY, VINCENT E	H	AFRA
ROSENTHAL, SANFORD M		AFRA	MC KNIGHT, EDWIN T	H	AFRA
ROWE, WALLACE P		AFRA	MEYROWITZ, ROBERT	E	AFRA
RUSSELL, ALBERT L	W	RA	MILLER, J CHARLES	H	AFRA
SCHRECKER, ANTHONY W	E	AFRA	MINARD, JAMES P		AFRA
SCOTT, DAVID B	W	AFRA	NACE, RAYMOND L	H	AFRA
SHANNON, JAMES A		AFRA	OWENS, JAMES P	GH	AFRA
SHEAR, MURRAY J	BG	AFRA	PHAIR, GEORGE	H	AFRA
SHELTON, EMMA		AFRA	REICHEN, LAURA E	E	AFRA
SHIOTA, TETSUO	W	RA	ROEDDER, EDWIN	BH	AFRA
SMITH, FALCONER	BU	AFRA	RUBIN, MEYER	4	AFRA
SMITH, WILLIE W	U	AFRA	SHAPIRO, LEONARD	E	AFRA

SPETZMAN, LLOYD A	K	RA	KURZWEG, HERMAN H	BX	AFRA
SPICER, H CECIL	H	AFRA	LIDDEL, URNER	BS3	AFRA
STRINGFIELD, VICTOR T	GH	AFRA	O KEEFE, JOHN A	B	AFRA
SVENSON, H K	K	RA	STAUS, HENRY E	V	AFRA
TAYLOR, GEORGE C JR	H	AFRA	TEPPER, MORRIS	XY	AFRA
THAYER, THOMAS P	H	AFRA	WADDEL, RAMOND C		AFRA
TOULMIN, PRIESTLEY III	4	AFRA			
WRATHER, W E	H	AFRA	1XNMC NAT METEOROLOGICAL CENTER		
ZEN, E-AN	H	AFRA	CRESSMAN, GEORGE P		AFRA
1IHEC NAT HOME ECONOMICS RES CR			1XNOD NAT OCEANOGRAPHIC DATA CENTER		
KERR, ROSE G	4	RA	JACOBS, WOODROW C	Y	AFRA
1INCP NATIONAL CAPITAL PARKS			1XNSF NAT SCIENCE FOUNDATION		
WESTER, HORACE V	K	RA	EDMUNDS, LAFE R	F	AFRA
1L DEPARTMENT OF LABOR			ETZEL, HOWARD W	G	AFRA
1LBLB BUREAU OF LABOR STATISTICS			HODGE, W H	K	RA
EVANS, W DUANE		AFRA	KECK, DAVID K	K	RA
1S DEPT OF STATE			LYMAN, JOHN	EY	AFRA
1SAID AGENCY FOR INTERNATIONAL DEV			MC MILLEN, J HOWARD	B	AFRA
JOHNSON, D R	F	RA	ROBERTSON, RANDAL M	BGL	AFRA
WILLIER, LILLIAN E	K	RA	RODNEY, WILLIAM S	B	AFRA
1SX DEPT OF STATE MISC			SEEGER, RAYMOND J	B	AFRA
JOYCE, JAMES W	BG	AFRA	SHANAHAN, A J	Q	AFRA
WELLS, HARRY W		AFRA	SPENCER, J T	G	AFRA
1T DEPT OF THE TREASURY			STEWART, ILEEN E		AFRA
1TIRS INTERNAL REVENUE SERVICE			WITHROW, ALICE P		AFRA
MATHERS, ALEX P	E	AFRA	1XSMI SMITHSONIAN INSTITUTION		
PRO, MAYNARD J	EG3	AFRA	BOWMAN, THOMAS E	D	AFRA
SCHOENEMAN, ROBERT L		AFRA	CARMICHAEL, LEONARD		AFRA
1X OTHER GOVERNMENT AGENCIES			CARTWRIGHT, O L	F	RA
1XAEC ATOMIC ENERGY COMMISSION			CLARKE, J F	F	RA
DALZELL, CARSON	OV3	AFRA	COCHRAN, DORIS M	G	AFRA
MAGIN, GEORGE B JR	EH3	AFRA	COLLINS, HENRY B	C	AFRA
REITEMEIER, ROBERT F		AFRA	CONGER, PAUL S		AFRA
SHEA, KEVIN G	4	RA	COOPER, G ARTHUR	H	AFRA
WENSCH, GLEN W	GV3	AFRA	COWAN, RICHARD S	K	RA
WHITMAN, MERRILL J	V3	AFRA	CUATRECASAS, JOSE	K	RA
1XCAB CIVIL AERONAUTICS BOARD			DAVIS, DON R	F	RA
HOLSHOUSER, WILLIAM L	GV	AFRA	DEIGNAN, HERBERT G		AFRA
1XCIA CENTRAL INTELLIGENCE AGENCY			DEIGNAN, STELLA		AFRA
PORTERFIELD, W M JR	K	RA	DRAKE, CARL J	F	RA
SCOVILLE, HERBERT JR		AFRA	DUCKWORTH, W DONALD	F	RA
1XDCG DIST OF COLUMBIA GOVT			EWERS, JOHN C		AFRA
TRAVIS, CLARENCE W	F	AMRA	EYDE, RICHARD H	K	RA
1XGSA GENERAL SERVICES ADMN			FIELD, WILLIAM D		AFRA
FIELDS, MELVIN D	4	RA	FLINT, OLIVER S	F	RA
1XLIC LIBRARY OF CONGRESS			FREEMAN, MONROE E	EU	AFRA
KENK, ROMAN	G	AFRA	GAZIN, CHARLES L	DH	AFRA
WEISS, FRANCIS J	BEGKQ	AFRA	HALE, MASON E JR	K	RA
WEISS, FRANCIS J	34	AFRA	HENDERSON, E P	H	AFRA
1XNAS NAT AERONAUTICS & SPACE AGENCY			KINGSOLVER, JOHN	F	RA
DRYDEN, HUGH L	BGOX	AFRA	MC CLURE, FLOYD A	K	RA
EDSON, JAMES B		AFRA	MC FADDEN, MAX	F	RA
JENKINS, DALE W	F	RA	MILLER, CARL F	CG	AFRA
			MORRISON, JOSEPH P	D	AFRA
			MORTON, CONRAD V	K	RA
			OEHSER, PAUL H	BD	AFRA
			REHDER, HARALD A	DG	AFRA
			ROBERTS, FRANK H	C	AFRA
			RUDD, VELVA E	DK	AFRA
			RUHOFF, F A	F	RA
			SCHMITT, WALDO L	D	AFRA
			SHETLER, STANWYN G	K	RA
			SHROPSHIRE, WALTER	K	RA
			SMITH, ALBERT C	K	RA
			SMITH, LYMAN B	K	RA
			SODERSTROM, THOMAS R	K	RA
			STERN, WILLIAM L	K	RA

STEWART, T DALE	Q	AFRA	MANDEL, H GEORGE	EU	AFRA
SWALLEN, J R	K	RA	MASON, MARTIN A	MOT	AFRA
WARNER, ROSE E	F	RA	MEARS, FLORENCE M		AFRA
WETMORE, ALEXANDER	DG	AFRA	MUNSON, S C	F	RA
WURDACK, JOHN J	K	RA	NAESER, CHARLES R	EGH	AFRA
1XUST U S TARIFF COMMISSION			PARLETT, ROBERT C	QU	AFRA
GONET, FRANK	E	AFRA	PERROS, THEODORE P	BE	AFRA
1XVET VETERANS ADMINISTRATION			RENKIN, EUGENE M		AFRA
GOODWIN, WILLIAM M	W	RA	ROBBINS, MARY L	GQU	AFRA
2 EDUCATION			SAGER, WILLIAM F	E	AFRA
2H HIGHER EDUCATION			STEVENS, RUSSELL B	K	AFRA
2HAMU AMERICAN UNIVERSITY			TELFORD, IRA R	U	AFRA
MOORE, HARVEY C		AFRA	TREADWELL, CARLETON R	EU	AFRA
SCHUBERT, LEO	BE	AFRA	VAN EVERA, BENJAMIN D	EG	AFRA
SITTERLY, BANCROFT W	B	AFRA	WALTHER, CARL H	GT	AFRA
2HCOU COLUMBIA UNION COLLEGE			WEINTRAUB, ROBERT L	E	AFRA
DAVIDSON, JOHN A	F	RA	WOOD, REUBEN E	E	AFRA
2HCUA CATHOLIC UNIV OF AMERICA			2ZHOU HOWARD UNIVERSITY		
ARNETT, ROSS H	F	RA	ABRAMS, ESTELLE	W	RA
BIBERSTEIN, FRANK A JR	BT	AFRA	AREFIAN, DANIEL	W	RA
CLAFFEY, PAUL J	T	AFRA	BARNES, R PERCY	E	AFRA
DARWENT, BASIL DE B	BE	AFRA	BRANSON, HERMAN		AFRA
DAVIDSON, ROBERT A	K	RA	CHILDS, VIRGINIA M	K	RA
DUTILLY, ARTHEME A	K	AFRA	COOPER, STEWART R	E	AFRA
GRIFFING, VIRGINIA	BE	AFRA	DOWNING, LEWIS K	T	AFRA
HENDERSON, MALCOLM C	B23	AFRA	FERGUSON, LLOYD N	E	AFRA
HERZFELD, KARL F	B2	AFRA	FINLEY, HAROLD E	D	AFRA
HERZFELD, REGINA F	C	AFRA	FLEMING, HAROLD	W	RA
KENNEDY, E R	GO	AFRA	GRIFFITHS, NORMAN H	W	RA
LITOVITZ, THEODORE A	B2	AFRA	HAMMOND, H DAVID	K	AMRA
LYNN, W GARDNER	B	AFRA	HAWTHORNE, EDWARD W		AFRA
O BRIEN, JOHN A JR	K	AFRA	HAYDEN, IDA	W	RA
OSGOOD, WILLIAM R	OT	AFRA	HAYES, R LEWIS	W	RA
ROCK, GEORGE D		AFRA	HENRY, JOSEPH L	W	RA
SARLES, MERRITT P	PZ	AFRA	MORRIS, JOSEPH B	E	AFRA
TALBOTT, F LEO	BG	AFRA	MORRIS, KELSO B	E	AFRA
VAN TASSELL, E R	F	RA	PENN, JOAN C	W	RA
2HDCT D C TEACHERS COLLEGE			REED, CLYDE F	K	RA
OLSON, HENRY W		AFRA	SHERESHEFSKY, J LEON	E	AFRA
2HGCU GEORGETOWN UNIVERSITY			SILBERWEIT, MARIA	W	RA
BHUSSRY, B R	W	RA	TALBERT, PRESTON T	E	AFRA
HEYDEN, FRANCIS J	BG	AFRA	TAYLOR, MARIE C	K	RA
KIGUEL, ENRIQUE B	W	RA	TAYLOR, MODDIE D	E	AFRA
KOPPANYI, THEODORE		AFRA	TURRELL, GEORGE C		AFRA
KRUGER, GUSTAV O	W	RA	2ZHJU JOHNS HOPKINS UNIV		
NEMES, J L	W	RA	BENEDICT, WILLIAM S		AFRA
RAULT, CLEMENS V	W	RA	DIEKE, G H	F	RA
RITTS, ROY E JR	IQU	AFRA	KALCKAR, HERMAN M		AFRA
ROSE, JOHN C	U	AFRA	ROZEBOOM, L E	F	RA
RUBIN, VERA C	B	AFRA	2HUMD UNIV OF MARYLAND		
STEINHARDT, JACINTO	E	AFRA	ANASTOS, GEORGE	GP	AFRA
THALER, WILLIAM J	2	AFRA	ANDREWS, T G		AFRA
2HGWU GEORGE WASHINGTON UNIV			ARBUCKLE, W S	4	RA
BOWMAN, PAUL W	K	RA	BAILEY, WILLIAM J	E	AFRA
BROWN, THOMAS M	IQ	AFRA	BAMFORD, RONALD	K	AFRA
CRAFTON, PAUL A	GNOX	AFRA	BARRY, CORNELIUS	F	RA
GRISAMORE, NELSON T	BGNS	AFRA	BICKLEY, WILLIAM E	FZ	AFRA
HANSEN, IRA B	DG	AFRA	BISSELL, T L	F	RA
JOHNSTON, FRANCIS E	B	AFRA	BRAM, RALPH A	F	RA
KULLBACK, SOLOMON	S	AFRA	BROWN, JOSHUA R C	G	AFRA
			BROWN, RUSSELL G	K	AFRA
			BURGERS, J M	BX	AFRA
			DAVIS, R F	U	AFRA
			DOETSCH, RAYMOND N	Q	AFRA
			DOSS, MILDRED A	P	AFRA
			EHEART, MARY S	4	RA
			FABER, JOHN E	Q	AFRA

FERRELL, RICHARD A	G	AFRA	SMITH, AUGUSTINE V P	K	RA
FOSTER, JAMES R	F	RA	2SMOC MONTGOMERY CO BD EDUCATION		
FREAR, SCOTT E	4	RA	DIAMOND, PAULINE		AFRA
GALLOWAY, RAYMOND A	K	RA	2SPGC PR GEORGES CO BD EDUCATION		
GARRETT, WALLACE T	F	RA	OWENS, HOWARD B	DF	AFRA
GARSTENS, HELEN L		AFRA	3 ASSOCIATIONS & INSTITUTIONS		
GAUCH, HUGH	K	RA	3A ASSOCIATIONS		
HARDING, WALLACE G	F	RA	3AAAS AMER ASSOC FOR THE ADV SCI		
HARRISON, FLOYD P	F	RA	MAYOR, JOHN R		AFRA
HAUT, IRVIN C		AFRA	TAYLOR, RAYMOND L		AFRA
HAVILAND, ELIZABETH	F	RA	WOLFLE, DAEL		AFRA
HELBACKA, NORMAN V	4	RA	3AABC AMER BOTTLERS CARBONATED BEV		
HOLMGREN, HARRY D		AFRA	KORAB, HARRY E	4	RA
JONES, JACK C	F	AFRA	STERNBERG, RICHARD	4	RA
JOSEPH, STANLEY E	F	RA	3AACS AMERICAN CHEMICAL SOCIETY		
KING, RAYMOND L	4	RA	EMERY, ALDEN H	EG	AFRA
KRAMER, AMIHUD	4	RA	3AAIC INTERNAT ASSOC ICE CREAM MFRS		
KRAUSS, ROBERT W	K	AFRA	SPEER, JOHN F	4	RA
KRESTENSEN, ELROY R	F	RA	3AAPS AMER PSYCHOLOGICAL ASSOC		
LANGFORD, GEORGE S	FZ	AFRA	ROSS, SHERMAN		AFRA
LASTER, HOWARD J	B	AFRA	TRUEBLOOD, CHARLES K		AFRA
LINK, CONRAD B	K	RA	3AATC AMER ASSOC TEXTILE CHEMISTS		
LIPPINCOTT, ELLIS R	E	AFRA	APPEL, WILLIAM D	E	AFRA
MALLACK, JERRY	F	RA	3ADIS DAIRY INDUSTRIES SUPPLY ASSOC		
MARTIN, MONROE H		AFRA	CRISS, WILLIAM H	4	RA
MASON, EDWARD A	BE	AFRA	WILLIAMS, DONALD H	G4	AMRA
MATTICK, JOSEPH F	4	RA	3AESA ENTOMOLOGICAL SOC OF AMER		
MC COMB, CHARLES W	F	RA	BUNN, RALPH W	FZ	AFRA
MC MINIMY, MARGARET	4	RA	NELSON, R H	FGZ	AFRA
MONTROLL, ELLIOTT W		AFRA	3AFEB FEDERATION AMER SOC EXP BIOL		
MORGAN, DELBERT T	K	RA	ZWEMER, RAYMUND L		AFRA
MORGAN, OMAR D JR	K	RA	3ANAF NAT ASSOC FROZEN FOOD PKRS		
MORGAN, RAYMOND		AFRA	SCHMITT, HERMAN P	4	RA
MYERS, RALPH D	B	AFRA	3ANCA NAT CANNERS ASSOCIATION		
PARRISH, DALE W	F	RA	BEE, GERALD R	4	RA
PATERSON, ROBERT A	K	RA	BELL, JAMES W	4	RA
PAYNE, LAWRENCE B		AFRA	BOHRER, WALLACE C	4	RA
PEARL, MARTIN H		AFRA	DE CAMP, ROGER A	4	RA
PELCZAR, MICHAEL J JR	Q	AFRA	DENNY, CLEVE B	4	RA
REEVE, E WILKINS	E	AFRA	ELKINS, EDGAR R JR	4	RA
RIVELLO, ROBERT M	OX	AFRA	FARROW, RICHARD P	E4	AFRA
SCHAMP, HOMER W JR	B	AFRA	GREENLEAF, CARLOS A	4	RA
SCHOENBORN, HENRY W		AFRA	GRINNELL, CHARLES N	4	RA
SCOTT, L E	4	RA	HAHN, ELISABETH H	4	RA
SHORB, MARY S	Q	AFRA	MAHONEY, CHARLES H	4	RA
SHRIVER, DAVID	F	RA	PARSONS, PHILIP C	4	RA
SPENCE, ROBERT J	4	RA	REED, JAMES M	4	RA
STEINHAUER, ALLEN L	F	RA	RHOADS, AUSTIN T	4	RA
TOLL, JOHN S	B	AFRA	SHRIVER, REBECCA F	4	RA
TRAUB, ROBERT	DFP	AFRA	SOMERS, IRA I	4	RA
TWIGG, BERNARD A	4	RA	3ANPV NAT PAINT VAR LACQUER ASSOC		
VANDERSLICE, J T	BE	AFRA	SCOFIELD, FRANCIS	E	AMRA
VEITCH, FLETCHER P JR	EU	AFRA	3AOSA OPTICAL SOC OF AMERICA		
WEAVER, LESLIE O	K	RA			
WEISSMAN, STANLEY	B	AFRA			
WHITE, CHARLES E	E	AFRA			
WILEY, ROBERT C	4	RA			
WILLIAMS, FLOYD J	K	RA			
WOODS, G FORREST	E	AFRA			
2S SECONDARY EDUCATION					
2SARC ARLINGTON COUNTY SCHOOLS					
ADAMS, CAROLINE A	K	RA			
FRANKLIN, TEMPIE R		AFRA			
KNIPLING, PHOEBE H		AFRA			
2SDCP D C PUBLIC SCHOOLS					
JOHNSON, KEITH C		AFRA			
MILLER, LULA A	K	RA			

WARGA, MARY E	BEG	AFRA			
31 INSTITUTIONS					
31ACI AMER CACAO INSTITUTE					
IMLE, E P	K	RA			
31APL APPLIED PHYSICS LAB JHU					
BERL, WALTER G	BE	AFRA			
FONER, SAMUEL N	B	AFRA			
GIBSON, RALPH E	BEX	AFRA			
GRAY, ERNEST P	B	AMRA			
HART, ROBERT W		AFRA			
HILL, FREEMAN K	BX	AFRA			
JEN, C K	B	AFRA			
MAHAN, ARCHIE I	B	AFRA			
MASSEY, JOSEPH T	BS	AFRA			
MC CLURE, FRANK T	BE	AFRA			
MONCHICK, LOUIS		AFRA			
STONE, A M	B	AFRA			
WESTENBERG, ARTHUR A	E	AFRA			
ZMUDA, ALFRED J	B	AFRA			
31ATC AMER TYPE CULTURE COLLECTION					
CLARK, WILLIAM A	Q	AMRA			
HWANG, SHUH-WEI	K	RA			
31CIR CORN INDUSTRIES RES FOUNDATION					
GOODWIN, JOHN T JR	4	RA			
HOOVER, WILLIAM J	4	RA			
31CIW CARNEGIE INSTITUTION OF WASH					
BURKE, BERNARD F		AFRA			
HASKINS, CARYL P	FR	AFRA			
31DTM DEPT TER MAG, CIW					
BOLTON, ELLIS T		AFRA			
COWIE, DEAN B		AFRA			
ROBERTS, RICHARD B		AFRA			
TUVE, M A	B	AFRA			
31FOF FORD FOUNDATION					
PATTERSON, MARGARET E		AFRA			
31FRI FRANKLIN INSTITUTE					
NEUENDORFFER, J A	G	AFRA			
31GEL GEOPHYSICAL LAB, CIW					
ABELSON, PHILIP H	BEHQ3	AFRA			
BOYD, FRANCIS R	H	AFRA			
HOERING, THOMAS C	EH	AFRA			
KULLERUD, GUNNAR	G	AFRA			
YODER, HATTEN S JR	EH	AFRA			
31ICE AMER INST CROP ECOLOGY					
NUTTONSON, M Y	K	RA			
31INAS NAT ACADEMY SCIENCES - NRC					
CAMPBELL, FRANK L	BDEFZ	AFRA			
COLEMAN, JOHN S	2	AFRA			
COOLIDGE, HAROLD J	G	AFRA			
FOOTE, PAUL D	B	AFRA			
HILL, BERTON F		AMRA			
JOHNSON, PAUL E	4	AFRA			
LAPP, C J	BG	AFRA			
LARRIMER, WALTER H	GLZ	AFRA			
SLACK, LEWIS	B	AFRA			
VORIS, LEROY		AFRA			
WAY, KATHARINE	B	AFRA			
WICHERS, EDWARD	E	AFRA			
31NFI NAT FISHERIES INSTITUTE					
BYRD, CLIFFORD S	4	RA			
MAGNUSSON, HARRIS W	4	RA			
31NGS NAT GEOGRAPHIC SOCIETY					
GROSVENOR, GILBERT	GJ	AFRA			
31SCS SCIENCE SERVICE					
DAVIS, WATSON	BHM	AFRA			
31WMI WILDLIFE MANAGEMENT INST					
GABRIELSON, IRA N		AFRA			
4 SELF EMPLOYED					
4CONS CONSULTANTS					
AMRINE, MICHAEL		AMRA			
ASLAKSON, CARL I	RT	AFRA			
BEAN, HOWARD S	O	AFRA			
BENNETT, MARTIN	E	AFRA			
DIEHL, WALTER S	X	AFRA			
GILLMAN, JOSEPH L JR	EMOV	AFRA			
GRAHAM, C E	4	RA			
GUNDERSON, FRANK L	4	RA			
HINMAN, WILBUR S JR	S	AFRA			
HOWE, PAUL E	E	AFRA			
INSLEY, HERBERT	B5	AFRA			
JACOB, KENNETH D	E	AFRA			
KAUFMAN, H PAUL	MR	AFRA			
LORING, BLAKE M	V	AFRA			
PARSONS, DOUGLAS E	BT	AFRA			
PHILLIPS, M LINDEMAN	S	AFRA			
READ, W T	E	AFRA			
REINHART, FRANK W	EG	AFRA			
SOUDER, WILMER	EW	AFRA			
STEVENSON, FREDERICK J	G	AFRA			
THOMAS, JAMES L		AFRA			
TOWNSEND, JOHN R	B	AFRA			
WEIL, GEORGE L	3	AFRA			
WINT, T CECIL	N3	AFRA			
4DENT DENTISTS					
CAMALIER, WILLARD C	W	RA			
DAWSON, CLARENCE E	W	RA			
ERIKSON, EDWIN B	W	RA			
KAPLAN, HARRY	W	RA			
KENNEDY, JAMES J	W	RA			
KROGH, HAROLD W	W	RA			
LYNCH, DANIEL F	W	RA			
MEAD, STERLING V	W	RA			
NELSEN, ROBERT J	W	RA			
SWANSON, HENRY A	W	RA			
4PHYS PHYSICIANS					
BERNTON, HARRY S	I	AFRA			
BURKE, FREDERIC G	I	AFRA			
COE, FRED O	GI	AFRA			
4X MISCELLANEOUS SELF EMPLOYED					
LAPP, RALPH E	B	AFRA			
5 BUSINESS CONCERNS					
5ARCO AUERBACH CORPORATION					
CLARK, GEORGE E JR		AFRA			
5ASPR ASSOCIATED PRESS					
CAREY, FRANCIS E		AFRA			
5AUCO AUTOMETRIC CORP					

SPoonER, CHARLES S JR	G	AFRA	JAY, GEORGE E JR	G	AFRA
5BEC0 BENDIX CORPORATION			WARD, THOMAS G	GQU	AFRA
O BRYAN, HENRY M	BSX	AFRA	5PORB POPULATION REFERENCE BUREAU		
5BERA BENDIX RADIO DIVISION			COOK, ROBERT C	CGK	AFRA
CARROLL, THOMAS J	B	AFRA	5RACO RAND CORPORATION		
5BOAL BOOZ - ALLEN APP RES			SMITH, PAUL A	BGHTX	AFRA
BOYD, DONALD M	4	RA	5RBEN RABINOW ENGINEERING CO		
5BOEN BOWLES ENGINEERING CO			RABINOW, JACOB	BS	AFRA
BOWLES, RONALD E		AFRA	5REAN RESEARCH ANALYSIS CORP		
5CAPC CAPITAL CHEMICAL CO			RUMBAUGH, LYNN H	B	AFRA
ROLLOW, J DOUGLAS	F	RA	5RERS RESOURCES RESEARCH CORP		
5CONC CONTINENTAL CAN CO			MC CABE, LOUIS C	CER	AFRA
WILKINS, GEORGE R	4	RA	5SCPR SCIENTIFIC PRODUCTS		
5DRDE DRUG DETECTION & DEV ORG			POPE, BRUCE R	4	RA
HILLIG, FRED	4	RA	5SHCH SHELL CHEMICAL CORP		
5ENLA C W ENGLAND LABORATORIES			COMPTON, CHARLES C	F	RA
ENGLAND, WALTER C	4	RA	ULLRICH, DONALD E	F	RA
5FOCN FOOD CHEMICAL NEWS			5SNUR A H SMALL & SONS NURSERY		
ROTHSCHILD, LOUIS JR	4	RA	TURPIN, JEAN M	K	RA
5GIFO GIANT FOODS			5SURE SURVEYS & RESEARCH CORP		
BENDER, ROBERT W	4	RA	RICE, STUART A		AFRA
KORNETSKY, AARON	4	RA	5UNCA UNION CARBIDE CHEMICALS		
5HALA HAZLETON LABORATORIES			MC BRIDE, GORDON W	E4	AFRA
HAZLETON, LLOYD W	EU	AFRA	5VAEN VALUE ENGINEERING CO		
5SHARE HARRIS RESEARCH LABS			WEINBERG, HAROLD P	V	AFRA
ALTER, HARVEY	E	AFRA	5WAPO WASHINGTON POST		
BERCH, JULIAN	E	AMRA	HASELTINE, NATE		AFRA
BROWN, ALFRED E	BEG	AFRA	5WATA WASHINGTON TECH ASSOCIATES		
BURAS, EDMUND M JR	E	AFRA	WADEY, WALTER G		AFRA
FOURT, LYMAN	E	AFRA	6 FOREIGN & INTERNATIONAL		
HARRIS, MILTON	E	AFRA	6AUSO AUSTRALIAN SCIENTIFIC OFFICE		
HOLLIES, NORMAN R S	E	AFRA	HARTLEY, WILLIAM	K	RA
KRASNY, JOHN F	E	AFRA	6FAOR FOOD & AGRI ORG, UN		
MENKART, JOHN H	E	AFRA	DAWSON, ROY C	Q	AFRA
MIZELL, LOUIS R	E	AFRA	6WOHE WORLD HEALTH ORGANIZATION		
SCHWARTZ, ANTHONY M	E	AFRA	CHAMBERLAYNE, EARL C	4	RA
SOOKNE, ARNOLD M	E	AFRA	7RETD RETIRED		
5HOSH HOT SHOPPES			ALLISON, FRANKLIN E	EGQ	AFRA
MILLAR, ZELMA A	4	RA	ANDERSON, MYRON S	E	AFRA
WOOD, WILLIAM H	4	RA	BROMBACHER, W G	B	AFRA
5HUAS HUNTER ASSOCIATES LAB			BUHRER, EDNA M	P	AFRA
HUNTER, RICHARD S	G	AFRA	CURRIER, LOUIS W	H	AFRA
5INCR INS CONTROL & RES			DAFT, FLOYD S	EU	AFRA
GERBERG, EUGENE J	F	RA	DETWILER, SAMUEL B	KL	AFRA
5JITH JOHN I THOMPSON & CO			DUERDSEN, JACOB A	BG	AFRA
THOMPSON, JOHN I	4	RA	FIELDNER, ARNO C	EGM	AFRA
5LIPR LIQUIDS PROCESS CO			FRACKER, STANLEY B	F	RA
ROLLER, PAUL S	BEG	AFRA	GARDNER, IRVINE C	B	AFRA
5MELP MELPAR INC.			GELLER, ROMAN F	BG5	AFRA
FALLON, ROBERT J	BEG	AFRA	GOLDBERG, MICHAEL	B	AFRA
RITT, PAUL E	S5	AFRA	GRAF, JOHN E	DFG	AFRA
5MIAS MICROBIOLOGICAL ASSOCIATES			GRANT, ULYSSES S III	GJMRT	AFRA

GRAVATT, G FLIPPO	KL	AFRA	HOFFMAN, RICHARD E	F	RA
HAMBLETON, JAMES I	F	AFRA	HUGH, RUDOLPH		AMRA
HENRY, THOMAS R		AFRA	HUNT, HOWARD L	F	RA
JESSUP, RALPH S	BG	AFRA	KALMBACK, KENNETH H	F	RA
JUDSON, LEWIS V	BG	AFRA	KENNEY, ARTHUR W		AFRA
JUHN, MARY	U	AFRA	KERR, ELIZABETH B	K	RA
KARRER, SEBASTIAN	BE	AFRA	KNOWLES, ZELDA	F	RA
KENNARD, RALPH B	BG	AFRA	PARKER, KITTIE	K	RA
KIESS, CARL C	G	AFRA	PEACOCK, ELIZABETH D		AMRA
KNOWLTON, KATHRYN	EU	AFRA	SMALL, HAROLD E	F	RA
LEONARD, MORTIMER D	FGZ	AFRA	STARCKE, HELLE	F	RA
LOFQUIST, ETSUKO O	U	AFRA	THOMPSON, JOHN V	F	RA
MADORSKY, SAMUEL L	E	AFRA	WENDT, LORINA	K	RA
MARTIN, JOHN H	GK	AFRA	WHEELER, NANCY H	F	RA
MAUSS, BESSE D		AFRA	WILSON, KATHERINE	K	RA
MC INTOSH, ALLEN	GP	AFRA			
MC KEE, SAMUEL A		AFRA			
MEGGERS, WILLIAM F	B	AFRA			
MOHLER, FRED L	BG	AFRA			
PAGE, BENJAMIN L	BG	AFRA			
POOS, FRED W	FGZ	AFRA			
PORTER, B A	F	AFRA			
RAPPLEYE, HOWARD S	BGMRT	AFRA			
ROBERTS, ELLIOTT B	B	AFRA			
ROBERTSON, MYRNA J	P	AFRA			
SAGER, THERON		AFRA			
SCHOENING, HARRY W	GQ	AFRA			
SCOFIELD, CARL S	K	AFRA			
SILSBEE, FRANCIS B	BGN	AFRA			
SIMMS, BENNETT T	G	AFRA			
SNOKE, HUBERT R		AFRA			
STIEBELING, HAZEL K	E	AFRA			
STIMSON, HAROLD F	BG	AFRA			
STIRLING, MATHEW W	CG	AFRA			
TOOL, ARTHUR Q		AFRA			
TORRESON, OSCAR W	BG	AFRA			
VACHER, HERBERT C	GV	AFRA			
WADLEY, F M	F	RA			
WALKER, EGBERT H	K	AFRA			
WARD, HENRY P	E	AFRA			
WATERMAN, ALAN T		AFRA			
WATTS, CHESTER B	BG	AFRA			
WEAVER, E R	CE	AFRA			
WEBB, J E	F	RA			
WEIGEL, C A	F	RA			
WOOD, W B	F	RA			
WORKMAN, WILLIAM G	G	AFRA			
ZOCH, RICHMOND T	Y	AFRA			

BCLUN CLASSIFICATION UNKNOWN

ALBERTS, HUGO	K	RA
AUTRY, HOMER V	F	RA
BAKER, W L	F	RA
BENDER, ALVA H	F	RA
BENDER, EDWARD K	F	RA
BIRGHAM, IRVING H	F	RA
BURKE, FRANK J	F	RA
CALVERT, CATHERINE R	4	RA
CHARTER, W V	W	RA
CHURCHILL, ETHAN D	K	RA
DARROW, BERTHA S	K	RA
DAWSON, WILSON F	F	RA
DONOVAN, JOSEPHINE R	K	RA
EMERSON, K C	F	RA
FOX, ADRIAN C	K	RA
FREDERIKSE, H P		AFRA
GAMMONS, JOHN G	F	RA
GODEK, THEODORE D	F	RA
HARNED, R W	F	RA
HOCHWALD, FRITZ	K	RA

Classification by Membership in Affiliated Societies

B	PHILOSOPHICAL SOC OF WASH								
	ABELSON, PHILIP H	3IGEL	AFRA		GRIFFING, VIRGINIA	2HCUA	AFRA		
	ALEXANDER, SAMUEL N	1CNBS	AFRA		GRISAMORE, NELSON T	2HGWU	AFRA		
	ALLEN, HARRY C JR	1CNBS	AFRA		HAMMERSCHMIDT, W W	1D-S	AMRA		
	ARMSTRONG, GEORGE T	1CNBS	AFRA		HAUPTMAN, HERBERT	1DNRL	AFRA		
	ASTIN, ALLEN V	1CNBS	AFRA		HENDERSON, MALCOLM C	2HCUA	AFRA		
	AXILROD, BENJAMIN M	1CNBS	AFRA		HERZFIELD, CHARLES M	1D-S	AFRA		
	BARBROW, LOUIS E	1CNBS	AFRA		HERZFIELD, KARL F	2HCUA	AFRA		
	BASS, ARNOLD M	1CNBS	AFRA		HEYDEN, FRANCIS J	2HGEU	AFRA		
	BEACH, LOUIS A	1DNRL	AFRA		HILL, FREEMAN K	3IAPL	AFRA		
	BEKKEDAHL, NORMAN	1CNBS	AFRA		HOBBS, ROBERT B	1CNBS	AFRA		
	BELSHEIM, ROBERT	1DNRL	AFRA		HOOVER, JOHN I	1DNRL	AFRA		
	BERL, WALTER G	3IAPL	AFRA		HUNTER, WILLIAM R	1DNRL	AFRA		
	BERLINER, ROBERT W	1HNIH	AFRA		HUNTOON, ROBERT D	1CNBS	AFRA		
	BIBERSTEIN, FRANK A JR	2HCUA	AFRA		INSLEY, HERBERT	4CONS	AFRA		
	BLOOM, MORTIMER C	1DNRL	AFRA		IRWIN, GEORGE R	1DNRL	AFRA		
	BRAATEN, NORMAN F	1CCGS	AFRA		JACKSON, JULIUS L	1CNBS	AFRA		
	BRECKENRIDGE, F C	1CNBS	AFRA		JEN, C K	3IAPL	AFRA		
	BREWER, KEITH A	1DNNO	AFRA		JESSUP, RALPH S	7RETD	AFRA		
	BROMBACHER, W G	7RETD	AFRA		JOHNSON, DANIEL P	1CNBS	AFRA		
	BROWN, ALFRED E	5HARE	AFRA		JOHNSTON, FRANCIS E	2HGWU	AFRA		
	BURGERS, J M	2HUMD	AFRA		JOYCE, JAMES W	1SX	AFRA		
	BURINGTON, RICHARD S	1DNBW	AFRA		JUDD, DEANE B	1CNBS	AFRA		
	BUTLER, WARREN L	1AMMR	AFRA		JUDSON, LEWIS V	7RETD	AFRA		
	CALDWELL, FRANK R	1CNBS	AFRA		KARLE, JEROME	1DNRL	AFRA		
	CALLEN, EARL R	1DNOL	AFRA		KARRER, SEBASTIAN	7RETD	AFRA		
	CAMPBELL, FRANK L	3INAS	AFRA		KENNARD, RALPH B	7RETD	AFRA		
	CARDER, DEAN S	1CCGS	AFRA		KESSLER, KARL G	1CNBS	AFRA		
	CARRINGTON, TUCKER	1CNBS	AFRA		KIES, JOSEPH A	1DNRL	AFRA		
	CARROLL, THOMAS J	5BERA	AFRA		KING, PETER	1DNRL	AFRA		
	CLAIRE, CHARLES N	1CCGS	AFRA		KLEIN, RALPH	1CNBS	AFRA		
	COHN, ROBERT	1DNHS	AFRA		KLUTE, CHARLES H	1DAHD	AFRA		
	COOK, HAROLD T	1AMMR	AFRA		KOSTKOWSKI, HENRY J	1CNBS	AFRA		
	COOK, RICHARD K	1CNBS	AFRA		KURZWEG, HERMAN H	1XNAS	AFRA		
	COOTER, IRVIN L	1CNBS	AFRA		LAPP, C J	3INAS	AFRA		
	CRAVEN, JOHN P	1DNNSP	AFRA		LAPP, RALPH E	4X	AFRA		
	DARWENT, BASIL DE B	2HCUA	AFRA		LASHOF, THEODORE W	1CNBS	AFRA		
	DAVIS, RAYMOND		AFRE		LASTER, HOWARD J	2HUMD	AFRA		
	DAVIS, WATSON	3ISCS	AFRA		LIDDEL, URNER	1XNAS	AFRA		
	DAVISSON, JAMES W	1DNRL	AFRA		LITOVITZ, THEODORE A	2HCUA	AFRA		
	DOLECEK, RICHARD L	1DNRL	AFRA		LYNN, W GARDNER	2HCUA	AFRA		
	DOUGLAS, CHARLES A	1CNBS	AFRA		MAHAN, ARCHIE I	3IAPL	AFRA		
	DRYDEN, HUGH L	1XNAS	AFRA		MARSHALL, WADE H	1HNIH	AFRA		
	DUERDSEN, JACOB A	7RETD	AFRA		MARVIN, ROBERT S	1CNBS	AFRA		
	DUNNING, KENNETH L	1DNRL	AFRA		MASON, EDWARD A	2HUMD	AFRA		
	EISENHART, CHURCHILL	1CNBS	AFRA		MASSEY, JOSEPH T	3IAPL	AFRA		
	ELBOURN, ROBERT D	1CNBS	AFRA		MAXWELL, LOUIS R	1DNOL	AFRA		
	FALLON, ROBERT J	5MELP	AFRA		MAY, DONALD C JR	1DNBW	AFRA		
	FONER, SAMUEL N	3IAPL	AFRA		MAZUR, JACOB	1CNBS	AFRA		
	FOOTE, PAUL D	3INAS	AFRA		MC CLAIN, EDWARD F JR	1DNRL	AFRA		
	FRAPS, RICHARD M	1ARFR	AFRA		MC CLURE, FRANK T	3IAPL	AFRA		
	FRENKIEL, FRANCOIS N	1DNDT	AFRA		MC ELHINNEY, JOHN	1DNRL	AFRA		
	FULLMER, IRVIN H	1CNBS	AFRA		MC MILLEN, J HOWARD	1XNSF	AFRA		
	FURUKAWA, GEORGE T	1CNBS	AFRA		MC NESBY, JAMES R	1CNBS	AFRA		
	GARDNER, IRVINE C	7RETD	AFRA		MC NISH, ALVIN G	1CNBS	AFRA		
	GELLER, ROMAN F	7RETD	AFRA		MC PHERSON, ARCHIBALD	1CNBS	AFRA		
	GHAFFARI, ABOLGHASSEM	1CNBS	AFRA		MEGGERS, WILLIAM F	7RETD	AFRA		
	GIBSON, RALPH E	3IAPL	AFRA		MITTLEMAN, DON	1CNBS	AFRA		
	GOLDBERG, MICHAEL	7RETD	AFRA		MOHLER, FRED L	7RETD	AFRA		
	GORDON, CHARLES L	1CNBS	AFRA		MUEHLHAUSE, CARL O	1CNBS	AFRA		
	GRAY, ERNEST P	3IAPL	AMRA		MURPHY, LEONARD M	1CCGS	AFRA		
	GREEN, MELVILLE S	1CNBS	AFRA		MYERS, RALPH D	2HUMD	AFRA		
	GREENSPAN, MARTIN	1CNBS	AFRA		O BRYAN, HENRY M	5BECO	AFRA		
					O KEEFE, JOHN A	1XNAS	AFRA		

OBOURN, ELLSWORTH S	1HOED AFRA	VINTI, JOHN P	1CNBS AFRA
OEHSER, PAUL H	1XSMI AFRA	WACHTMAN, J B JR	1CNBS AFRA
OSTEN, EDWARD J	1DNDDT AMRA	WALL, LEO A	1CNBS AFRA
PAGE, BENJAMIN L	7RETD AFRA	WARGA, MARY E	3AOSA AFRA
PAGE, CHESTER H	1CNBS AFRA	WATTS, CHESTER B	7RETD AFRA
PARSONS, DOUGLAS E	4CONC AFRA	WAY, KATHARINE	3INAS AFRA
PEISER, H STEFFEN	1CNBS AFRA	WEBB, ROBERT W	1AMMR AFRA
PENTZER, WILBUR T	1AMMR AFRA	WEISS, FRANCIS J	1XLIC AFRA
PERROS, THEODORE P	2HGWU AFRA	WEISSBERG, SAMUEL	1CNBS AFRA
PLYLER, EARL K	1CNBS AFRA	WEISSLER, ALFRED	1DFOS AFRA
POLACHEK, HARRY	1DNDDT AFRA	WEISSMAN, STANLEY	2HUMD AFRA
RABINOW, JACOB	5RBEN AFRA	WEXLER, ARNOLD	1CNBS AFRA
RADO, GEORGE T	1DNRL AFRA	WEYL, F JOACHIM	1DNOR AFRA
RAPPLEYE, HOWARD S	7RETD AFRA	WHITTEN, CHARLES A	1CCGS AFRA
ROBERTS, ELLIOTT B	7RETD AFRA	WILDHACK, W A	1CNBS AFRA
ROBERTSON, RANDAL M	1XNSF AFRA	WILSON, BRUCE L	1CNBS AFRA
RODNEY, WILLIAM S	1XNSF AFRA	YOU DEN, WILLIAM J	1CNBS AFRA
ROEDDER, EDWIN	1IGES AFRA	ZMUDA, ALFRED J	3IAPL AFRA
ROESER, WILLIAM F	1CNBS AFRA	ZWANZIG, ROBERT W	1CNBS AFRA
ROLLER, PAUL S	5LIPR AFRA		
ROSENBLATT, DAVID	1CNBS AFRA	C ANTHROPOLOGICAL SOC OF WASH	
ROTKIN, ISRAEL	1DAHD AFRA	COLLINS, HENRY B	1XSMI AFRA
RUBIN, ROBERT J	1CNBS AFRA	COOK, ROBERT C	5PORB AFRA
RUBIN, VERA C	2HGEU AFRA	HERZFELD, REGINA F	2HCUA AFRA
RUMBAUGH, LYNN H	5REAN AFRA	MC CABE, LOUIS C	5RERS AFRA
SALKOVITZ, EDWARD I	1DNOR AFRA	MILLER, CARL F	1XSMI AFRA
SANDERSON, JOHN A	1DNRL AFRA	ROBERTS, FRANK H	1XSMI AFRA
SCHAMP, HOMER W JR	2HUMD AFRA	STIRLING, MATHEW W	7RETD AFRA
SCHAEER, MILTON D	1CNBS AFRA	WEAVER, E R	7RETD AFRA
SCHINDLER, ALBERT I	1DNRL AFRA		
SCHOOOVER, IRL C	1CNBS AFRA	D BIOLOGICAL SOC OF WASHINGTON	
SCHUBAUER, GALEN B	1CNBS AFRA	ALDRICH, JOHN W	1IFWS AFRA
SCHUBERT, LEO	2HAMU AFRA	BENJAMIN, CHESTER R	1ARFR AFRA
SCHULMAN, JAMES H	1DNRL AFRA	BORTHWICK, HARRY A	1ARFR AFRA
SCOTT, ARNOLD H	1CNBS AFRA	BOWMAN, PAUL W	1HNIH AFRA
SEEGER, RAYMOND J	1XNSF AFRA	BOWMAN, THOMAS E	1XSMI AFRA
SHAPIRO, MAURICE M	1DNRL AFRA	CAMPBELL, FRANK L	3INAS AFRA
SHEAR, MURRAY J	1HNIH AFRA	FINLEY, HAROLD E	2HHOU AFRA
SHULER, KURT E	1CNBS AFRA	FULLER, HENRY S	1DAWR AFRA
SILSBEE, FRANCIS B	7RETD AFRA	GAZIN, CHARLES L	1XSMI AFRA
SILVERMAN, SHIRLEIGH	1DNOR AFRA	GRAF, JOHN E	7RETD AFRA
SITTERLY, BANCROFT W	2HAMU AFRA	GURNEY, ASHLEY B	1ARFR AFRA
SITTERLY, CHARLOTTE M	1CNBS AFRA	HAMBLETON, EDSON J	1ARRP AFRA
SLACK, LEWIS	3INAS AFRA	HANSEN, IRA B	2HGWU AFRA
SLAWSKY, ZAKA I	1DNOL AFRA	LAKI, KOLOMAN	1HNIH AFRA
SMALL, JAMES B	1CCGS AFRA	MORRISON, JOSEPH P	1XSMI AFRA
SMITH, FALCONER	1HNIH AFRA	OEHSER, PAUL H	1XSMI AFRA
SMITH, PAUL A	5RACO AFRA	OWENS, HOWARD B	2SPGC AFRA
SMITH, PAUL L	1DNRL AFRA	REHDER, HAROLD A	1XSMI AFRA
STEINER, ROBERT F	1DNMR AFRA	RUDD, VELVA E	1XSMI AFRA
STEPHENS, ROBERT E	1CNBS AFRA	RUSSELL, LOUISE M	1ARFR AFRA
STIEHLER, ROBERT D	1CNBS AFRA	SCHMITT, WALDO L	1XSMI AFRA
STILLER, BERTRAM	1DNRL AFRA	ST GEORGE, RAYMOND A	1AFOR AFRA
STIMSON, HAROLD F	7RETD AFRA	TRAUB, ROBERT	2HUMD AFRA
STONE, A M	3IAPL AFRA	WETMORE, ALEXANDER	1XSMI AFRA
SWINDELLS, JAMES F	1CNBS AFRA		
TALBOTT, F LEO	2HCUA AFRA	E CHEMICAL SOC OF WASHINGTON	
TATE, DOUGLAS R	1CNBS AFRA	ABELSON, PHILIP H	3IGEL AFRA
TAYLOR, JOHN K	1CNBS AFRA	ALEXANDER, ALLEN L	1DNRL AFRA
TCHEN, CHAN-MOU	1CNBS AFRA	ALEXANDER, LYLE T	1ARFR AFRA
TEELE, RAY P	1CNBS AFRA	ALLEN, HARRY C JR	1CNBS AFRA
TOLL, JOHN S	2HUMD AFRA	ALLISON, FRANKLIN E	7RETD AFRA
TORRESON, OSCAR W	7RETD AFRA	ALTER, HARVEY	5HARE AFRA
TOUSEY, RICHARD	1DNRL AFRA	ANDERSON, MYRON S	7RETD AFRA
TOWNSEND, JOHN R	4CONC AFRA	ANDERSON, WENDELL L	1DNRL AFRA
TRENT, HORACE M	1DNRL AFRA	APPEL, WILLIAM D	3AATC AFRA
TREXLER, JAMES H	1DNRL AFRA	ARMSTRONG, GEORGE T	1CNBS AFRA
TUVE, M A	3IDTM AFRA	AUSLOOS, PIERRE J	1CNBS AFRA
VANDERSLICE, J T	2HUMD AFRA	BAILEY, WILLIAM J	2HUMD AFRA
VIGNESS, IRWIN	1DNRL AFRA	BARKER, ROY J	1ARFR AFRA

BARNES, R PERCY	2HHOU AFRA	GRIFFING, VIRGINIA	2HCUA AFRA
BATES, ROGER G	1CNBS AFRA	HAGUE, JOHN L	1CNBS AFRA
BAUER, HUGO	1HNIH AFRA	HALL, STANLEY A	1ARFR AFRA
BECKER, EDWIN D	1HNIH AFRA	HALLER, HERBERT L	1ARFR AFRA
BECKETT, CHARLES W	1CNBS AFRA	HAMER, WALTER J	1CNBS AFRA
BEKKEDAHL, NORMAN	1CNBS AFRA	HARRIS, MILTON	5HARE AFRA
BENDER, MAURICE	1HPHS AFRA	HARVALIK, Z V	1DAER AFRA
BENNETT, MARTIN	4CONS AFRA	HAZLETON, LLOYD W	5HALA AFRA
BERCH, JULIAN	5HARE AMRA	HEINZE, PETER H	1AMMR AFRA
BERL, WALTER G	3IAPL AFRA	HIATT, CASPAR W	1HNIH AFRA
BLOOM, MORTIMER C	1DNRL AFRA	HOBBS, ROBERT B	1CNBS AFRA
BOND, HOWARD W	1HNIH AFRA	HOERING, THOMAS C	3IGEL AFRA
BRAUER, GERHARD M	1CNBS AFRA	HOFFMAN, JOHN D	1CNBS AFRA
BRENNER, ABNER	1CNBS AFRA	HOLLIES, NORMAN R S	5HARE AFRA
BREWER, KEITH A	1DNNO AFRA	HOOVER, THOMAS B	1CNBS AFRA
BRODIE, BERNARD B	1HNIH AFRA	HOWARD, FRANK L	1CNBS AFRA
BROWN, ALFRED E	5HARE AFRA	HOWE, PAUL E	4CONS AFRA
BUCKLEY, FLOYD W	1CNBS AFRA	HUBBARD, DONALD	1CNBS AFRA
BURAS, EDMUND M JR	5HARE AFRA	IRVING, GEORGE W JR	1ARNI AFRA
BURK, DEAN	1HNIH AFRA	ISBELL, HORACE S	1CNBS AFRA
CAMPBELL, FRANK L	3INAS AFRA	JACOB, KENNETH D	4CONS AFRA
CARHART, HOMER W	1DNRL AFRA	JOHANNESSEN, ROLF B	1CNBS AFRA
CARRINGTON, TUCKER	1CNBS AFRA	KANAGY, JOSEPH R	1CNBS AFRA
CARROLL, WILLIAM R	1HNIH AFRA	KANE, EDWARD A	1ARFR AFRA
CARRON, MAXWELL K	1IGES AFRA	KARLE, JEROME	1DNRL AFRA
CASSEL, JAMES M	1CNBS AFRA	KARRER, SEBASTIAN	7RETD AFRA
CAUL, HAROLD J	1CNBS AFRA	KEEGAN, HARRY J	1CNBS AFRA
CHEEK, CONRAD H	1DNRL AFRA	KERESZTESY, JOHN C	1HNIH AFRA
CLARK, KENNETH G	1ARFR AFRA	KING, PETER	1DNRL AFRA
COOPER, STEWART R	2HHOU AFRA	KLEIN, RALPH	1CNBS AFRA
COULSON, JACK E	1ARNI AFRA	KLINE, GORDON M	1CNBS AFRA
CREITZ, CARROLL E	1CNBS AFRA	KLUTE, CHARLES H	1DAHD AFRA
CUTTITTA, FRANK	1IGES AFRA	KNOBLOCK, EDWARD C	1DAWR AFRA
DAFT, FLOYD S	7RETD AFRA	KNOWLTON, KATHRYN	7RETD AFRA
DARWENT, BASIL DE B	2HCUA AFRA	KRUGER, JEROME	1CNBS AFRA
DAVIS, MARION M	1CNBS AFRA	KURTZ, FLOYD E	1ARNI AFRA
DAVIS, RAYMOND	AFRE	LAKI, KOLOMAN	1HNIH AFRA
DEITZ, VICTOR R	1DNRL AFRA	LIEBERMAN, MORRIS	1AMMR AFRA
DETWILER, SAMUEL B JR	1ARNI AFRA	LINNEBOM, VICTOR J	1DNRL AFRA
DOUGLAS, THOMAS B	1CNBS AFRA	LIPPINCOTT, ELLIS R	2HUMD AFRA
EGLI, PAUL H	1DNRL AFRA	LOCKHART, LUTHER B JR	1DNRL AFRA
ELLIS, NED R	1ARFR AFRA	LOVE, S KENNETH	1IGES AFRA
EMERY, ALDEN H	3AACS AFRA	LYMAN, JOHN	1XNSF AFRA
FAHEY, JOSEPH J	1IGES AFRA	MADORSKY, SAMUEL L	7RETD AFRA
FALLON, ROBERT J	5MELP AFRA	MAGIN, GEORGE B JR	1XAEC AFRA
FARROW, RICHARD P	3ANCA AFRA	MANDEL, H GEORGE	2HGWU AFRA
FERGUSON, LLOYD N	2HHOU AFRA	MANDEL, JOHN	1CNBS AFRA
FIELDNER, ARNO C	7RETD AFRA	MANN, DAVID E	1CNBS AFRA
FLETCHER, HEWITT G	1HNIH AFRA	MARVIN, ROBERT S	1CNBS AFRA
FLORIN, ROLAND E	1CNBS AFRA	MARYOTT, ARTHUR A	1CNBS AFRA
FORD, T FOSTER	1DNRL AFRA	MASON, EDWARD A	2HUMD AFRA
FORZIATI, ALPHONSE F	1D-S AFRA	MATHERS, ALEX P	1TIRS AFRA
FORZIATI, FLORENCE H	1ARNI AFRA	MATLACK, MARION B	1ARFR AFRA
FOURT, LYMAN	5HARE AFRA	MAY, IRVING	1IGES AFRA
FOX, MATTIE R	1HFDA AFRA	MC BRIDE, GORDON W	5UNCA AFRA
FOX, ROBERT B	1DNRL AFRA	MC CABE, LOUIS C	5RERS AFRA
FRAME, ELIZABETH G	1HNIH AFRA	MC CLURE, FRANK J	1HNIH AFRA
FRANKLIN, PHILIP J	1D-S AFRA	MC CLURE, FRANK T	3IAPL AFRA
FREEMAN, MONROE E	1XSMI AFRA	MC DONALD, EMMA J	1CNBS AFRA
FRIESS, SEYMOUR L	1DNMR AFRA	MC PHERSON, ARCHIBALD	1CNBS AFRA
FRUSH, HARRIET L	1CNBS AFRA	MENKART, JOHN H	5HARE AFRA
FULTON, ROBERT A	1ARFR AFRA	MEYROWITZ, ROBERT	1IGES AFRA
FURUKAWA, GEORGE T	1CNBS AFRA	MILLER, CLEM O	1HNIH AFRA
GIBSON, RALPH E	3IAPL AFRA	MILLER, ROMAN R	1DNRL AFRA
GILLMAN, JOSEPH L JR	4CONS AFRA	MIZELL, LOUIS R	5HARE AFRA
GINNINGS, DEFOE C	1CNBS AFRA	MORRIS, JOSEPH B	2HHOU AFRA
GLASGOW, AUGUSTUS R JR	1CNBS AFRA	MORRIS, KELSO B	2HHOU AFRA
GOLUMBIC, CALVIN	1AMMR AFRA	NAESER, CHARLES R	2HGWU AFRA
GONET, FRANK	1XUST AFRA	OKABE, HIDEO	1CNBS AFRA
GORDON, CHARLES L	1CNBS AFRA	PEISER, H STEFFEN	1CNBS AFRA

PERROS, THEODORE P	2HGWU AFRA	ADAMS, JEAN R	1AX RA
PLYLER, EARL K	1CNBS AFRA	ADLER, VICTOR E	1ARFR RA
POMMER, ALFRED M	1ARNI AFRA	ALFORD, HAROLD G	1ARRP RA
PRO, MAYNARD J	1TIRS AFRA	ANDERSON, DONALD M	1ARFR RA
PROSEN, EDWARD J	1CNBS AFRA	ANDERSON, WILLIAM H	1ARFR AFRA
READ, W T	4CONS AFRA	APP, BERNARD A	1ARFR RA
REEVE, E WILKINS	2HUMD AFRA	ARNETT, ROSS H	2HCUA RA
REICHEN, LAURA E	1IGES AFRA	AUTRY, HOMER V	8CLUN RA
REINHART, FRANK W	4CONS AFRA	BAKER, EDWARD W	1ARRP RA
ROLLER, PAUL S	5LIPR AFRA	BAKER, HOWARD	1ARFR RA
SAGER, WILLIAM F	2HGWU AFRA	BAKER, W L	8CLUN RA
SCHAFFER, ROBERT	1CNBS AFRA	BARKER, ROY J	1ARFR AFRA
SCHECHTER, MILTON S	1ARFR AFRA	BARNHART, CLYDE S	AFNA
SCHEER, MILTON D	1CNBS AFRA	BARRY, CORNELIUS	2HUMD RA
SCHOONOVER, IRL C	1CNBS AFRA	BEAL, JAMES A	1AFOR RA
SCHRECKER, ANTHONY W	1HNIH AFRA	BENDER, ALVA H	8CLUN RA
SCHUBERT, LEO	2HAMU AFRA	BENDER, EDWARD K	8CLUN RA
SCHWARTZ, ANTHONY M	5HARE AFRA	BICKLEY, WILLIAM E	2HUMD AFRA
SCOFIELD, FRANCIS	3ANPV AMRA	BILLINGS, SAMUEL C	1ARRP RA
SCRIBNER, BOURDON F	1CNBS AFRA	BISSELL, T L	2HUMD RA
SHAPIRO, LEONARD	1IGES AFRA	BLAKE, DORIS H	AFRE
SHERESHEFSKY, J LEON	2HHOU AFRA	BLICKENSTAFF, CARL C	1ARFR RA
SINGLETERRY, CURTIS R	1DNRL AFRA	BODENSTEIN, WILLIAM G	1ARFR RA
SLADER, JAROMIL V	1HFDA AFRA	BOETTCHER, RICHARD E	1HNIH RA
SOLLNER, KARL	1HNIH AFRA	BONGBERG, JACK W	1AFOR RA
SOOKNE, ARNOLD M	5HARE AFRA	BRADLEY, G H	1HPHS RA
SOUDER, WILMER	4CONS AFRA	BRAM, RALPH A	2HUMD RA
SPIES, JOSEPH R	1ARNI AFRA	BRIGHAM, IRVING H	8CLUN RA
STEINER, ROBERT F	1DNMR AFRA	BROOKMAN, BERNARD	1HNIH RA
STEINHARDT, JACINTO	2HGEU AFRA	BULLOCK, HOWARD R	1AX RA
STERN, KURT H	1CNBS AFRA	BUNN, RALPH W	3AESA AFRA
STEVENS, HENRY	1ARNI AFRA	BURKE, FRANK J	8CLUN RA
STIEBELING, HAZEL K	7RETD AFRA	BURKS, BARNARD D	1ARFR RA
STIEHLER, ROBERT D	1CNBS AFRA	BUSBY, RUTH L	1ARFR RA
SWEENEY, WILLIAM T	1CNBS AFRA	CALLAGHAN, GEORGE F	1ARRP RA
TALBERT, PRESTON T	2HHOU AFRA	CALLAWAY, MINNIE B	1ARRP RA
TAYLOR, JOHN K	1CNBS AFRA	CAMPBELL, FRANK L	3INAS AFRA
TAYLOR, MODDIE D	2HHOU AFRA	CANTWELL, GEORGE	1ARFR RA
TIPSON, R STUART	1CNBS AFRA	CAPPS, HAHN W	1ARFR RA
TORGESEN, JOHN L	1CNBS AFRA	CARTWRIGHT, O L	1XSMI RA
TREADWELL, CARLETON R	2HGWU AFRA	CHRISTENSON, LEROY D	1ARFR AFRA
TRYON, MAX	1CNBS AFRA	CLARK, G M	1IFWS RA
VAN EVERA, BENJAMIN D	2HGWU AFRA	CLARKE, J F	1XSMI RA
VANDERSLICE, J T	2HUMD AFRA	COMPTON, CHARLES C	5SCH RA
VEITCH, FLETCHER P JR	2HUMD AFRA	CONKLE, HERBERT J	1ARRP RA
WALL, LEO A	1CNBS AFRA	COOPER, JAMES F	1ARFR RA
WALTON, WILLIAM W	1CNBS AFRA	CORY, ERNEST N	AFRE
WARD, HENRY P	7RETD AFRA	COULSON, JACK R	1ARFR RA
WARGA, MARY E	3AOSA AFRA	COUSHMAN, HELENE G	1ANAL RA
WEAVER, E R	7RETD AFRA	DAHMS, REYNOLD G	1ARFR RA
WEINTRAUB, ROBERT L	2HGWU AFRA	DAVIDSON, JOHN A	2HCOU RA
WEISS, FRANCIS J	1XLIC AFRA	DAVIS, DON R	1XSMI RA
WEISSBERG, SAMUEL	1CNBS AFRA	DAWSON, WILSON F	8CLUN RA
WEISSLER, ALFRED	1DFOS AFRA	DEWS, SAM C	1DAX RA
WESTENBERG, ARTHUR A	3IAPL AFRA	DIEKE, G H	2HJHU RA
WHITE, CHARLES E	2HUMD AFRA	DOWDEN, PHILIP B	1ARFR RA
WHITTAKER, COLIN W	1ARFR AFRA	DRAKE, CARL J	1XSMI RA
WICHERS, EDWARD	3INAS AFRA	DUCKWORTH, W DONALD	1XSMI RA
WILSON, WILLIAM K	1CNBS AFRA	DUTKY, SAMSON R	1ARFR RA
WITKOP, BERNHARD	1HNIH AFRA	EDMUNDS, LAFE R	1XNSF AFRA
WOMACK, MADELYN	1ARNI AFRA	ELDRIDGE, BRUCE F	1DAWR RA
WOOD, LAWRENCE A	1CNBS AFRA	EMERSON, K C	8CLUN RA
WOOD, REUBEN E	2HGWU AFRA	FALES, JOHN H	1ARFR RA
WOODS, G FORREST	2HUMD AFRA	FLINT, OLIVER S	1XSMI RA
YODER, HATTEN S JR	3IGEL AFRA	FLUNO, JOHN A	1ARFR RA
YODEN, WILLIAM J	1CNBS AFRA	FOOTE, RICHARD H	1ARFR RA
ZELENY, LAWRENCE	1AMRP AFRA	FOSTER, JAMES R	2HUMD RA
ZISMAN, WILLIAM A	1DNRL AFRA	FRACKER, STANLEY B	7RETD RA
		FULLER, HENRY S	1DAWR AFRA
		GAMMONS, JOHN G	8CLUN RA

F ENTOMOLOGICAL SOC OF WASH

GARRETT, WALLACE T	2HUMD	RA	PARRISH, DALE W	2HUMD	RA
GERBERG, EUGENE J	5INCR	RA	PELTIER, PAUL X	1ARRP	RA
GILBERT, ENGEL L	1ARRP	RA	POOS, FRED W	7RETD	AFRA
GODEK, THEODORE D	8CLUN	RA	POPHAM, WILLIAM L	1ARRP	RA
GRAF, JOHN E	7RETD	AFRA	PORTER, B A	7RETD	AFRA
GURNEY, ASHLEY B	1ARFR	AFRA	RAINWATER, CLYDE F	1ARFR	RA
HAEUSSLER, GILBERT J	1ARFR	RA	REAGAN, EUGENE P	1ARRP	RA
HAINES, KENNETH A	1ARAO	AFRA	REED, LUCIUS B	1ARFR	RA
HALL, DAVID G	1ARAO	RA	REED, WILLIAM D	1DAEC	AFRA
HALLER, HERBERT L	1ARFR	AFRA	REOLLOW, J DOUGLAS	5CAPC	RA
HAMBLETON, EDSON J	1ARRP	AFRA	ROZEBOOM, L E	2HJHU	RA
HAMBLETON, JAMES I	7RETD	AFRA	RUHOFF, F A	1XSMI	RA
HARDING, WALLACE G	2HUMD	RA	RUSSELL, LOUISE M	1ARFR	AFRA
HARNED, R W	8CLUN	RA	SABROSKY, CURTIS W	1ARFR	RA
HARRISON, FLOYD P	2HUMD	RA	SHEPARD, HAROLD H	1AASC	AFRA
HASKINS, CARYL P	3ICIW	AFRA	SHERMAN, RALPH W	1ARRP	RA
HAVILAND, ELIZABETH	2HUMD	RA	SHRIVER, DAVID	2HUMD	RA
HEIMPEL, A M	1ARFR	RA	SIEGLER, EDOUARD H		AFRE
HENNEBERRY, THOMAS J	1ARFR	AFRA	SMALL, HAROLD E	8CLUN	RA
HERRING, JON L	1ARFR	RA	SMITH, FLOYD F	1ARFR	AFRA
HILL, SAMUEL O	1ARFR	RA	SMITH, MARLON R	1ARFR	RA
HIRST, JOHN M	1DNMC	RA	SNYDER, THOMAS E		RE
HODGES, RONALD W	1ARFR	RA	SOLLERS-RIEDEL, HELEN	1ARRP	RA
HOFFMAN, RICHARD E	8CLUN	RA	SPANGLER, PAUL J	1ARFR	RA
HOFFMANN, CLARENCE H	1ARFR	AFRA	SPILMAN, THEODORE J	1ARFR	RA
HOLWAY, R T	1D-PC	RA	ST GEORGE, RAYMOND A	1AFOR	AFRA
HUGHES, JOHN H	1HPHS	RA	STARCKE, HELLE	8CLUN	RA
HULL, WILLIAM B	1DNMS	RA	STEINHAUER, ALLEN L	2HUMD	RA
HUNT, HOWARD L	8CLUN	RA	STEYSKAL, GEORGE C	1ARFR	RA
HUTTON, GEORGE L	1DNBY	AFRA	STONE, ALAN	1ARFR	RA
JENKINS, DALE W	1XNAS	RA	SULLIVAN, WILLIAM N JR	1ARFR	RA
JOHNSON, D R	1SAID	RA	TAYLOR, ROBERT T	1DNX	RA
JONES, JACK C	2HUMD	AFRA	THOMPSON, JOHN V	8CLUN	RA
JONES, SLOAN E	1ARFR	RA	THURMAN, ERNESTINE B	1HNIH	AFRA
JOSEPH, STANLEY E	2HUMD	RA	TODD, EDWARD L	1ARFR	RA
KALMBACK, KENNETH H	8CLUN	RA	TODD, FRANK E	1ARFR	AFRA
KINGSOLVER, JOHN	1XSMI	RA	TRAUB, ROBERT	2HUMD	AFRA
KNIPLING, EDWARD F	1ARFR	AFRA	TRAVIS, CLARENCE W	1XDCG	AMRA
KNOWLES, ZELDA	8CLUN	RA	ULLRICH, DONALD E	5SHCH	RA
KRAMER, JAMES P	1ARFR	RA	VAN TASSELL, E R	2HCUA	RA
KRESTENSEN, ELROY R	2HUMD	RA	VANCE, ARLO M	1ARFR	RA
KROMBEIN, KARL V	1ARFR	RA	VAZQUEZ, ALBERTO W	1HFDA	RA
LANCHESTER, HORACE P	1ARFR	RA	VINCENT, R H	1DFX	RA
LANE, JOHN E	1HNIH	RA	VJGT, GEORGE B	1ARFR	RA
LANGFORD, GEORGE S	2HUMD	AFRA	WADLEY, F M	7RETD	RA
LAUDANI, HAMILTON	1AMRP	RA	WALKER, ROBERT L	1ARFR	RA
LEONARD, MORTIMER D	7RETD	AFRA	WALKLEY, LUELLA M	1ARFR	RA
LLOYD, GEORGE W	1ARRP	RA	WALTON, MARGARET	1AX	RA
LUGENBILL, PHILIP JR	1ARFR	RA	WARNER, ROSE E	1XSMI	RA
MAKSYMUK, BOHDAN	1AFOR	RA	WEBB, J E	7RETD	RA
MALLACK, JERRY	2HUMD	RA	WEIGEL, C A	7RETD	RA
MASON, HORATIO C	1ARFR	RA	WEISMAN, DONALD M	1ARFR	RA
MC COMB, CHARLES W	2HUMD	RA	WELD, L H		RE
MC FADDEN, MAX	1XSMI	RA	WHEELER, NANCY H	8CLUN	RA
MC GOVRAN, EDWARD R	1ACSE	RA	WHITE, RICHARD O	1ARRP	RA
MICHAEL, ALBERT S	1ARFR	RA	WIRTH, WILLIS W	1ARFR	RA
MITCHELL, ROBERT T	1IFWS	RA	WOKE, PAUL A	1HNIH	RA
MOORE, ARTHUR D	1AFOR	RA	WOLBARSH, MYRON L	1DNMR	RA
MORRISON, HAROLD		AFRE	WOLF, VIRGINIA S	1ARFR	RA
MUESEBECK, CARL F		AFRE	WOOD, W B	7RETD	RA
MUNSON, S C	2HGWU	RA	YATES, LUCILLE W	1ARRP	RA
MURRAY, WILLIAM S	1DNX	RA	YUILL, JOSEPH S	1AFOR	AFRA
MURRILL, ROBERT D	1HNIH	RA			
NEAL, T J	1DAWR	RA	G NATIONAL GEOGRAPHIC SOCIETY		
NELSON, R H	3AES A	AFRA	AKERS, ROBERT P	1HNIH	AFRA
NEWSON, HAROLD D	1DAX	RA	ALLEN, HARRY C JR	1CNBS	AFRA
O NEILL, KELLIE	1ARRP	RA	ALLISON, FRANKLIN E	7RETD	AFRA
OAKLEY, RICHARD G	1ARRP	RA	ANASTOS, GEORGE	2HUMD	AFRA
OMAN, PAUL W	1ARFR	RA	ARMSTRONG, GEORGE T	1CNBS	AFRA
OWENS, HOWARD B	2SPGC	AFRA	BARKER, ROY J	1ARFR	AFRA

BEACH, LOUIS A	1DNRL AFRA	HEINZE, PETER H	1AMMR AFRA
BEKKEDAHL, NORMAN	1CNBS AFRA	HERMAN, CARLTON M	1IFWS AFRA
BELSHEIM, ROBERT	1DNRL AFRA	HEYDEN, FRANCIS J	2HGUE AFRA
BENJAMIN, CHESTER R	1ARFR AFRA	HIATT, CASPAR W	1HNIH AFRA
BENNETT, JOHN A	1CNBS AFRA	HICKOX, GEORGE H	1DAER AFRA
BLACK, RICHARD B	1DNOR AFRA	HOBBS, ROBERT B	1CNBS AFRA
BORTHWICK, HARRY A	1ARFR AFRA	HOLSHOUSER, WILLIAM L	1XCAB AFRA
BOUTWELL, JOHN M	AFNA	HOOVER, JOHN I	1DNRL AFRA
BRENNER, ABNER	1CNBS AFRA	HOTTLE, GEORGE A	1HNIH AFRA
BREWER, KEITH A	1DNNO AFRA	HOUGH, FLOYD W	AFNA
BROWN, ALFRED E	5SHARE AFRA	HUBBARD, DONALD	1CNBS AFRA
BROWN, JOSHUA R C	2HUMD AFRA	HUNTER, RICHARD S	5HUAS AFRA
BURINGTON, RICHARD S	1DNBW AFRA	HUTTON, GEORGE L	1DNBY AFRA
BURNETT, HARRY C	1CNBS AFRA	JAY, GEORGE E JR	5MIAS AFRA
BYRNE, ROBERT J	1HNIH AFRA	JESSUP, RALPH S	7RETD AFRA
CALDWELL, FRANK R	1CNBS AFRA	JOYCE, JAMES W	1SX AFRA
CARHART, HOMER W	1DNRL AFRA	JUDSON, LEWIS V	7RETD AFRA
CARROLL, DOROTHY	1IGES AFRA	KAGARISE, RONALD E	1DNRL AFRA
CHAPIN, EDWARD J	1DNRL AFRA	KARLE, ISABELLA	1DNRL AFRA
CHRISTENSON, LEROY D	1ARFR AFRA	KEEGAN, HARRY J	1CNBS AFRA
COCHRAN, DORIS M	1XSMI AFRA	KENK, ROMAN	1XLIC AFRA
COE, FRED O	4PHYS AFRA	KENNARD, RALPH B	7RETD AFRA
COOK, ROBERT C	5PORB AFRA	KENNEDY, E R	2HCUA AFRA
COOLIDGE, HAROLD J	3INAS AFRA	KESSLER, KARL G	1CNBS AFRA
CRAFTON, PAUL A	2HGWU AFRA	KIES, JOSEPH A	1DNRL AFRA
CURRAN, HAROLD R	1ARNI AFRA	KIESS, CARL C	7RETD AFRA
CUTTITTA, FRANK	1IGES AFRA	KLEIN, RALPH	1CNBS AFRA
DAVIS, MARION M	1CNBS AFRA	KNAPP, DAVID G	1CCGS AFRA
DE PUE, LELAND A	1DNRL AFRA	KOHLER, HANS W	1DAHD AFRA
DICKSON, GEORGE	1CNBS AFRA	KULLERUD, GUNNAR	3IGEL AFRA
DOLECEK, RICHARD L	1DNRL AFRA	LAKI, KOLOMAN	1HNIH AFRA
DOUGLAS, CHARLES A	1CNBS AFRA	LAMBERT, EDMUND B	1ARFR AFRA
DRYDEN, HUGH L	1XNAS AFRA	LAPP, C J	3INAS AFRA
DUERDSEN, JACOB A	7RETD AFRA	LARRIMER, WALTER H	3INAS AFRA
DURBIN, CHARLES G	1HFDA AFRA	LASHOF, THEODORE W	1CNBS AFRA
EDDY, BERNICE E	1HNIH AFRA	LEONARD, MORTIMER D	7RETD AFRA
EDDY, NATHAN B	1HNIH AFRA	LOVE, S KENNETH	1IGES AFRA
EHRMAN, JOACHIM B	1DNRL AFRA	MARTIN, JOHN H	7RETD AFRA
ELLINGER, GEORGE A	1CNBS AFRA	MARVIN, ROBERT S	1CNBS AFRA
ELLIS, NED R	1ARFR AFRA	MAY, DONALD C JR	1DNBW AFRA
EMERY, ALDEN H	3AACS AFRA	MAY, IRVING	1IGES AFRA
EMMART, EMILY W	1HNIH AFRA	MC CLELLAN, WILBUR D	1ARFR AFRA
ETZEL, HOWARD W	1XNSF AFRA	MC CULLOUGH, NORMAN B	1HNIH AFRA
FAHEY, JOSEPH J	1IGES AFRA	MC INTOSH, ALLEN	7RETD AFRA
FALLON, ROBERT J	5MELP AFRA	MC PHERSON, ARCHIBALD	1CNBS AFRA
FERRELL, RICHARD A	2HUMD AFRA	MILLER, CARL F	1XSMI AFRA
FIELDNER, ARNO C	7RETD AFRA	MITCHELL, J MURRAY JR	1CWEB AFRA
FLETCHER, HEWITT G	1HNIH AFRA	MOHLER, FRED L	7RETD AFRA
FOX, MATTIE R	1HFDA AFRA	MOORE, GEORGE A	1CNBS AFRA
FOX, ROBERT B	1DNRL AFRA	MOSTOFI, F K	1D-IP AFRA
FULLMER, IRVIN H	1CNBS AFRA	NAESER, CHARLES R	2HGWU AFRA
FURUKAWA, GEORGE T	1CNBS AFRA	NELSON, R H	3AESU AFRA
GELLER, ROMAN F	7RETD AFRA	NEUENDORFFER, J A	3IFRI AFRA
GLASGOW, AUGUSTUS R JR	1CNBS AFRA	NICKERSON, DOROTHY	1AMRP AFRA
GORDON, CHARLES L	1CNBS AFRA	OWENS, JAMES P	1IGES AFRA
GRAF, JOHN E	7RETD AFRA	PAGE, BENJAMIN L	7RETD AFRA
GRANT, ULYSSES S III	7RETD AFRA	PAGE, CHESTER H	1CNBS AFRA
GREENOUGH, M L	1CNBS AFRA	POLLOCK, BRUCE M	1ARFR AFRA
GREENSPAN, MARTIN	1CNBS AFRA	POMMER, ALFRED M	1ARNI AFRA
GRISAMORE, NELSON T	2HGWU AFRA	POOS, FRED W	7RETD AFRA
GROSVENOR, GILBERT	3INGS AFRA	PRO, MAYNARD J	1TIRS AFRA
GURNEY, ASHLEY B	1ARFR AFRA	PUTNINS, PAUL H	1CWEB AFRA
HACSKAYLO, EDWARD	1AFOR AFRA	RAPPELEYE, HOWARD S	7RETD AFRA
HAGUE, JOHN L	1CNBS AFRA	REED, WILLIAM D	1DAEC AFRA
HAINES, KENNETH A	1ARAO AFRA	REHDER, HARALD A	1XSMI AFRA
HALL, WAYNE C	1DNRL AFRA	REINHART, FRANK W	4CONS AFRA
HALLER, HERBERT L	1ARFR AFRA	RIOCH, DAVID M	1DAWR AFRA
HAMBLETON, EDSON J	1ARRP AFRA	ROBBINS, MARY L	2HGWU AFRA
HANSEN, IRA B	2HGWU AFRA	ROBERTSON, A F	1CNBS AFRA
HAUPTMAN, HERBERT	1DNRL AFRA	ROBERTSON, RANDAL M	1XNSF AFRA

RODRIGUEZ, RAUL	1DAER AFRA	CARROLL, DOROTHY	1IGES AFRA
ROESER, WILLIAM F	1CNBS AFRA	CARRON, MAXWELL K	1IGES AFRA
ROLLER, PAUL S	5LIPR AFRA	COOPER, G ARTHUR	1XSMI AFRA
ROTH, FRANK L	1CNBS AFRA	CURRIER, LOUIS W	7RET AFRA
RUSSELL, LOUISE M	1ARFR AFRA	CUTTITTA, FRANK	1IGES AFRA
SAUNDERS, JAMES B	1CNBS AFRA	DANE, CARLE H	1IGES AFRA
SAVILLE, THORNDIKE JR	1DAEB AFRA	DAVIS, WATSON	31SCS AFRA
SCHOENING, HARRY W	7RET AFRA	DUNCAN, HELEN M	1IGES AFRA
SCOTT, ARNOLD H	1CNBS AFRA	FAHEY, JOSEPH J	1IGES AFRA
SHEAR, MURRAY J	1HNIH AFRA	FAUST, GEORGE T	1IGES AFRA
SILSBEE, FRANCIS B	7RET AFRA	FOURNIER, ROBERT O	1IGES AFRA
SIMMS, BENNETT T	7RET AFRA	GAZIN, CHARLES L	1XSMI AFRA
SITTERLY, CHARLOTTE M	1CNBS AFRA	HENDERSON, E P	1XSMI AFRA
SLAWSKY, MILTON M	1DFOS AFRA	HOERING, THOMAS C	3IGEL AFRA
SMITH, PAUL A	5RACO AFRA	HOOKER, MARJORIE	1IGES AFRA
SNAVELY, BENJAMIN L	1DNOL AFRA	LOVE, S KENNETH	1IGES AFRA
SNAY, HANS G	1DNOL AFRA	MAGIN, GEORGE B JR	1XAEC AFRA
SPENCER, J T	1XNSF AFRA	MAY, IRVING	1IGES AFRA
SPOONER, CHARLES S JR	5AUCO AFRA	MC KELVEY, VINCENT E	1IGES AFRA
STAIR, RALPH	1CNBS AFRA	MC KNIGHT, EDWIN T	1IGES AFRA
STEVENSON, FREDERICK J	4CONS AFRA	MILLER, J CHARLES	1IGES AFRA
STEWART, DEWEY	1ARFR AFRA	NACE, RAYMOND L	1IGES AFRA
STIEHLER, ROBERT D	1CNBS AFRA	NAESER, CHARLES R	2HGWU AFRA
STILLER, BERTRAM	1DNRL AFRA	OWENS, JAMES P	1IGES AFRA
STIMSON, HAROLD F	7RET AFRA	PHAIR, GEORGE	1IGES AFRA
STIRLING, MATHEW W	7RET AFRA	POMMER, ALFRED M	1ARNI AFRA
STRINGFIELD, VICTOR T	1IGES AFRA	ROEDDER, EDWIN	1IGES AFRA
TALBOTT, F LEO	2HCUA AFRA	ROMNEY, CARL F	1DFX AFRA
TATE, DOUGLAS R	1CNBS AFRA	SMITH, PAUL A	5RACO AFRA
TAYLOR, JOHN K	1CNBS AFRA	SPICER, H CECIL	1IGES AFRA
TEELE, RAY P	1CNBS AFRA	STRINGFIELD, VICTOR T	1IGES AFRA
THURMAN, ERNESTINE B	1HNIH AFRA	TAYLOR, GEORGE C JR	1IGES AFRA
TODD, MARGARET R	1IGED AFRA	THAYER, THOMAS P	1IGES AFRA
TORGESEN, JOHN L	1CNBS AFRA	TODD, MARGARET R	1IGED AFRA
TORRESON, OSCAR W	7RET AFRA	TRUESDELL, PAGE E	1DNPI AFRA
TREXLER, JAMES H	1DNRL AFRA	VIGNESS, IRWIN	1DNRL AFRA
VACHER, HERBERT C	7RET AFRA	WRATHER, W E	1IGES AFRA
VAN EVERA, BENJAMIN D	2HGWU AFRA	YODER, HATTEN S JR	3IGEL AFRA
VINTI, JOHN P	1CNBS AFRA	ZEN, E-AN	1IGES AFRA
WACHTMAN, J B JR	1CNBS AFRA		
WALTHER, CARL H	2HGWU AFRA	I MEDICAL SOC OF THE DIST COL	
WARD, THOMAS G	5MIAS AFRA	BERNTON, HARRY S	4PHYS AFRA
WARGA, MARY E	3AOSA AFRA	BROWN, THOMAS M	2HGWU AFRA
WATERMAN, PETER	1DNRL AFRA	BURKE, FREDERIC G	4PHYS AFRA
WATTS, CHESTER B	7RET AFRA	COE, FRED O	4PHYS AFRA
WEIHE, WERNER K	1DAER AFRA	MC CULLOUGH, NORMAN B	1HNIH AFRA
WEISS, FRANCIS J	1XLIC AFRA	RITTS, ROY E JR	2HGEU AFRA
WEISS, RICHARD A	1DARO AFRA	STEWART, SARAH E	1HNIH AFRA
WENSCH, GLEN W	1XAEC AFRA		
WETMORE, ALEXANDER	1XSMI AFRA	J COLUMBIA HISTORICAL SOCIETY	
WHITTAKER, COLIN W	1ARFR AFRA	GRANT, ULYSSES S III	7RET AFRA
WHITTEN, CHARLES A	1CCGS AFRA	GROSVENOR, GILBERT	3INGS AFRA
WILDHACK, W A	1CNBS AFRA		
WILLIAMS, DONALD H	3ADIS AMRA	K BOTANICAL SOC OF WASHINGTON	
WILSON, BRUCE L	1CNBS AFRA	ACKERMAN, WILLIAM L	1ARFR RA
WORKMAN, WILLIAM G	7RET AFRA	ADAIR, CHARLES R	1ARFR RA
WRENCH, JOHN W JR	1DNDR AFRA	ADAMS, CAROLINE A	2SARC RA
WYMAN, LEROY L	1CNBS AFRA	ALBERTS, HUGO	8CLUN RA
YOUNG, ROBERT T JR	1DAHD AFRA	AMES, LAWRENCE M	1DAEX AFRA
YUILL, JOSEPH S	1AFOR AFRA	ANDERSEN, ALICE M	1AMRP RA
ZELNY, LAWRENCE	1AMRP AFRA	APPLEMAN, CHARLES O	AFRE
ZWANZIG, ROBERT W	1CNBS AFRA	ARTZ, LENA	RE
		BAMFORD, RONALD	2HUMD AFRA
H GEOLOGICAL SOC OF WASHINGTON		BARCLAY, ARTHUR S	1ARFR RA
ABELSON, PHILIP H	3IGEL AFRA	BARKER, HENRY D	1ARFR RA
BAKER, ARTHUR A	1IGES AFRA	BARRE, H W	NE
BENNETT, ROBERT R	1IGES AFRA	BARSS, HOWARD P	AFNE
BOUTWELL, JOHN M	AFNA	BENJAMIN, CHESTER R	1ARFR AFRA
BOYD, FRANCIS R	3IGEL AFRA	BIEN, CORABEL	RE
CARDER, DEAN S	1CCGS AFRA	BORTHWICK, HARRY A	1ARFR AFRA

BOWMAN, PAUL W	2HGWU	RA	HAYES, DORIS W	1AFOR	RA
BOWMAN, PAUL W	1HNIH	AFRA	HEERMAN, RUBEN M	1ACSE	RA
BOYD, HELEN C	1ANAL	RA	HEGGESTAD, HOWARD E	1ARFR	RA
BRADLEY, MARY A		NE	HEINZE, PETER H	1AMMR	AFRA
BRIERLEY, PHILIP	1ARFR	RA	HIGGINS, JOSEPH J	1ARFR	RA
BROWN, EDGAR		AFRE	HILDEBRAND, EARL M	1ARFR	RA
BROWN, RUSSELL G	2HUMD	AFRA	HOCHWALD, FRITZ	8CLUN	RA
BUCK, RAYMOND W	1ARFR	RA	HODGE, W H	1XNSF	RA
CASH, EDITH K		AFRE	HUNT, N REX		NE
CASH, LILLIAN		RE	HUTCHINS, LEE M		AFNA
CHAPLINE, W R		AFRE	HWANG, SHUH-WEI	3IATC	RA
CHASE, AGNES		AFRE	HYLAND, HOWARD L	1ARFR	RA
CHASE, FLORENCE M		RE	IMLE, E P	3IACI	RA
CHILDS, VIRGINIA M	2HHOU	RA	JENKINS, ANNA E		AFNE
CHURCHILL, ETHAN D	8CLUN	RA	JOHNSON, A G		RE
CLARK, J ALLEN		RE	JOHNSON, FALBA		NE
COCHRAN, LLOYD C	1ARFR	RA	JOHNSTON, FREDERICK A	1ARRP	RA
COE, GERALD E	1ARFR	RA	JUSTICE, OREN L	1AMMR	RA
COFFMAN, FRANKLIN A	1ARFR	RA	KECK, DAVID K	1XNSF	RA
COLBRY, VERA	1AMRP	RA	KENNARD, WILLIAM C		NA
COOK, HAROLD T	1AMMR	AFRA	KENWORTHY, FRANCIS T	1ARRP	RA
COOK, ROBERT C	5PORB	AFRA	KEPHART, L W		RE
COOLEY, J S		RE	KERR, ELIZABETH B	8CLUN	RA
COONS, GEORGE H		AFRE	KERR, THOMAS	1ARFR	RA
COWAN, RICHARD S	1XSMI	RA	KILTZ, BURTON F	1DAEC	RA
CROOKS, DONALD M	1ARFR	RA	KNIGHT, ROBERT J		NA
CUATRECASAS, JOSE	1XSMI	RA	KRAUSS, ROBERT W	2HUMD	AFRA
CULBERTSON, JOSEPH O	1ARFR	RA	KREITLOW, KERMIT W	1ARFR	AFRA
CULLINAN, FRANK P	1ARFR	AFRA	KULIK, MARTIN M	1AMRP	RA
DARROW, BERTHA S	8CLUN	RA	KYLE, CURTIS H		RE
DARROW, G M		RE	LAMBERT, EDMUND B	1ARFR	AFRA
DARROW, ROBERT A	1DAFD	RA	LE CLERG, ERWIN L	1ARFR	AFRA
DAVIDSON, ROBERT A	2HCUA	RA	LEFEBVRE, CAMILLE L	1ACSE	RA
DEAN, HORACE S		NE	LEIGHTY, CLYDE E		AFRE
DEMAREE, J B		RE	LENTZ, PAUL L	1ARFR	RA
DERMEN, HAIG	1ARFR	AFRA	LEUKEL, ROBERT W		RE
DETWILER, SAMUEL B	7RETD	AFRA	LINK, CONRAD B	2HUMD	RA
DIEHL, WILLIAM W		AFRE	LIPSCOMB, BERNARD R	1ARFR	RA
DIENER, THEODOR O	1ARFR	RA	LITTLE, ELBERT L JR	1AFOR	AFRA
DILLER, J D	1AFOR	RA	LITTLE, RUBY R	1ARNI	RA
DONOVAN, JOSEPHINE R	8CLUN	RA	LOEGERING, WILLIAM Q	1ARFR	RA
DOWN, ROBERT J	1ARFR	RA	LOHR, ANNIE		RE
DRECHSLER, CHARLES	1ARFR	AFRA	LUMSDEN, DAVID V	1ARFR	RA
DUTILLY, ARTHEME A	2HCUA	AFRA	LUTZ, JACOB M	1AMMR	AFRA
EGOLF, DONALD R	1ARFR	AFRA	MA, ROBERTA	1ARFR	RA
EISENBERG, WILLIAM	1HFDA	RA	MAGNESS, J R		RE
ELLIOTT, CHARLOTTE		AFNE	MARTIN, JOHN H	7RETD	AFRA
EMMONS, CHESTER W	1HNIH	RA	MATHEWS, OSCAR		RE
EMSWELLER, SAMUEL L	1ARFR	AFRA	MAY, CURTIS	1ARFR	RA
EYDE, RICHARD H	1XSMI	RA	MAY, EUGENE		RE
EZEKIEL, WALTER N	1DNX	RA	MC CLELLAN, WILBUR D	1ARFR	AFRA
FARR, MARIE L	1ARFR	RA	MC CLURE, FLOYD A	1XSMI	RA
FOX, ADRIAN C	8CLUN	RA	MC GRATH, HILDE M	1ARFR	RA
FREEMAN, OLIVER H		NE	MC GREW, JOHN R	1ARFR	RA
FULKERSON, JOHN F	1ACSE	RA	MC KAY, HAZEL H	1AFOR	RA
FULTON, H R		RE	MC KAY, JOHN W	1ARFR	RA
GALLOWAY, RAYMOND A	2HUMD	RA	MC KINNEY, HAROLD H		AFRE
GAUCH, HUGH	2HUMD	RA	MC MURTREY, JAMES E JR	1ARFR	AFRA
GOLDSWORTHY, M C		NE	MEYER, FREDERICK G	1ARFR	RA
GOLL, F L		RE	MILLER, ALVIN H		NA
GOOS, ROGER D	1HNIH	RA	MILLER, LULA A	2SDCP	RA
GOTH, ROBERT W	1ARFR	RA	MILLER, PAUL R	1ARFR	AFRA
GRAUMANN, HUGO O	1ARFR	RA	MORGAN, DELBERT T	2HUMD	RA
GRAVATT, ANNIE R	1ARFR	RA	MORGAN, OMAR D JR	2HUMD	RA
GRAVATT, G FLIPPO	7RETD	AFRA	MORTON, CONRAD V	1XSMI	RA
HACSKAYLO, EDWARD	1AFOR	AFRA	NANCE, NELLIE		NE
HALE, MASON E JR	1XSMI	RA	NIIMOTO, DOROTHY H	1ARFR	RA
HAMMOND, H DAVID	2HHOU	AMRA	NORTON, J B		RE
HANSBROUGH, RAYMOND	1AFOR	RA	NUTTONSON, M Y	3IICE	RA
HARTLEY, WILLIAM	6AUSO	RA	O BRIEN, JOHN A JR	2HCUA	AFRA

PAGE, CHESTER H	1CNBS AFRA	SCHOENING, HARRY W	7RETD AFRA
ROTKIN, ISRAEL	1DAHD AFRA	SHANAHAN, A J	1XNSF AFRA
SCOTT, ARNOLD H	1CNBS AFRA	SHORB, MARY S	2HUMD AFRA
SHAPIRO, GUSTAVE	1CNBS AFRA	SLOCUM, GLENN G	1HFDA AFRA
SILSBEE, FRANCIS B	7RETD AFRA	STEPHAN, ROBERT M	1HNIH AFRA
WINT, T CECIL	4CONS AFRA	STEWART, SARAH E	1HNIH AFRA
		STEWART, T DALE	1XSMI AFRA
O AMER SOC OF MECHANICAL	ENG	TITSLER, RALPH P	1ARNI AFRA
ALLEN, WILLIAM	1CMAA AFRA	WARD, THOMAS G	5MIAS AFRA
BEAN, HOWARD S	4CONS AFRA	WEISS, FRANCIS J	1XLIC AFRA
BELSHEIM, ROBERT	1DNRL AFRA		
CRAFTON, PAUL A	2HGWU AFRA	R SOC OF AMER MILITARY	ENG
DALZELL, CARSON	1XAEC AFRA	AMIRIKIAN, ARSHAM	1DNBY AFRA
DRYDEN, HUGH L	1XNAS AFRA	ASLAKSON, CARL I	4CONS AFRA
FULLMER, IRVIN H	1CNBS AFRA	BRAATEN, NORMAN F	1CCGS AFRA
GILLMAN, JOSEPH L JR	4CONS AFRA	CARDER, DEAN S	1CCGS AFRA
MASON, MARTIN A	2HGWU AFRA	CLEAVER, OSCAR P	1DAER AFRA
OSGOOD, WILLIAM R	2HCUA AFRA	GRANT, ULYSSES S III	7RETD AFRA
RIVELLO, ROBERT M	2HUMD AFRA	HASKINS, CARYL P	3ICIW AFRA
STIEHLER, ROBERT D	1CNBS AFRA	HICKOX, GEORGE H	1DAER AFRA
		HOUGH, FLOYD W	AFNA
P HELMINTHOLOGICAL SOC OF WASH		HOWARD, GEORGE W	1DAER AFRA
ANASTOS, GEORGE	2HUMD AFRA	KAUFMAN, H PAUL	4CONS AFRA
ANDREWS, JOHN S	1ARFR AFRA	MC CABE, LOUIS C	5REAS AFRA
BUHRER, EDNA M	7RETD AFRA	RAPPELEYE, HOWARD S	7RETD AFRA
DOSS, MILDRED A	2HUMD AFRA	REED, WILLIAM D	1DAEC AFRA
DURBIN, CHARLES G	1HFDA AFRA	RICE, DONALD A	1CCGS AFRA
FARR, MARION M	1ARFR AFRA	RODRIGUEZ, RAUL	1DAER AFRA
FOSTER, AUREL O	1ARFR AFRA	ROESER, WILLIAM F	1CNBS AFRA
HERMAN, CARLTON M	1IFWS AFRA	SHALOWITZ, AARON L	1CCGS AFRA
MC INTOSH, ALLEN	7RETD AFRA	SIMMONS, LANSING G	1CCGS AFRA
ROBERTSON, MYRNA J	7RETD AFRA	SMALL, JAMES B	1CCGS AFRA
SARLES, MERRITT P	2HCUA AFRA	WEBER, EUGENE W	1DAEX AFRA
SHORB, DOYS A	1ARFR AFRA	WHITTEN, CHARLES A	1CCGS AFRA
TAYLOR, ALBERT L	1ARFR AFRA		
TRAUB, ROBERT	2HUMD AFRA	S INSTITUTE OF RADIO ENG	
TROMBA, FRANCIS G	1ARFR AFRA	ALEXANDER, SAMUEL N	1CNBS AFRA
TURNER, JAMES H	1ARFR AFRA	APSTEIN, MAURICE	1DAHD AFRA
VON BRAND, THEODOR C	1HNIH AFRA	ASTIN, ALLEN V	1CNBS AFRA
WOOD, LAWRENCE A	1CNBS AFRA	DOCTOR, NORMAN J	1DAHD AFRA
		ELBOURN, ROBERT D	1CNBS AFRA
Q AMER SOC FOR MICROBIOLOGY		FRANKLIN, PHILIP J	1D-S AFRA
ABELSON, PHILIP H	3IGEL AFRA	GRISAMORE, NELSON T	2HGWU AFRA
ALEXANDER, AARON D	1DAWR AFRA	GUARINO, P A	1DAHD AFRA
ALLISON, FRANKLIN E	7RETD AFRA	HALL, WAYNE C	1DNRL AFRA
BARON, LOUIS S	1DAWR AFRA	HICKLEY, THOMAS J	1CCGS AFRA
BOZEMAN, MARILYN F	1DAWR AFRA	HINMAN, WILBUR S JR	4CONS AFRA
BREWER, CARL R	1HNIH AFRA	HUNTOON, ROBERT D	1CNBS AFRA
BROWN, THOMAS M	2HGWU AFRA	KALMUS, HENRY P	1DAHD AFRA
BYRNE, ROBERT J	1HNIH AFRA	KOHLER, HANS W	1DAHD AFRA
CLARK, WILLIAM A	3IATC AMRA	KOTTER, F RALPH	1CNBS AFRA
CURRAN, HAROLD R	1ARNI AFRA	KULLBACK, SOLOMON	2HGWU AFRA
DAWSON, ROY C	6FAOR AFRA	LANDIS, PAUL E	1DAHD AFRA
DOETSCH, RAYMOND N	2HUMD AFRA	LIDDEL, URNER	1XNAS AFRA
EDDY, BERNICE E	1HNIH AFRA	MASSEY, JOSEPH T	3IAPL AFRA
EMMART, EMILY W	1HNIH AFRA	MAYER, CORNELL H	1DNRL AFRA
FABER, JOHN E	2HUMD AFRA	MC CLAIN, EDWARD F JR	1DNRL AFRA
HAMP, EDWARD G	1HNIH AFRA	O BRYAN, HENRY M	5BECO AFRA
HIATT, CASPAR W	1HNIH AFRA	PAGE, CHESTER H	1CNBS AFRA
HICKOX, GEORGE H	1DAER AFRA	PAGE, ROBERT M	1DNRL AFRA
HOTTLE, GEORGE A	1HNIH AFRA	PHILLIPS, M LINDEMAN	4CONS AFRA
KENNEDY, E R	2HCUA AFRA	POLING, AUSTIN C	1CCGS AFRA
LAMANNA, CARL	1DARO AFRA	RABINOW, JACOB	5RBN AFRA
MC CULLOUGH, NORMAN B	1HNIH AFRA	RITT, PAUL E	5MELP AFRA
PARLETT, ROBERT C	2HGWU AFRA	ROTKIN, ISRAEL	1DAHD AFRA
PELCZAR, MICHAEL J JR	2HUMD AFRA	SHAPIRO, GUSTAVE	1CNBS AFRA
PITTMAN, MARGARET	1HNIH AFRA	SMITH, PAUL L	1DNRL AFRA
REYNOLDS, HOWARD	1ARNI AFRA	SMITH, SIDNEY T	1DNRL AFRA
RITTS, ROY E JR	2HGWU AFRA	SOMMER, HELMUT	1DAHD AFRA
ROBBINS, MARY L	2HGWU AFRA	STAIR, RALPH	1CNBS AFRA

TREXLER, JAMES H	1DNRL AFRA	STEPHAN, ROBERT M	1HNIH AFRA
WATERMAN, PETER	1DNRL AFRA	STEWART, SARAH E	1HNIH AFRA
WEIHE, WERNER K	1DAER AFRA	TELFORD, IRA R	2HGWU AFRA
WEISS, RICHARD A	1DARO AFRA	TREADWELL, CARLETON R	2HGWU AFRA
YAPLEE, BENJAMIN S	1DNRL AFRA	VEITCH, FLETCHER P JR	2HUMD AFRA
YOUNG, ROBERT T JR	1DAHD AFRA	VON BRAND, THEODOR C	1HNIH AFRA
		WARD, THOMAS G	5MIAS AFRA
		WOMACK, MADELYN	1ARNI AFRA
		WOODS, MARK W	1HNIH AFRA
T AMER SOC OF CIVIL ENG		V AMERICAN SOC FOR METALS	
AMIRKIAN, ARSHAM	1DNBY AFRA	ACHTER, MEYER R	1DNRL AFRA
ASLAKSON, CARL I	4CONS AFRA	BENNETT, JOHN A	1CNBS AFRA
BIBERSTEIN, FRANK A JR	2HCUA AFRA	BROWN, B F	1DNRL AFRA
CALDWELL, JOSEPH M	1DAEB AFRA	BURNETT, HARRY C	1CNBS AFRA
CLAFFEY, PAUL J	2HCUA AFRA	CAUL, HAROLD J	1CNBS AFRA
DOWNING, LEWIS K	2HHOU AFRA	CHAPIN, EDWARD J	1DNRL AFRA
GRANT, ULYSSES S III	7RETD AFRA	DALZELL, CARSON	1XAC AFRA
HIATT, CASPAR W	1HNIH AFRA	DE PUE, LELAND A	1DNRL AFRA
HICKOX, GEORGE H	1DAER AFRA	DIGGES, THOMAS G	AFRE
HOUGH, FLOYD W	AFNA	ELLINGER, GEORGE A	1CNBS AFRA
HOWARD, GEORGE W	1DAER AFRA	GEIL, GLENN W	1CNBS AFRA
MASON, MARTIN A	2HGWU AFRA	GILLMAN, JOSEPH L JR	4CONS AFRA
OSGOOD, WILLIAM R	2HCUA AFRA	HOLSHOUSER, WILLIAM L	1XCAB AFRA
PARSONS, DOUGLAS E	4CONS AFRA	KIES, JOSEPH A	1DNRL AFRA
RAPPLEYE, HOWARD S	7RETD AFRA	KUSHNER, LAWRENCE M	1CNBS AFRA
SAVILLE, THORNDIKE JR	1DAEB AFRA	LOGAN, HUGH L	1CNBS AFRA
SIMMONS, LANSING G	1CCGS AFRA	LORING, BLAKE M	4CONS AFRA
SMITH, PAUL A	5RACO AFRA	MEBS, RUSSELL W	1CNBS AFRA
WALTHER, CARL H	2HGWU AFRA	MOORE, GEORGE A	1CNBS AFRA
WEBER, EUGENE W	1DAEX AFRA	OREM, THEODORE H	1CNBS AFRA
		PELLINI, WILLIAM S	1DNRL AFRA
		PITTS, JOSEPH W	1CNBS AFRA
		STAUSS, HENRY E	1XNAS AFRA
		SWEENEY, WILLIAM T	1CNBS AFRA
		THOMAS, PAUL D	1CCGS AFRA
		VACHER, HERBERT C	7RETD AFRA
		WEINBERG, HAROLD P	5VAEN AFRA
		WENSCH, GLEN W	1XAC AFRA
		WHITMAN, MERRILL J	1XAC AFRA
		WYMAN, LEROY L	1CNBS AFRA
U SOC FOR EXP BIOL & MEDICINE		W INTERNATL ASSOC FOR DENTAL RES	
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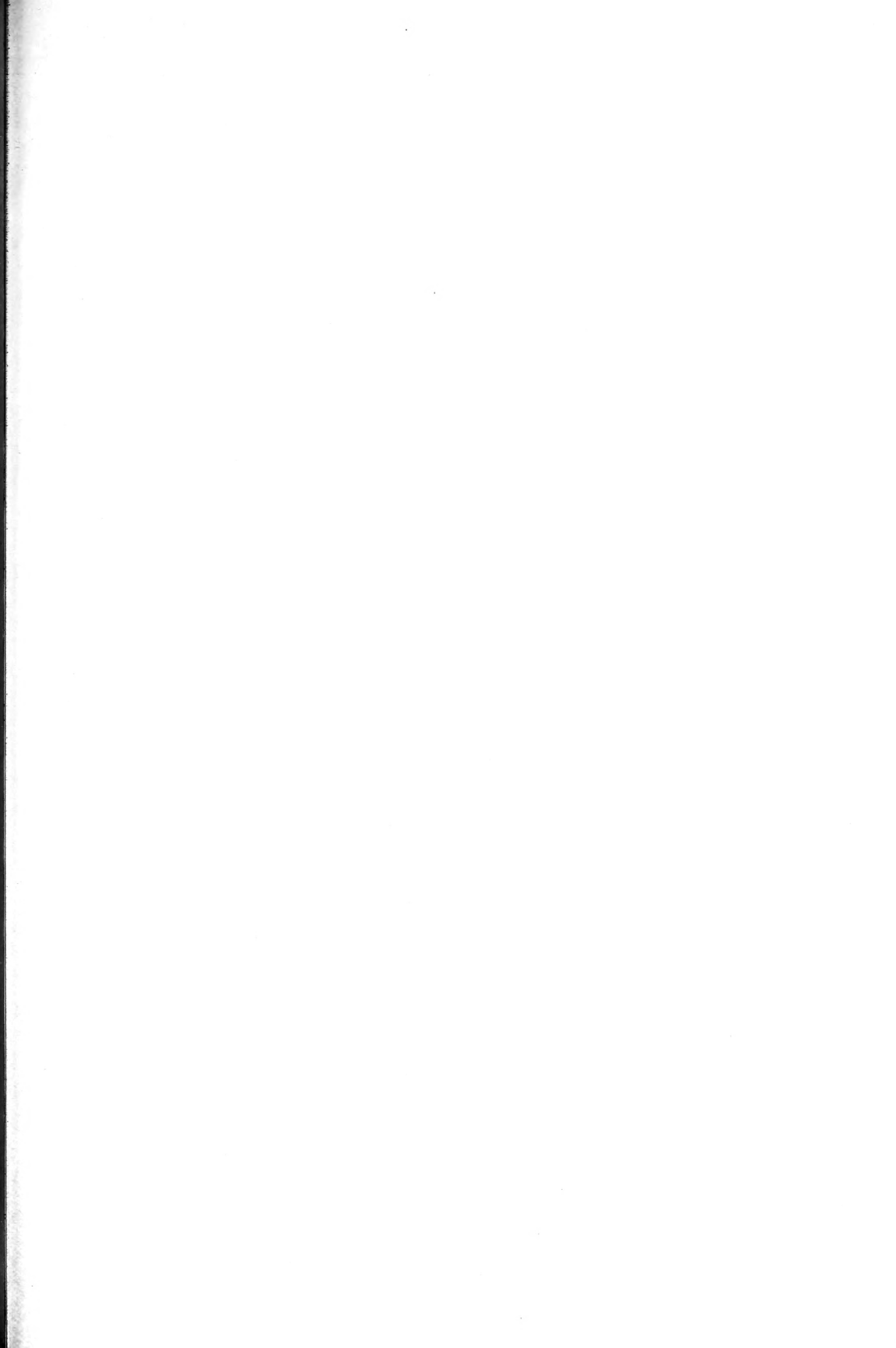
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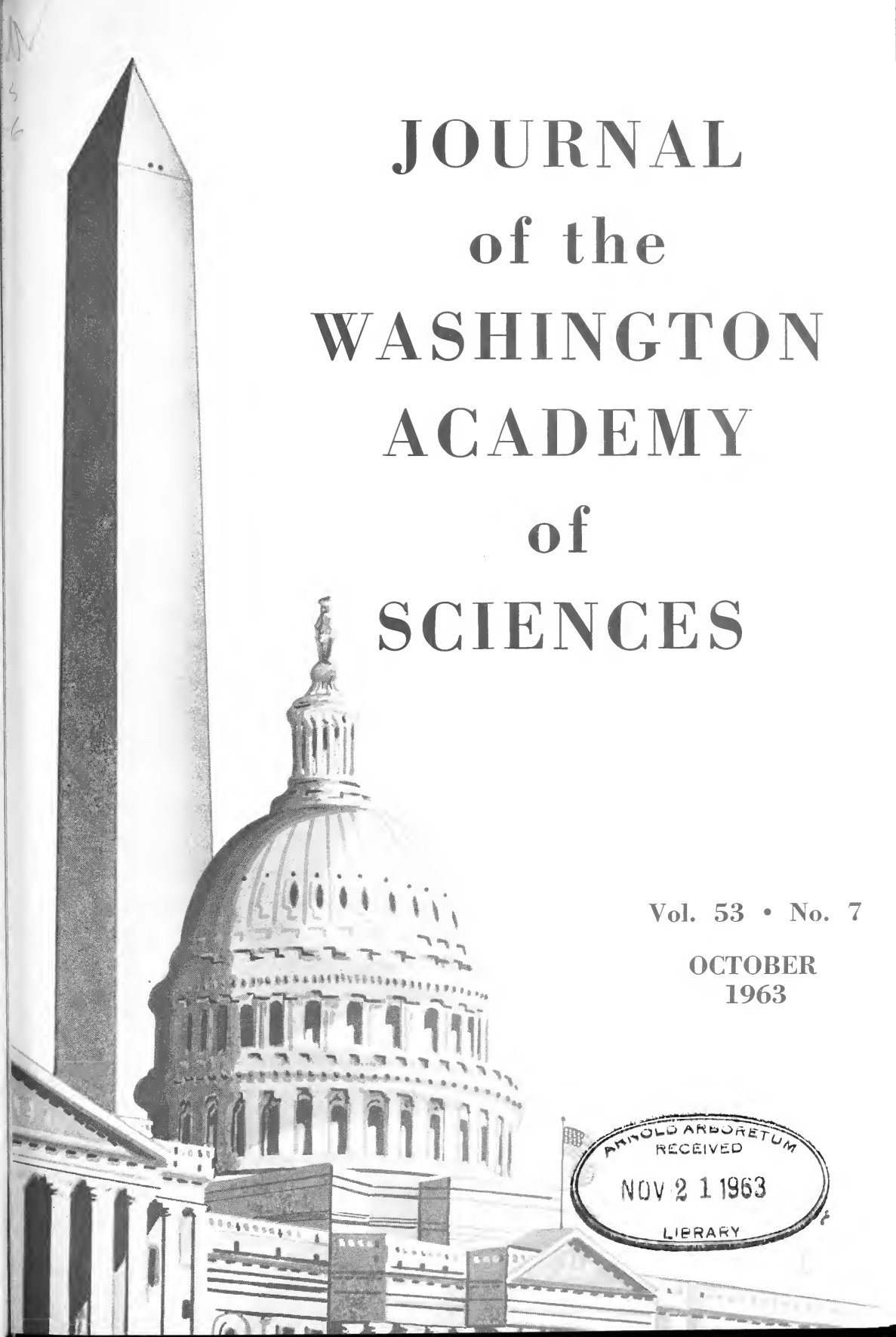
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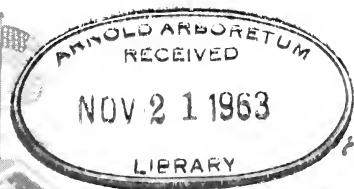
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The Plunge Into Darkness*

Ralph G. S. Siu

Scientific Director, Research Division, U. S. Army Materiel Command

I. Introduction

It is a distinct pleasure to be here with such a select group of kindred spirits. It is my understanding that most of our younger colleagues in this hall have decided, at least tentatively, to embark upon a creative career, probably in science and engineering, perhaps in the humanities, and possibly even in both.

I am sure that Dean Hobbs, General Beach, and the rest of us here today share your keen interest in creativity. We realize that it is one of the dynamos behind the welfare of our country and the betterment of man. All of us, therefore, are concerned with what makes for creativity—especially with what makes for that rare and true creative genius who provides the enormous advances of our culture.

I propose that we search among both the sciences and the humanities for clues which bear on this matter. Is there some fundamental characteristic that all great creators must possess? And what must be done to insure that this important characteristic be permitted to blossom forth?

II. Myth of Nganaoa

Let us first examine the humanities. One of the best places to look is mythological stories. These stories are not factual in the literal sense, of course. But they can tell us a lot about how men think, and about the subconscious forces that move men to action. If one is observant, he can draw some very meaningful conclusions from the symbols that are present throughout these

stories. Among the most fascinating of these stories are those dealing with heroes.

A typical tale is the Polynesian myth of Nganaoa.

One day Nganaoa was out in his tiny canoe in the wide ocean, when suddenly a great whale came swimming toward him with its huge jaws wide open. The lower jaw was already under the boat and the upper one was above it when Nganaoa sprang into action. He broke his spear in two, and just as the jaws were about to close, he stuck the two pieces in the monster's gullet so that his enemy could not close its jaws. Then our hero leaped into the maw of the whale and peered into its belly. And what did he see? There sat his two parents, his father Tairitokerau and his mother Vaiaroa, who had been swallowed by the monster when they were out fishing. Nganaoa then took one of the two sticks from the animal's gullet—the other was sufficient to prevent the whale from closing its jaws—and broke it in two. He told his father to hold one piece firmly below, while he himself manipulated the other until the fire began to smoulder. Then blowing them into a flame, he began to burn the fatty parts inside the belly. Writhing with pain, the monster sought relief by swimming to shore. As soon as it reached the sand bank, the hero and his father and his mother stepped ashore.

This is a charming little story which has been repeated over and over again in many different languages. The symbolic lesson in it brings us to the title of my talk. It is in the dark that a person gains enlightenment. To find what he is really seeking, a creative person must plunge into the darkness of the depths. As you recall from the Bible, it

*An address before the Army's National Junior Science and Humanities Symposium at West Point, N. Y., April 3, 1963.

was in the belly of the whale when Jonah saw the "mighty mysteries."

III. Photoperiodism

So much for the humanities. Let us now cross-over to the sciences and see what we can find on this score.

Perhaps you have learned from your biology courses that some plants, such as wheat and barley, flower only when the day is long and the night is short. Other plants, such as soybean and chrysanthemum, flower only when the day is short and the night is long.

We may look upon flowering as the plant's expression of creativity. The question arises whether it is the light of the day or the darkness of the night that is crucial for flowering—for creativity at the fundamental level of life. Experiments have been completed which provide an inspiring answer.

When the light period was interrupted by darkness, the flowering response of the plant remained unaffected. When the dark period was interrupted by so much as a minute of light, however, flowering ceased. So you see, it is the darkness that is essential for flowering, for creativity. And again the symbolism of the laboratory confirms the symbolism of mythology.

IV. The Great Whales

Men in general, however, have always been fearful of the darkness of the unknown. They have felt much more comfortable in the light of a clearly defined objective, in the beacon of a tried and proven path, in the sunshine of bandwagons, and in the spotlight of publicity and the cliché. This is understandable. It is also understandable why most men in research and development, being all too human, also reflect the same fears and preferences. The bright surface is much safer. I believe it may well be for the good of society that most people have tendencies in this direction. Otherwise social order may degenerate into chaos.

But I am not talking today about *most* men to such a select group. I believe you

would like to hear about the characteristics of the most creative of the creative men. These are the men whom the novelist, Herman Melville, admired when he said, "I like all men who dive. Any fish can swim near the surface, but it takes a great whale to go down five miles or more." These are the men who know the meaning behind the historian, Charles A. Beard, when he said, "When it is dark enough, you can see the stars." These are the men who agree with the entomologist, J. H. Fabre, when he said, "The darkness is light enough."

I am sure you have read about such men of capacity and conviction: Galileo during his ostracism from conventional thinking, and Darwin in his search along the tropical islands.

V. The Three Temptations

These men have known the loneliness of the dark. But they have come through with the brilliance of their creative power. They were not, of course, the first of their kind. And I am sure they will not be the last. More will follow, perhaps from this very luncheon group.

I believe, however, that in some respects there are more obstacles standing in the way of a potentially creative young genius today than during Galileo's and Darwin's time. I am not saying that it was easy to be great during their days. It is difficult—extremely difficult—for anybody to be great at any time. What I mean to infer is the presence of several fascinating temptations that have appeared with our present scientific affluence. There are three temptations, in particular, of which I would like to speak.

The first is the fascination with gadgets.

The second is the worship of bigness.

The third is the comfort of methodology.

VI. Gadgetry

Let us say a few words about the first temptation.

Two months ago, I visited a well-known electronic manufacturing company. The manager of one of the departments showed me an expensive piece of apparatus under

construction. I was surprised at the willingness of the customer to pay the rather high price. The manager replied, "Well, you know the way it is with many research people nowadays. Whenever they think about doing research, they think about buying some new gadget, which can make some measurements." What the manager said typifies one of the common temptations of the times. It is to boast of some newfangled, very expensive apparatus, which can make many, many measurements very, very rapidly, and indeed keep many, many people busy for many, many years. There is nothing wrong about having complex apparatus, *per se*. It is very useful in the pursuit of an idea, and frequently essential. The danger comes from the subordination of the hard and lonely work on the part of the researcher, in reaching into the farthest depths of his own mind for the nebulous clues of the dimly lit secrets of nature, and its replacement by the visibly impressive work of making ingenious measurements by means of machines. The most debilitating danger arises when the original purpose of an expensive apparatus has been served. But because of the cost of the machine, the staff feels compelled to keep it operating for fear of adverse criticism. In this case, the experimental scientist is no longer the master of the research that is to be done. The gadget has become the master. And the scientist has forfeited his intellectual soul.

So much for temptation Number One. Actually, this is not too formidable a temptation to overcome. One needs only to be alert and attentive to the measure of his objective.

VII. Bigness

A far more seductive temptation to the modern researcher is that of bigness. I should make it clear that BIG SCIENCE, with its billion-dollar budgets, massive teams, and spectacular laboratories is necessary for modern technological progress. Many problems can only be solved by a massive attack. BIG SCIENCE has become

part of the fabric of our culture and, if used wisely, can contribute greatly. Yet it is because of this very necessity that it is hard to resist.

The facets of this temptation are alluring indeed. For one thing, there is no faster and easier way to become well-known in scientific and international circles than by becoming a member of the BIG SCIENCE fraternity. This is a consequence of its very nature. To assure the financial support it requires, BIG SCIENCE must have continued publicity. Its members must remain in the spotlight of public acclaim. It must adopt some of the drama of the theater and the press.

But as Ralph Emerson has said, "Nature never gives anything to anyone. Everything is sold." So we ask ourselves, "What is the price that an individual has to pay to be part of BIG SCIENCE?" The answer is straightforward: "Give up part of your lonely search in the farthest reaches of your personal innermost thinking, grappling with the really basic issues of the mind, which shun the marketplace of public clamor. In other words, do not plunge into the darkness of the unknown."

So much for Temptation Number Two. It is a very difficult one to overcome.

VIII. Methodology

But the most subtle and deceiving temptation, which is almost impossible to avoid, is the ritualization of methodology.

The distinguished philosopher Alfred North Whitehead has reminded us that "Some of the major disasters of mankind have been produced by the narrowness of men with a good methodology." Men of stature have always been able to decide when it is appropriate to use the techniques in which they are expert, when they should be discarded, and when new methodologies should be developed.

I should like to discuss just one example which is close to our hearts. It is the methodology of basic research in the scientific laboratory.

Although it is fashionable to talk about basic research nowadays, it is not an inven-

tion of modern days. If we look at its essence, basic research is nothing more than inquiries at the prevailing boundaries of human knowledge. There has always been a prevailing boundary and man has always been curious.

Let us look at the basic research taking place during the period just before the birth of the scientific era. During that time, basic research in philosophy had as one of its prime objectives the support of applied philosophy, orthodox theology, and the ruling social order. It sought answers, consistent with traditions, that have been built up by the philosophical techniques. It attempted to strengthen medieval philosophy as a tool for understanding nature.

As these basic researchers delved deeper into the ways of nature, however, they began to find that the methods available were no longer capable of providing satisfying answers. If their intellectual integrity was to be satisfied, new methodologies were required. In the search for these new approaches, imperceptible step by imperceptible step, they began to undermine the very methodology they were supporting as the dominant means of enlightenment. As a matter of fact, many of them, such as Descartes, recognized what was happening and were never fully at ease with their lot in breaking away from tradition. Others, such as Galileo, experienced an even more difficult time.

I wonder whether or not the truly pioneering researcher in the scientific laboratory today is being confronted with a comparable problem. He is trying to grapple with problems of formidable proportions—the origin of life, the infinity of the cosmos, and the nature of time. The tools of science appear so puny in contrast. Thus we observe the modern biochemist resorting to circular explanations in trying to understand the nature of life—just like the medieval philosophers used to do in trying to explain the nature of the soul. We find the

modern physicist resorting to the creation of matter out of nothing to explain the heavens—just like the medieval philosophers used to do in trying to explain the earth.

So we ask ourselves: Can the modern scientist find the answers to the questions he poses by means of the scientific method as we know it? The concern becomes more acute in cases involving human behavior and decision, such as in the fields of operations research, psychiatry, and other interfaces between the sciences and the humanities.

Science, as we know her today, cannot furnish what the philosopher F. S. C. Northrop calls the "immediate apprehension of the totality," so that man can act now, at every instant, with an enlightened strategic understanding of nature. It cannot provide the keen awareness of living that has so far defied explicit description. It may well be that the most significant movement of the twentieth century will begin with the foremost scientist breaking away from the methodology of science itself and formulating a new approach to knowledge.

The new way of thinking may be as different from the scientific method as the scientific method is from scholastic philosophy. It will only come, however, from the pioneer who is not bound by the rituals of accepted methods.

IX. Concluding Remarks

We come now to the final question: Who will be the new Galileo, the new Darwin, with the creative spark within himself, and the fortitude to withstand the three temptations of gadgetry, of bigness, and of methodology? Who will plunge into the darkness and bring new light to blaze our further advance into the unknown?

If your generation succeeds in producing just one such individual, history will judge this act to be your greatest achievement in creativity.



Studies on Epidemic Typhus Vaccines*

Elizabeth B. Jackson

Laboratory of Virology and Rickettsiology, Division of Biologics Standards, National Institutes of Health

Citizens of the United States are well aware of the new vaccines for poliomyelitis and measles which have been developed, licensed, and launched during the last decade. But even veteran travellers know little about the "shots" which they receive before departing on trips to areas of the world where diseases no longer known to us are endemic. Continuing studies to maintain or improve the efficacy of established vaccines, and to develop new vaccines, are being conducted in many countries. In the United States, one of these organizations is the Division of Biologics Standards, NIH. As a member of the DBS staff, I have been engaged in studies on vaccines against epidemic typhus, a disease which has not occurred in this country in several decades, but one which is endemic in a number of areas of the world to which our troops, and now our Peace Corps, are being sent.

Epidemic, classical, or louse-borne typhus is an acute febrile disease characterized by severe headache, chills, general aches, and a rash. Prior to the advent of the broad spectrum antibiotics, the mortality rate varied from 10 to 40 percent in different epidemics. The disease has a world-wide distribution, occurring in colder regions (including mountainous portions of the tropics) where groups of persons living in unsanitary conditions are louse infested. Typhus fever has been intimately associated with the history of man, occurring in epidemic form during wars, famines, and other catastrophic events.

During the years encompassed by the two World Wars, numerous attempts were made to develop anti-typhus vaccines. These efforts followed two quite different approaches. Some, notably Blanc and his colleagues in North Africa, tried to produce a mild infection and resultant immunity by means of living attenuated rickettsiae, while others attempted to immunize with inactive or killed rickettsiae. The latter attempts were hampered by inability to grow the infectious agent in large amounts. Weigl vaccine, prepared from the phenolized intestines of artificially infected human lice, was used in Poland and Russia. Castañeda's rodent lung vaccine, which is theoretically satisfactory for mass production, has not been widely used.

In 1938 Cox demonstrated that rickettsiae multiplied well in the yolk sac of the chick embryo, and subsequently showed that formalinized vaccines prepared from such material were effective in protecting guinea pigs. This ended the search for a source of abundant rickettsiae for the preparation of vaccines. Millions of doses of Cox-type yolk sac vaccines were produced in this country during World War II, and vaccines of this type are now used throughout the world.

Why then are we, as rickettsiologists and members of the staff of the DBS, concerned with further work on an established vaccine for a disease which does not occur in our country? In these days of cold war, when our military forces must be ready to go at short notice to any part of the world, they must be immunized, if vaccines are available, against the diseases which they may encounter. Hence, it behooves us to make

*Presented at the annual dinner of the Society of the Sigma Xi, District of Columbia Chapter, on May 6, 1963.

certain that these vaccines are properly prepared and will produce the desired immunity.

Some years ago a number of incidental observations accumulated to suggest that the then currently produced commercial typhus vaccines, although meeting the required standards of potency, were not as immunogenic as those produced at the end of the War. It is not unusual for such complaints to arise from time to time with any established product. There are a number of reasons for this. One of these is to be found in the commercial organization. When a product advances from the research stage to the production stage and stays there for a number of years, it is no longer in the hands of a specialist who understands the complexities of the problem and has a personal, scientific interest in the high quality of the material produced. Over a period of years, various minor changes may be introduced into the production procedure which, in sum, alter the antigenic composition of the product to the point where it is no longer capable of eliciting the desired response. Another arises in the research laboratory, where the young investigator, new to the field, may not be thoroughly familiar with the background information (much of which remains unwritten) and the complex techniques employed. At times his criticisms are based on a few insignificant observations.

Because of the various complaints, we reviewed production protocols of the vaccine manufacturers and reassayed a number of vaccines both by animal potency tests and by *in vitro* serological tests. The results indicated that all the vaccines were of adequate potency but that some were well above the minimum acceptable level. Furthermore, vaccines which appeared turbid or contained a sediment had a higher protective capacity in animals, while the more attractive, clear, opalescent products barely passed the standard assay. Hence, it was suggested that the steps introduced to clarify the products be deleted from the procedure. A further review last spring of

the potency assays of all typhus vaccines released within the previous four years indicated that the majority of the preparations had an immunogenic capacity well above the minimum required.

These observations were borne out by the results of a cooperative vaccination study conducted in 1961-62 by the Bureau of Medicine, the Walter Reed Army Institute of Research, and the Division of Biologics Standards. Marine recruits at Parris Island were vaccinated with commercial vaccine obtained from military supplies. They received either the standard dose in use for many years or smaller doses. Serological tests, performed at appropriate times, indicated a much better response than had been anticipated. This led to a reduction in the amount of typhus vaccine to be administered to military personnel and to a change in the philosophy of immunization against typhus. The present idea is to give each military recruit one dose of vaccine shortly after he arrives in the Service. This induces demonstrable protective antibody in the majority of persons and "prepares" all of the recipients immunologically so that they will subsequently respond in a booster fashion when given another dose of vaccine. Those soldiers who remain in this country, where they are not exposed to typhus, may serve out their tour of duty without ever receiving a second dose of typhus vaccine. On the other hand, those persons who are subsequently assigned to overseas duty will immediately receive another dose of vaccine, which will render them solidly immune. These studies are being continued.

Another aspect of our continuing studies on typhus vaccine deals with assay of potency. The guinea pig potency assay for typhus vaccine came into use when the vaccine was developed. Although cumbersome, time-consuming, and indirect, this method has had 20 years of usage, and a body of information has been built up which correlates the serological responses of guinea pigs and man. During World War II, investigators in Canada employed a simple mouse protection test for assaying

typhus vaccine, and this was subsequently used by the Japanese. In contrast to the indirect guinea pig assay, which takes 28 days to perform, the direct mouse test can be completed in one week. In our vaccine studies over the past several years, we have run the mouse protection test concurrently with the standard guinea pig assay. In our hands, the results of the mouse test correlate well with those obtained by older methods. We hope that this test can be introduced as an alternate procedure for the potency assay of typhus vaccines.

As stated earlier, there is little demand in this country for a vaccine against typhus except for the immunization of military personnel and the irregular needs of tourists bound for endemic areas of the world. Nevertheless, stocks of vaccine must be kept available in the event of some catastrophe such as the recent earthquakes of Chile, North Africa, and Iran, or even a nuclear holocaust. The presently available liquid vaccines have a shelf life of 18 months at 5°C. It would be helpful if highly stable typhus vaccines were available, which if kept in a cool place would retain their potency for 5 to 10 years. Since freeze-drying improves the keeping qualities of many biological materials, studies were undertaken on the qualities of dried concentrated partially-purified typhus vaccines. Such preparations were found to be highly immunogenic in both animals and man and have remained stable for more than three years.

A second and perhaps preferable way to produce immunity to a disease is to induce a mild infection either with a closely related infectious agent or with an attenuated strain of the virulent agent. An example of the first type is cowpox, or vaccinia, used since 1798 to induce resistance to smallpox. Sabin-type oral poliomyelitis vaccine and live attenuated measles vaccine, both licensed within the last two years, are examples of the second type. Early investigations employing living typhus vaccines were carried out primarily in North Africa. In these studies, a number of unmodified,

and sometimes fatal infections followed inoculation with some of the early materials, indicating that a truly attenuated strain of rickettsiae of low pathogenicity for man had not yet been attained.

A more attenuated strain, designated E for España, was isolated in 1941 by Spanish investigators while studying an outbreak of typhus in Madrid. They noted the decreased virulence of this strain for animals and reported the results of preliminary tests in man which indicated that it might be suitable for human immunization. Subsequent work by Fox in prison volunteers over a period of years served to establish the optimal dose which would produce a good serological response and an immunity to challenge with virulent rickettsiae without inducing an undue number of undesirable side reactions. He showed that the immunity lasted for at least 5½ years.

We have conducted studies with Strain E in order to develop procedures for the production and lyophilization of stable high titer vaccine and to develop an acceptable reliable infectivity assay to serve in biological control. Our observations indicated that the avirulent Strain E of *Rickettsia prowazeki* has growth characteristics in embryonated eggs similar to those of the highly virulent Breinl strain. Hence, living avirulent vaccines can be prepared by employing some of the techniques already developed and used in the production of killed epidemic typhus vaccine. Using these procedures and in collaboration with our colleagues at Walter Reed, we have produced a commercial size lot of freeze-dried vaccine. This lot has been shown to be highly potent and stable under conditions of refrigeration. Furthermore, even when kept at 35°C. for four weeks, it still had a sufficiently high infectivity to be usable. Hence, the vaccine could be transported without refrigeration for use in some remote areas of the mountainous tropics. Titration of this lot of vaccine in human volunteers has recently been carried out by C. L. Wissemann, Jr., of the University of Maryland Medical School, in order to establish the proper dilution to use.

It is hoped that a field trial with this vaccine can be conducted in some area of the world where louse-borne typhus occurs.

I shall draw no conclusions from the material presented except to point out that

even the old problems and biological products require continuous scrutiny and study. Such tasks are as important to the Division of Biologics Standards as the development and monitoring of new vaccines.

Academy Proceedings

November Meeting

(476th Meeting of the Washington Academy of Sciences)

SPEAKER: IRVIN E. WALLEN

Assistant Director for Oceanography
U. S. National Museum



SUBJECT: INTERNATIONAL INDIAN OCEAN EXPEDITION

TIME: THURSDAY, NOVEMBER 21, 1963
8:15 P.M.

**PLACE: JOHN WESLEY POWELL AUDITORIUM,
COSMOS CLUB**
2170 Florida Avenue, N.W.

Abstract of Address—The International Indian Ocean Expedition resulted from the first meeting of the Special Committee for Oceanic Research of the International Council of Scientific Unions in 1958. Thirteen ship-operating nations and seven other participating nations have been involved. Four major areas of research will be undertaken: A geophysical and geological description of the Indian Ocean basin; a chemical and physical description of the water and the study of its motions; a description of the biological components; and the interaction between the atmosphere and the oceans. Dr. Wallen will talk primarily about the biological program. For the U. S. Biology Program, two oceanographic vessels—the R/V *Anton Bruun* and the R/V *TeVega*—have been converted. Land facilities for the study of oceanic problems are available at Bombay, Mandapam Camp, and Cochin, India; at Nossi Bé, Madagascar; and on many islands in the area. Arrangements are being made for maximum procurement of biological collections for future study. An international sorting center for the handling of standard plankton samples was established in Cochin, India. Most of the biological collections taken on the R/V *Anton Bruun* will be processed at the existing Smithsonian Oceanographic Sorting Center. The IIOE will end approximately at the end of calendar year 1964; however, some activity and the production of publications based on experience in the Indian Ocean will probably continue for the next several years.

The Speaker—Irvin E. Wallen is a marine biologist whose work has carried him from a small pond in his native state of Oklahoma to the depths of the Indian Ocean. From 1948 to 1956 he taught at his undergraduate *alma mater*, Oklahoma State University.

finding time to obtain the Ph.D. degree at the University of Michigan in 1950. At the time he left Oklahoma State he was associate professor of zoology and chairman of biological science courses. After a year in the Science Teaching Improvement Program of the American Association for the Advancement of Science in Washington, he joined the Atomic Energy Commission, first as a foreign training officer in the division of International Affairs, then as a marine biologist in the Division of Biology and Medicine. In August, 1962, he accepted his present position of assistant director for oceanography at the National Museum. In this capacity he is responsible, among other things, for coordinating all activities in the Museum relating to oceanography. In two summer seasons (1960 and 1963) he merged his academic and international interests by serving as visiting professor of zoology in Pakistan.

ACHIEVEMENT AWARD NOMINATIONS REQUESTED

Chairman Robert W. Berliner 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 1963 winners of these awards will be honored at the annual dinner meeting of the Academy in January 1964. Academy members are invited to submit nominations for the awards, in accordance with the following procedures.

Eligibility. Candidates for the first four awards must have been born in 1923 or later; there is no age limit on the teaching of science 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, 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. It would be helpful to the Awards Committee, in reviewing the nominations, if duplicate copies of the recommendation could be submitted.

Citation. Particular attention should be given to preparation of a citation of 80 typewriter spaces or less, which summarizes the candidate's specific accomplishments and which would be used in connection with presentation of the award to the successful candidate.

Re-nomination. Previous nominees may be renominated, with or without additional evidence, provided sponsors make known their desires by letter to Chairman Berliner.

Initial compliance with the foregoing desiderata will facilitate prompt evaluation of the nominations. Further information may be obtained from Dr. Berliner or the various subcommittee chairmen, as follows:

Robert W. Berliner (general chairman), National Heart Institute, NIH, 496-2116.

Louis Baron (biological sciences), Walter Reed Army Institute of Research, 576-2230.

Frank A. Butrico (engineering sciences), Public Health Service, OL 4-9310, Ext. 231.

William Koch (physical sciences), National Bureau of Standards, EM 2-4040, Ext. 7888.

David Nelson (mathematics), George Washington University, FE 8-0250, Ext. 388.

Lewis Slack (teaching of science), National Academy of Sciences, 961-1238.

BYLAWS CHANGES, NEW AFFILIATION RATIFIED

In mail balloting conducted during September, the Academy's membership

ratified previous actions of the Board of Managers, concerned with revision of Article IV of the Bylaws, and with affiliation of the Washington-Baltimore Section of the Electrochemical Society.

By a vote of 402 *for* and 4 *against*, the membership accepted proposed Bylaws changes designed to reflect current Academy practice concerning elective and appointive offices. Previously, the Bylaws had recognized eight officers—president, president-elect, secretary, treasurer, editor of the Journal, managing editor of the Journal, archivist, and custodian of publications—of which the first four were elected by the membership and the last four were appointed. According to the present revised Bylaws, only the first four of these positions are recognized as officers of the Academy. As concerns the appointive positions, the posts of editor and managing editor have been consolidated into one position; the post of archivist has been made permissive rather than mandatory; and the post of custodian of publications has been abolished.

The revised Bylaws will appear in the November issue of the Journal.

By a vote of 402 *for* and 2 *against*, the membership accepted the Washington-Baltimore Section of the Electrochemical Society as the Academy's 30th affiliate.

BOARD OF MANAGERS MEETING NOTES

May Meeting

The Board of Managers held its 556th meeting on May 15 at the National Academy of Sciences, with President Van Evera presiding.

The minutes of the 555th meeting were approved with minor corrections.

Membership. In the absence of Chairman Hobbs, the secretary presented the names of six candidates for resident fellowship, for First Reading.

Encouragement of Science Talent. In the absence of Chairman Heyden, Dr. Van Evera reported on the recent award dinner at Georgetown University for high school

students, at which certificates of merit were awarded. The banquet speaker was Robert Page of Naval Research Laboratory, who spoke on "Man and Machines in the World Today." At the meeting after the banquet, the speaker was Hans Green, professor of physics at the University of Maryland, who spoke on an aspect of astronomy under the title, "The Old Becomes the New."

Election of Fellows. Following the Second Reading of their names by the secretary (in the absence of Dr. Hobbs), the following persons were elected to fellowship in the Academy: T. C. Byerly, C. H. Cheek, R. Gary, T. B. Hoover, and V. J. Linnenbom.

Treasurer. Treasurer Henderson reported the following current balances: Senior Academy, \$2,171.85 + \$5,000; Junior Academy, \$1,094.37 + \$1,539.92.

Editor. Editor Detwiler reported that the May issue of the Journal had been mailed on May 9. He indicated that he expected to consult with the secretary and treasurer concerning a master list of members for the September (directory) issue of the Journal.

Dr. Van Evera announced receipt of a letter from Frank Campbell, resigning his position as associate editor of the Journal. It was suggested by several that Dr. Campbell and the editor might find ways and means for continuing informal collaborative relationships.

Grants-in-Aid. Chairman McPherson reported that he had received a request for grant-in-aid to Hunter Woodward, but that supporting papers had not yet been received. The Board empowered the Executive Committee to approve a grant in an amount not exceeding \$200, upon receipt of suitable justification.

New Business. Dr. Van Evera called the Board's attention to Engineers, Scientists, and Architects Day, held annually in Washington and devoted to a program which includes speakers, a luncheon, and recognition of outstanding secondary school teachers and young scientists. For many years this activity has been supported and

arranged almost entirely by the engineers of the area. The Board felt that the Academy could and should play a more active part in this affair, and authorized Dr. Van Evera to appoint Academy members to work with the people responsible for this program.

The question of bonding the treasurer was discussed and tabled pending receipt of a reply from a bonding company, concerning the cost and provisions of bonding.

The question of a joint directory for the scientific societies of Washington was discussed. Dr. Van Evera indicated that the Chemical Society of Washington had expressed a lack of interest in being included in such a directory. The potential interest of the Botanical Society and the International Association for Dental Research was then discussed. It was suggested that Editor Detwiler might wish to incorporate several of the smaller affiliated societies in the directory at minimum or no expense, to determine the feasibility of a joint directory on a larger scale.

The question of a joint journal for the various scientific societies in the Washington area was discussed. Suggestions included the publication of a newsletter for wide, frequent distribution, together with less frequent issues of the Journal proper. No definite conclusions were reached.

Old Business. Attention was called to a proposal at the April Board meeting, that the Academy sponsor an annual symposium particularly appropriate to Washington and not suitable for individual scientific societies. Dr. Van Evera indicated that he would move forward on this idea.

June Meeting

The Board of Managers held its 557th meeting on June 11 at the National Academy of Sciences, with President Van Evera presiding.

The minutes of the 556th meeting were approved with minor corrections.

Grants-in-Aid. Chairman McPherson indicated that the balance available at the beginning of the present year was \$970,

consisting of \$53 of unexpended 1961 funds, \$460 of unexpended 1962 funds, and \$457 of new 1963 funds. So far this year, the Board has approved obligation of only \$50. Since the funds are available for expenditure only over a two-year period, the 1961 funds will be forfeited if they are not spent in 1963.

On Dr. McPherson's recommendation, the Board approved a grant of \$250 to Hunter Woodward, for utilization of acoustic vibrations to destroy boundary layers in electro dialysis; and a grant of \$100 to Daniel Peacock, for a study of the distribution of small mammals in the Middle Peninsula of Virginia.

Membership. There were no candidates for fellowship to present for First Reading. Chairman Hobbs reported that the Membership Committee had approved two applications for membership, as follows: Clarence W. Travis and Rudolph Hugh.

Encouragement of Science Talent. Chairman Heyden announced that he was revising for publication the red book of the Junior Academy. His Committee roster is now complete except for one individual. He reported that (1) he planned to meet with Junior Academy officers several times during the summer to organize plans for next year; (2) Junior Academy elections were held at the end of May; and (3) he expected to suggest changes in the absentee ballot provisions of the Junior Academy's Bylaws to clarify the use of proxies in elections.

Election of Fellows. Following the Second Reading of their names by Dr. Hobbs, the following persons were elected to fellowship in the Academy: Donald B. Brooks, Lawrence E. Payne, William H. Pell, Joseph W. Pitts, Joseph C. Richmond, and Lewis Slack.

Science Education. Chairman Taylor reported that he was currently preparing his annual report, and that he expected soon to begin developing plans for next year. The Joint Board now has an Advisory Committee, with William F. Sager as chairman. The newly-elected officers of the Joint

Board are Churchill Eisenhart, chairman; Harold E. Finley, vice-chairman; William F. Sager, secretary; and Joseph H. Broome, treasurer. Dr. Taylor plans to have his guidance counselor programs, formerly held on Saturdays, on a day of the school week this year.

Old Business. Further discussion of the bonding of the treasurer revealed that the cost would be \$2.50 per thousand per year. The bonding company had suggested that the president as well as the treasurer be bonded. A motion to bond the treasurer to the extent of the Academy's fluid assets (not to exceed \$10,000) failed for lack of a second.

The Board reviewed the membership status of Frank M. Setzler, a former president of the Academy, who has been transferred to emeritus status and was eligible for such status two years ago. It was agreed that he should not be charged for back dues.

The Board agreed that the Journal should be sent gratis to all past presidents emeritus.

Dr. Stevens suggested that uncertainties concerning arrival at eligibility for emeritus status might be eliminated by incorporating in the regular dues notice a statement of the rules with respect to emeritus status, and a request that members inform the treasurer when transfer to emeritus status is requested.

Dr. Stevens initiated a brief discussion on activities of the Academy that would be of interest to, and better serve, the affiliated societies. Dr. Weil expressed the opinion that, contrary to the belief of some, most of the affiliated societies do more than "hold technical meetings once a month." Dr. Brauer suggested that the Academy Journal each month might contain an article about one or more of the affiliated societies. Dr. Taylor suggested that the Academy consider a general meeting once a year, including presentation of papers, in which all affiliated societies would be invited to participate. Dr. Stevens agreed to accumulate more information about the

specific activities of the affiliated societies, and report subsequently to the Board.

Dr. Stevens indicated that the Botanical Society had agreed to participate in the 1963 Academy directory to be published in the September Journal.

Secretary Irving reported for Treasurer Henderson, who could not be present, that the latter was expecting to prepare letters to 35 members who had been delinquent in dues over the past two years, indicating that if dues were not paid up within the next two months, they would be dropped from the rolls. The Board approved Dr. Henderson's proposed action.

Dr. McPherson proposed that the Academy take steps to establish a planetarium in Washington. At Dr. Van Evera's request, the subject was discussed by Father Heyden, who is president of a corporation set up to plan, and solicit funds for, the construction of a planetarium in Washington. Depending on the response to a drive for funds that will be launched in the near future, a planetarium costing between \$2 and \$5 million is visualized. It would be erected on Daingerfield Island near National Airport. Dr. Van Evera is vice-chairman of the group, and Edward Teller is a key member of the Advisory Board. If funds were available, it is anticipated that building could be started some time in 1964.

JOINT BOARD ON SCIENCE EDUCATION

The Joint Board has announced election of the following officers for the 1963-64 season:

Chairman: Churchill Eisenhart of the National Bureau of Standards.

Vice-chairman: Harold E. Finley, professor of zoology at Howard University.

Secretary: William F. Sager, professor of chemistry at George Washington University.

Treasurer: Joseph H. Broome of the Bureau of Business and Defense Services, Department of Commerce.

WASHINGTON JUNIOR ACADEMY OF SCIENCES

Report for 1962-63

During the past year, the Washington Junior Academy of Sciences has both planned and taken part in many varied activities to inspire scientific drive and interest in members and nonmembers. October was highlighted by the fall organizational meeting, at which Marie Taylor spoke on "The Effortless Achievements of Plants." In addition, the first of five trips to Philadelphia was conducted.

Science club officers and members benefited by the Science Club Conference in November. Later, in December, alumni, members, and their guests met at the Annual Christmas Convention, which consisted essentially of a luncheon and presentation of papers.

Calendar year 1963 was started off with the Summer Research Opportunities Meeting; and in February, WJAS and the Chemical Society of Washington heard a lecture by James Bonner on "Chemistry and Biology of the Chromosome." A special lecture was given in March by Jerome Wiesner, on "Opportunities for Young Scientists of the Future." At this time of year, the area science fairs and the Westinghouse Science Talent Search Fair took place.

May was marked by a meeting with the Senior Academy; and on May 3, a tele-

scopic tour of the moon was arranged with the National Capital Astronomers.

The year came to a close with the election meeting on May 25. In addition to election of new officers, the National Science Fair finalists of the Washington area presented papers dealing with their projects.

—*Randall C. Zisler,*
President of WJAS, 1963-64

Staff for 1963-64

Officers: *President,* Randall C. Zisler (OT 4-9494); *vice-president,* Kristin Wilson (JO 1-0571); *secretary,* Tessa Orellana (384-9270); *treasurer,* Glen Smoak (KE 8-6761).

Membership Councilors: Fred Leonberger (Montgomery); Margaret Howell (District of Columbia); Bruce Andrews (Prince Georges); Susan Hill (Alexandria-Fairfax); Pat Evans (Arlington); John Jelen (Independent).

Committees: Karen Walker (Trips); Bob Epstein (Publications); Cathy Gody (Program); Virginia Fano (Membership); John Liebesny (Convention).

Adult Advisors: Francis J. Heyden (liaison WAS); Stephen Hopkins (executive secretary); Phoebe Knipling (membership); James McCullough (program); Howard Owens (trips); Keith Johnson (Science Fair); Charles Davis (advisor); Edmund Burke (advisor); Berenice G. Lamberton (secretary); David Frome and Grover W. Sherlin (alumni).



Science in Washington

CALENDAR OF EVENTS

November 12—Washington Association of Scientists

Study group on "Outer Space and National Policy," led by John Toll.

Institute for Policy Studies, 1900 Florida Ave., N.W., 8:30 p.m.

November 13—American Society for Quality Control

Grant T. Wernimount, Eastman Kodak Company, "Sticky Statistics, or How to Make Good Fudge."

Arnold's Hofbrau, 1724 Pennsylvania Ave., N.W. Refreshments at 6:30 p.m., dinner at 7:00, lecture at 8:00.

November 13—Geological Society of Washington

Regular meeting. Speaker to be announced.

Powell Auditorium, Cosmos Club, 8:00 p.m.

November 14—American Society of Mechanical Engineers

Talk and discussion on "Fuels." Speaker to be announced.

Pepco Auditorium, 10th & E Sts., N.W., 8:00 p.m.

November 18—Society of Photographic Scientists and Engineers

Robert Murche, Patrick Air Force Base, Florida, "Photo Instrumentation at Cape Canaveral."

Dinner at 6:30 p.m., Blackie's House of Beef. Lecture at 8:15, National Academy of Sciences.

November 18-24—American Rocket Society

Annual meeting of American Rocket Society and Space Flight Exposition, in Washington.

November 18-20—Institute of Electrical and Electronics Engineers

Sixteenth Annual Conference on Engineering in Medicine and Biology, sponsored by IEEE and Instrument Society of

America.

Lord Baltimore Hotel, Baltimore.

November 20—Washington Society of Engineers

Fifty-eighth Annual Stag Banquet. Eric A. Walker, president of Pennsylvania State University and of Engineers Joint Council, "The Engineer and His Responsibility to Society."

Grand ballroom, Mayflower Hotel. Refreshments at 6:00 p.m., dinner at 7:00, address thereafter.

November 23—Society of American Foresters

Dinner and meeting. Program to be announced.

Southgate Motel. Time to be announced.

November 27—Geological Society of Washington

Regular meeting. Speaker to be announced.

Powell Auditorium, Cosmos Club, 8:00 p.m.

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, Federal Center Building, Hyattsville, Md.

AGRICULTURE DEPARTMENT

Wilbur T. Pentzer, director of the Market Quality Research Division, Agricultural Marketing Service, received the Department's Distinguished Service Award last May for outstanding direction and leadership of a national research program on measurement, maintenance, and improvement in quality of agricultural commodities. At the same ceremonies. Superior Service Awards were given to **Karl H. Norris**, also of the Market Quality Research Division, for contributions in the area of quality measurement in agricultural commodities by nondestructive physical methods; to **Frank P. Cullinan**, associate

director of the Crops Research Division, Agricultural Research Service, for inspirational leadership and stimulation of research in horticulture; and to **John H. Martin**, also of the Crops Research Division, for outstanding scientific and research leadership contributions to wheat and grain sorghum improvement.

Warren L. Butler, head of biophysical research in the Market Quality Research Division, AMS, is one of 10 scientists to receive the first Charles F. Kettering Award, established to foster basic and pioneering research in biophysics.

Paul R. Miller attended the Third International Biometeorological Congress held in Pau, France, September 1-13. Dr. Miller served as chairman of the forecasting section of a Symposium on Biometeorology and Epidemiology of Fungal Diseases of Plants, held in conjunction with the Congress. While in Europe, Dr. Miller also evaluated the program and facilities for forecasting potato late blight in England, Scotland, and Ireland, and investigated tobacco blue mold in Italy, Germany, and France. Tobacco blue mold, only recently introduced in Europe, has become very destructive throughout the entire tobacco producing area.

Stanley A. Hall gave a talk on "Future Methods of Insect Control" at the national meeting of the American Institute of Chemical Engineers, held in San Juan, P. R., September 30-October 3.

W. B. Ennis, Jr., attended the 5th International Pesticides Congress in London, July 17-23, and presented a paper, on "Selective Toxicity of Herbicides." Dr. Ennis also visited various laboratories on the European continent.

Lawrence Zeleny recently attended an international meeting in Geneva, Switzerland, called by the Committee on Agricultural Problems of the Economic Commission for Europe. Purpose of the meeting was to attempt to obtain a degree of international standardization of methods of sampling and evaluating the quality of grain moving in international trade. It was

attended by delegates from Czechoslovakia, West Germany, France, Italy, Poland, Romania, Sweden, Switzerland, the United States, USSR, and Yugoslavia.

Wilbur T. Pentzer attended the 11th International Congress of Refrigeration in Munich, August 27-September 4, presiding at a Plenary Session on Time-temperature Tolerance of Frozen Foods and a session of Commission 4 on Food Refrigeration. The Congress was attended by approximately 1,800 persons from 35 countries. Mr. Pentzer was elected vice-president of the Executive Committee of the International Institute of Refrigeration for the next four years. The next Congress will be held in Madrid, in 1967.

Edson J. Hambleton was guest speaker at a meeting of the American Entomological Society, held in Philadelphia September 26. Mr. Hambleton spoke on foreign technical assistance in plant protection, with special emphasis on the work of the Regional Insect Control Project in the Near East and Africa.

Justus C. Ward gave a talk on "The Latest from Washington" before the Association of American Pesticide Control Officials in Salt Lake City, August 14.

Harold T. Cook participated in the Symposium on Biometeorology and Epidemiology of Fungal Diseases of Plants, which was held in conjunction with the Third International Biometeorological Congress in Pau, France, September 1-13. Afterwards Dr. Cook reviewed progress in P.L. 480 research projects in Italy and the Netherlands, and visited laboratories in Munich.

Samuel B. Detwiler, Jr., assistant to the administrator of the Agricultural Research Service, received the 1963 Honor Award of the Washington Chapter of the American Institute of Chemists, at a dinner meeting on May 14. The award was given for "selfless devotion and untiring services to scientific societies and their publications, and his ability and accomplishments as a research scientist in agricultural chemistry."

CARNEGIE INSTITUTION OF WASHINGTON

M. A. Tuve, director of the Department of Terrestrial Magnetism, has been appointed to the recently-established Latin Science Board, which will advise the U.S. coordinator of the Alliance for Progress on programs in science and technology.

COAST AND GEODETIC SURVEY

Charles A. Whitten has been appointed deputy assistant director, Office of Physical Sciences; **Leroy Alldredge** has been appointed chief of the Division of Geomagnetism; and **Leonard M. Murphy** has been appointed chief of the Division of Seismology.

Charles N. Claire retired from the Survey on August 31 after 35 years of service.

Donald A. Rice was re-elected president of the Gravimetry Section, International Association of Geodesy, at the 13th General Assembly of IUGG, held last August at Berkeley, Calif. Others attending the IUGG General Assembly were **C. A. Whitten**, **B. K. Meade**, **James B. Small**, **Norman F. Braaten**, **Dean S. Carder**, **David G. Knapp**, **J. L. Stearn**, and **Leonard M. Murphy**. Mr. Small presented a paper entitled, "Interim Report on Vertical Crustal Movement in the United States." Mr. Braaten presented a paper, "Mean Sea Level Variations as Indicated by a 1963 Adjustment of First-order Leveling in the United States," by himself and Charles E. McCombs. Dr. Carder presented a paper entitled, "Improved Seismic Wave Travel Times from Surface Foci." Dr. Knapp presented "Some Notes on Field Patterns in Relation to Dip Poles" and "Position Parameters in the Rise of Geomagnetic Cartography, Specifically Dip Versus Latitude."

Joseph L. Stearn presented a paper entitled, "Accuracies of Super-design Geodetic Networks," before the 44th annual meeting of the American Geophysical Union, in Washington on April 18.

FOOD & DRUG ADMINISTRATION

Oral L. Kline was recently named assistant commissioner for science for FDA. **Philip L. Harris**, formerly of NIH, has succeeded Dr. Kline as director of the FDA Division of Nutrition.

GEOLOGICAL SURVEY

Several Geological Survey people appear as authors in Special Paper No. 1, the first of a new publication series of the Mineralogical Society of America, appearing in October. The volume contains the papers and proceeding of the Third General Meeting of the International Mineralogical Association. **Thomas P. Thayer** is the author of "Flow-layering in Alpine Peridotite-gabbro Complexes"; **Priestley Toulmin, III**, is co-author of "Equilibrium in Ore Deposits" and of "Thermodynamic Study of Pyrrhotite and Pyrite"; and **Edwin Roedder** is author of "The Composition of Quartz-forming Fluids in Nature."

George T. Faust, who is chairman of the Nomenclature Committee of the Mineralogical Society of America, attended the 1963 International Clay Conference (CIPEA) in Stockholm, August 12-16. He took part in a field trip to Bornholm Island, and later visited mineralogical laboratories at Copenhagen, Heidelberg, Göttingen, and Cambridge.

Edwin Roedder attended a meeting of the International Union of Geodesy and Geophysics in San Francisco, August 26-30. He also was a delegate of the Geological Survey to the Prague Symposium on Problems of Post-magnetic Ore Deposition, September 16-21, and participated in both pre- and post-meeting field trips to many of the classic mining localities in Czechoslovakia. He also was an invited speaker at the joint meeting of the German and Austrian Mineralogical Societies, held in Vienna in September, and afterwards visited laboratories in Göttingen, Karlsruhe, Tübingen, Leyden, and Paris.

Clarence S. Ross, Roebling medalist of the Mineralogical Society of America, was awarded an honorary degree of Doctor

of Science by his alma mater, the University of Illinois, on June 15, in recognition of his pioneering work and achievements in clay mineralogy and volcanology.

Waldemar T. Schaller, 81, often called the dean of world mineralogists, observed his 60th year with the Geological Survey on October 1. Dr. Schaller is credited with the discovery or description of more than 40 minerals and he has written more than 200 professional papers on minerals, geology, and chemistry. The veteran government scientist began his service with the Geological Survey soon after his graduation from the University of California in 1903. Dr. Schaller retired in 1953, but was recalled to duty in the Survey's Branch of Geochemistry and Petrology, Geologic Division, to permit him to continue important investigations begun years ago.

GEORGE WASHINGTON UNIVERSITY

Benjamin D. Van Evera, dean of sponsored research, spent a month in the western states during August and September. He attended the 17th National Conference on the Administration of Research, visited the Air Force Missile Center at Cheyenne, Wyo., and visited the chemistry departments of a number of universities.

On October 10-11 Dean Van Evera served as member of a team representing the Middle States Association of Colleges and Secondary Schools at St. John's University, Jamaica, L. I.

Minoru Sakaguchi of the University of Electro-Communications, Tokyo, has joined the Statistics Department to undertake teaching and research under an NSF foreign scientist fellowship.

GEORGETOWN UNIVERSITY

Theodore Koppanyi, chairman of the Pharmacology Department, is co-author of a newly-revised third edition of "Experimental Pharmacodynamics." Alexander G. Karczmar of Loyola University collaborated in preparation of this combined text and manual.

HARRIS RESEARCH LABORATORIES

Harris Research Laboratories again participated this year in the summer institute for high school science teachers sponsored by the National Science Foundation; this was the eighth year of HRL participation. Eleven outstanding science teachers from various parts of the country spent half of their time on research investigation at HRL, to broaden their science background; the remainder of their time involved course work at American University.

Milton Harris has been appointed to the Advisory Committee to the American Chemical Society president for 1964. Dr. Harris also has been made a member of the American Management Association's Research and Development Planning Council.

Norman R. S. Hollies presented a paper, "Visualization and Meaning of Air-flow Patterns over Fabric Surfaces and in Clothing Spaces," at the Gordon Research Conference on Textiles on July 11.

Milton Harris recently attended a meeting of directors of industrial research at the IBM Watson Research Center in Tarrytown, N. Y. Dr. Harris also testified before Senator Hubert Humphrey's Senate Small Business Committee, on barriers to the development of civilian industrial technology and possible Government action.

Arnold M. Sookne spoke before a meeting of the Society of Plastics Engineers, on "The Use of Plastics in the Textile Industry." on September 17. The meeting was held at College Park, Md.

Lyman E. Fourt and **Edmund M. Buras, Jr.**, presented talks at the 145th ACS National Meeting in New York on September 9. Both papers were contributions to the Symposium on Searching the Literature of Specialized Fields.

HOWARD UNIVERSITY

Lloyd N. Ferguson is author of a textbook published last July, on "The Modern Structural Theory of Organic Chemistry."

Dr. Ferguson served as a visiting profes-

sor of chemistry at the University of Oregon during the 1963 summer session.

Martin R. Feldman has been appointed assistant professor of chemistry. He received the Ph.D. degree from UCLA under Saul Winstein, and spent a post-doctoral year under Andrew Streitwieser at the University of California at Berkeley.

J. Leon Shereshefsky served on the physical chemistry panel which selected the recipient of the Pure Chemistry Award of the American Chemical Society for 1963.

George C. Turrell presented a paper entitled, "On the Vibrational Spectra of Impurities in Crystals," at the Annual Symposium on Molecular Structure and Spectroscopy held last June at Ohio State University, Columbus.

NATIONAL AERONAUTICS & SPACE ADMINISTRATION

Hugh L. Dryden, deputy administrator, was elected last April to a third four-year term as home secretary of the National Academy of Sciences.

NATIONAL BUREAU OF STANDARDS

Director **Allen V. Astin** has announced staff appointments and related organizational changes aimed at giving greater emphasis to Bureau programs that support directly the Commerce Department's responsibilities for promoting economic growth through science and technology.

Robert D. Huntoon, formerly deputy director, has been assigned responsibility for managing the Standard Reference Data Program, and has been redesignated deputy director for basic standards and services. Dr. Huntoon will continue to manage NBS programs associated with the development of basic measurement standards and calibration services associated with dissemination of the basic measurement standards.

Irl C. Schoonover, formerly associate director, has been appointed to the newly-created position of deputy director for technological standards and services. He will have responsibility for all programs

involving the development of industrial standards and test methods which provide a common basis for the exchange of technological products and services in industry and commerce.

A. T. McPherson, formerly an associate director of NBS and more recently associate director of the Office of Technical Services, is returning to the Bureau as special assistant to the director for international standards.

Harry Burnett and his wife recently returned from Europe, where he visited the National Engineering Laboratories in Scotland and attended the AGARD Conference on Refractory Materials in Oslo. He also traveled through the USSR, visiting laboratories in Moscow, Leningrad, and Kiev.

Churchill Eisenhart has been made a senior research fellow on the director's staff. Prior to this appointment, Dr. Eisenhart had served as chief of the Statistical Engineering Section, Applied Mathematics Division.

M. S. Green left on June 16 for Mexico City, to undertake a program of teaching and research consultation at the Instituto Polytechnico Nacional of Mexico. Dr. Green returned to NBS in September.

Walter J. Hamer, a section chief in the Electricity Division, has been elected president of the Electrochemical Society, an international association of 3700 members. Dr. Hamer was installed in office at the association's spring meeting in Pittsburgh.

Julius Jackson sailed on August 16 for the Netherlands, to study at the University of Leiden under a Fulbright fellowship until June 1964. He will then go to the Weizmann Institute in Israel for three months, and will return to NBS in September 1964.

William F. Meggers, former chief of the Spectroscopy Section, received the 1963 Award of the Spectroscopy Society of Pittsburgh for his contributions to the field of emission spectroscopy.

Herbert F. Schiefer, consultant on

textiles, was awarded an honorary doctorate of science by Ferris Institute of Big Rapids, Mich., at its commencement on June 9.

Douglas E. Parsons, consultant to the director, retired from NBS on August 3, after approximately 40 years of service.

F. C. Breckenridge, engineering physicist in the field of signal lighting, recently retired from the Photometry and Colorimetry Section after 43 years of service.

Earle K. Plyer retired from NBS on October 8, to become head of the Physics Department at Florida State University, Tallahassee.

Herbert C. Vacher, chief of the Microscopy and Diffraction Section, retired from NBS in March after a 37-year career in metallurgical research.

Talks by NBS Washington Personnel

S. N. Alexander: "The Current Status of Graphic Storage Techniques: Their Potential Application to Library Mechanization"—Library of Congress, Warrenton, Va.

J. A. Bennett: "Effect of Reactions with Atmosphere During Fatigue of Metals"—Army Materials Research Agency, Sagamore Lake, N.Y.

G. Brauer: "A Proposed New Anterior Filling Material"—New York State Dental Society, Syracuse, N.Y.

C. Eisenhart: "The Background and Evolution of the Method of Least Squares"—International Statistical Institute, Carleton University, Ottawa, Canada. "On the Early History of Least Squares"—Section on Physical and Engineering Sciences, American Statistical Association, Cleveland.

R. E. Florin: "Crosslinking by Radiation"—Division of Rubber Chemistry of the American Chemical Society, Toronto.

A. Chaffari: "On a New Approximation Method for Nonlinear Nonautonomous Differential Equations"—Applied Mathematics Research Laboratory, Aerospace Research Laboratories, U.S. Air Force, Wright-Patterson Air Force Base.

J. L. Hague: "The Role of Chelating Agents in Ferrous Analysis"—American Chemical Society, Division of Analytical Chemistry, and University of Arizona, Tucson.

W. J. Hamer: "Electrode Potentials in Molten Salts"—Gordon Research Conference, Kimball Union Academy, Meriden, N. H.

R. D. Huntoon: "Present Status of the National Standards for the Basic Physical Quantities"—Dedication of Stations WWVL and WWVB; also, VLF Symposium, Ft. Collins, Colo.

H. S. Isbell: "Oxidation of Myo-inositol and

Aromatization of Cyclohexitols"—Starch Round Table Conference, Melvin Village, N. H.

D. P. Johnson: "Stable Table Control Systems"—Gordon Research Conference on Instrumentation, Colby Junior College, New London.

G. M. Kline: "Polymer Research at the National Bureau of Standards, 1962-1963"—XV International Plastics Congress and Elastomers Symposium, Turin, Italy.

J. Kruger: "Optical Studies of Thin Oxide Films"—12th Annual AEC Corrosion Symposium, Pleasanton, Calif.

J. Mandel: "A New Look at an Old Experiment"—American Society for Quality Control, Louisville Section, Louisville, Ky.

D. E. Mann: "The Structure and Vibrational Spectrum of $\text{SO}_2 \text{F}_2$: A Case History"—Chemistry Department, Ohio State University, Columbus.

R. S. Marvin: "Relations Between Molecular Motions Involved in Shearing and Dilatational Deformations in Polymers"—Polymer Research Institute, University of Massachusetts, Amherst, Mass.

A. G. McNish: "Quantum Mechanical Processes for Frequency and Length Standards"—Seminar, Lebedev Institute, Moscow. "Use of Optical Masers as Length Standards"—Mendeleev Institute, Leningrad. "Standards for Contact Lenses"—National Eye Research Foundation, Chicago, Ill.

S. B. Newman: "Resinography with 8A X-rays"—American Society for Testing Materials, Atlantic City.

G. C. Paffenbarger: "New Knowledge of Amalgams: How You Can Use Them in the Office," "Clinical and Laboratory Testing of Denture Base Resins," and "Silicate Cements and Direct Filling Resins"—Hawaii State Dental Association, Honolulu, Hawaii; "Acceptance of the Alfred C. Fones Award"—Connecticut State Dental Association, New London; and "Current Research on Dental Materials at the National Bureau of Standards"—Main Line Dental Society, Ardmore, Pa.

C. M. Sitterly: "The Present State of Ultraviolet Laboratory and Solar Spectroscopy" and "Diatom Molecules in Cometary Spectra"—Max Planck-Institut für Astrophysik, Munich.

C. M. Tchen: "Kinetic Problems in Plasma"—Plasma Physics Institute, Garching, Germany; "Kinetic Equation and Landau Damping"—Institute for High Temperature Research, Technical University, Stuttgart; "Interaction of Plasma Flows with Magnetic Fields"—Laboratory for the Structure of Materials, University of Amsterdam; "Kinetic Theories of Plasmas"—Institute Battelle, Centre de Recherche de Geneve; and "Plasma Oscillations with Collective Correlations"—International Symposium on Ionization Phenomena in Gases, Paris.

W. J. Youden: "Precision and Accuracy in Spectrochemical Analysis"—Society for Applied

Spectroscopy, Western Reserve University, Cleveland; "Sampling and Statistical Design"—Symposium on Environmental Measurements, sponsored by the U.S. Public Health Service, Cincinnati.

F. E. Washer: "Optical T-Bench Method for Measurement of Optical Path Difference"—Society of Photographic Instrumentation Engineers, Los Angeles.

The following talks were presented before the 18th Annual Instrument Society of America Instrument Automation Conference and Exhibit, Chicago:

A. G. McNish: "Résumé of Trip to the Soviet Union."

H. S. Peiser and J. Wachtman, Jr.: "Space Groups and Structures of Strained Crystals."

The following talks were presented before the 145th National American Chemical Society Meeting, New York City:

H. L. Isbell: "Utilization of Isotope Effects for Study of Reaction Mechanisms. Oxidation of Aldehydes with Chlorous Acid."

D. R. Lide: "Microwave Spectra of High-Temperature Species."

R. Schaffer: "D-glucosyl-L-glycero-3-octulose Derivatives and Two Derived 2-octuloses."

M. D. Scheer: "Desorption Kinetics of Alkali Ions on Rhenium."

NATIONAL INSTITUTES OF HEALTH

Marshall Nirenberg, head of the Section on Biochemical Genetics in the National Heart Institute, has won the American Chemical Society's \$1,000 Pfizer Paul-Lewis Award in Enzyme Chemistry, according to announcement at the Society 145th national meeting in New York City on September 10. The "cracking of the genetic code" has been Dr. Nirenberg's most notable achievement; he and his collaborators were the first to identify one "word" in the message that a living cell uses to direct the synthesis of proteins. Last year he received the National Academy of Sciences award for distinguished research in molecular biology and the Washington Academy of Sciences award in the biological sciences.

G. Robert Coatney, chief of the Laboratory of Parasite Chemotherapy, National Institute of Allergy and Infectious Diseases, visited Pakistan in June to complete arrangements for field testing of the new long-acting antimalarial drug C1501.

Kenneth S. Cole, chief of the Laboratory of Biophysics, National Institute of Neurological Diseases and Blindness, is spending the fall of 1963 at the University of California, Berkeley, as regents professor of medical physics.

Paul H. Keyes, Laboratory of History and Pathology, National Institute of Dental Research, lectured to the students and staffs of dental schools in Denmark, Finland, Norway, and Sweden during September. Dr. Keyes discussed NIDR research findings on biological and bacteriological factors in dental caries and periodontal disease in hamsters.

Francis A. Arnold, director of the National Institute of Dental Research, has received the 1963 Callahan Award of the Ohio State Dental Association.

Roman Kulwich has been appointed scientist administrator with responsibilities in the operation of Institute research support programs. For the past year Dr. Kulwich has been an NIH grants associate in the Division of Research Grants.

John E. Lane has been appointed executive secretary of the Toxicology Study Section, Division of Research Grants.

NAVAL ORDNANCE LABORATORY

Curtis J. Humphreys, scientist at the NOL laboratories in Corona, Calif., received the Navy Award for Distinguished Achievement in Science on June 21. The award, which consists of a certificate, a medal, and a monetary grant of \$5,000, was given in recognition of Dr. Humphreys' outstanding and pioneering research in the field of atomic line emission spectroscopy.

NAVAL RESEARCH LABORATORY

Victor J. Linnenbom, Radiation Division, attended a recent meeting of the International Electrotechnical Commission in Venice, Italy, as a U.S. delegate.

Conrad H. Cheek and **Dr. Linnenbom** attended the first meeting of the Faraday Society in the United States, on radiation chemistry, held at the University of Notre Dame on September 2-4.

Alan C. Kolb attended the Sixth International Conference on Ionization Phenomena in Gases at Paris in July, where he presented a paper entitled, "Radiation from High Temperature Plasmas." He also attended a Conference on Atomic Collision Phenomena held in London in July.

George R. Irvin gave a lecture, "Structural Aspects of Brittle Fracture," at a meeting of the Structures and Materials Panel of AGARD in London on September 2. He remained in England for the balance of the month to work at the British Welding Research Association Laboratory near Cambridge.

Maurice M. Shapiro, superintendent of the Nucleonics Division and head of the Cosmic Ray Branch, has returned to his duties following a year's study and lecturing at the Weizmann Institute of Science at Rehovoth, Israel. Dr. Shapiro's fellowship provided for studies of the primary cosmic radiation and recent developments in the theory of nuclear structure. While at the Institute, he served as visiting professor of physics and lectured at Hebrew University, Jerusalem, and at the Israel Institute of Technology in Haifa. Dr. Shapiro was sponsored in his research work by a Guggenheim fellowship and assistance from NRL.

Robert G. Glasser recently returned to the Cosmic Ray Branch of NRL after a year of research at CERN, Switzerland, where he worked in the field of high energy physics. Dr. Glasser was the recipient of a senior postdoctoral National Science Foundation fellowship.

SMITHSONIAN INSTITUTION

The following scientists have recently joined the staff of the Museum of Natural History:

Wallace R. Ernst, formerly botanist at the Harvard University Herbaria, as associate curator, Division of Phanerogams.

Richard C. Froeschner, formerly associate professor of zoology at Montana State University, as associate curator in charge of the new Division of Hemiptera.

David B. Lellinger, a graduate student of the University of Michigan about to receive his doctoral degree, as associate curator, Division of Ferns.

Richard L. Zusi, formerly assistant professor of zoology at the University of Maine, as associate curator, Division of Birds.

Robert H. Gibbs, Jr., formerly assistant professor of biology at Boston University, as associate curator, Division of Fishes.

Marion H. Pettibone, formerly associate professor of zoology at the University of New Hampshire, as associate curator, Division of Marine Invertebrates.

WASHINGTON POST

Nate Haseltine has won the American Chemical Society's \$1,000 James T. Grady Award for outstanding reporting of chemical progress to the public, according to announcement at the Society's 145th national meeting in New York City on September 10. A newspaperman for 32 years and the *Post's* science writer for the last 14 years, Mr. Haseltine was honored "for his versatile contributions to public knowledge and understanding of chemistry, chemical engineering, and related fields." The medalist is immediate past president of the National Association of Science Writers. Previously he had won the AAAS-George Westinghouse Award as the outstanding science writer of 1953, and the 1956 Howard Blakeslee-American Heart Association Award for a series entitled, "Within a Child's Heart."

WEATHER BUREAU

Francis W. Reichelderfer retired in July after 25 years as chief of the Weather Bureau. At the time of his retirement he received a letter from the Secretary of Commerce, commending him for his leadership in raising the Bureau to its present status as the largest and most sophisticated weather system in the world, and for introducing new forecasting techniques.

UNCLASSIFIED

Roger Revelle was awarded the Agassiz Medal for outstanding achievement in oceanography at the National Academy of Sciences meeting in April. Dr. Revelle recently assumed new duties as dean of research at the University of California, after serving for a year and a half as science adviser to the Secretary of the Interior.

Emanuel R. Piore, vice president for research and engineering at International Business Machines Corporation, was elected to the National Academy of Sciences at its April meeting.

Bernard Frank, professor of watershed management in the Forestry Department of Colorado State University and a nonresident member of the Academy, has received the degree of fellow in the Soil Conservation Society of America. This degree, the highest honor the Society bestows, is awarded to the professional members of the Society in recognition of exceptionally outstanding service and leadership in the field of soil and water conservation. It was presented on August 28 during the Society's three-day meeting at Logan, Utah.

DEATHS

Michael X. Sullivan, former head of the Chemistry Department at Georgetown University, died of cancer on May 3 at the age of 87. Dr. Sullivan was a native of Fall River, Mass. He received the bachelor's degree from Harvard University in 1899 and the master's and Ph.D. degrees from Brown University. He held the honorary Doctor of Science degree from Georgetown University. Dr. Sullivan was well known for his work on the chemistry of cancer. He received the Hillebrand Prize from the Chemical Society of Washington in 1941, and the Ernst Bischoff Award from the American Association of Clinical Chemists in 1955.

Harold Dorn, chief of Biometrics Research Branch, National Heart Institute, died May 9 at the age of 56. Dr. Dorn was a native of Tompkins County, N. Y. He received the B.S. and M.S. degrees from

Cornell University and the Ph.D. degree from Wisconsin in 1933. Dr. Dorn was recognized internationally as a leader in the field of biometrics research. His statistical study in 1959 of the death rate from lung cancer and from cardiovascular, respiratory, and other diseases among men who have used tobacco and those who have never smoked, was instrumental in determining the PHS stand in the tobacco and lung cancer controversy.

Francis M. Defandorf died August 18 at the age of 66. Dr. Defandorf had been head of the Electrical Instruments Section of the National Bureau of Standards for the last 17 years. He was a native of Garrett Park, Md., and received the bachelor's, master's, and doctor's degrees from Johns Hopkins University. The 2-million-volt high-voltage laboratory at the Bureau was planned and directed by Dr. Defandorf. He was president of the Philosophical Society of Washington in 1946, and of the Washington Academy of Sciences in 1954.

Virginia F. Griffing, 46, professor of chemistry at Catholic University since 1957, died September 5 of a hemorrhage while on vacation in Nova Scotia. She was an expert on ultrasonics and the structure of molecules. A native of Lexington, Ky., she taught in public schools there before coming to Catholic University in 1943; she received the Ph.D. degree in physics from the University in 1947. Burial services were held in Lexington.

SCIENCE AND DEVELOPMENT

Total water supply in the United States is not decreasing. But water requirements have increased greatly, according to an article by Charles J. Robinove of the Geological Survey, in the annual report of the Smithsonian Institution. Water is used today for numerous purposes, many of which were not anticipated 50 years ago. Each area has water problems that may differ greatly from those in other areas of the country. The ultimate solution will require comprehensive planning and development of an area's water resources to provide

the greatest benefit for all. The principles of water management are based on the physical and chemical regimen of water and are modified as required by economic, legal, and sociological factors.

An 1800-meter taped base line to aid in research on distance measuring instruments has been established in the Washington area by the Coast and Geodetic Survey. It is located at the Agricultural Research Center airport near Beltsville, Md. The first measurements were completed in August with a precision of 1 part in 2,000,000 probable error.

Application of lasers to problem areas in mapping and geodesy is being investigated by the Army Engineers' Geodesy, Intelligence, and Mapping R&D Agency at Fort Belvoir. One potential application in geodesy is for ultra-precise distance and angle measurements between points on the earth's surface, between ground and aircraft, and between earth and satellite. Another is for monitoring baseline shift, shifts of the earth's surface, and earthquakes. Lasers may also be used as gyroscope and rotation sensors, and as part of a gravity measuring system. In mapping and photogrammetry, lasers may be applied to height measuring, and to extremely fine resolution of lines and points on photographic plates, as well as to measurement of distances between these lines and points.

Floating platforms would be used for mine detection, according to plans of the Army Engineer R&D Laboratories. The group has let a contract for development of a mine detector mounted on an air-cushion carrier, using a multi-blade fan to support the assembly at least six inches above the ground. The assembly would be attached to the front of a truck by means of a 20-foot hinged boom.

Potted azaleas in bloom will be available any time of the year, according to predictions of Department of Agriculture scientists. These popular shrubs, which normally flower in the spring, can be induced to flower out of season by chemical treatments and regulating the duration of

light in each 24-hour period. This will make it possible for homeowners to buy potted azaleas in flower for special occasions such as Christmas.

A camera that takes 8 million pictures per second is being used by Army engineers to study the physical forces that interact within explosives as they detonate under various conditions. Key to the development is a complex synchronization system for coordinating lighting with the detonation of the explosive. Two 5,000-volt pulsers are timed to fire at a precise instant during rotation of a turbine that spins an optical mirror at 5,500 revolutions per second. The turbine is run by high-pressure nitrogen gas, and brilliant illumination is obtained by detonating an auxiliary explosive charge in a 3-foot tube of argon gas. The shutter is closed by another explosive charge that shatters the glass lenses, stopping the passage of light.

As part of its 175th anniversary celebration, **Georgetown University has announced the James Curley Lectures in Science**, honoring the Reverend James Curley, S.J. (1796-1889), who founded Georgetown Observatory. The lectures began in October, and will extend into next May. Schedule for the nine remaining lectures is as follows: November 19, "Biological Evolution, with Special Reference to Man and His Culture," by Theodosius Dobzhansky, Rockefeller Institute; December 17, "The Limitations of Science," by Rev. Ernan McMullin of Notre Dame; January 14, "Life in Space," by C. C. Kiess, Georgetown Observatory; February 18, "The Socialization of Science," by Gen. James McCormack, MIT; March 10, "Practical Uses of Atomic Energy," by Arthur Ruark, AEC; April 7, "Population Trends and Population Control," by Ansley J. Coale, Princeton University; April 21, "The Impact of New Materials and New Instrumentation on Our Foreseeable Technology," by E. R. Piore, IBM; May 1, "Design for a Brain," by Phillip Morse, MIT; and May 19, "The Revolution in Biology and Medicine," by Bentley Glass, Johns Hopkins

University. All lectures will start in Gaston Hall at 8:30 p.m. Complimentary tickets are available from Anniversary House at GU, 3610 O St., N.W.

Catholic University has established a Division of Space Science and Applied Physics in its School of Engineering and Architecture. C. C. Chang is chairman of the Division, which is believed to be the first of its kind to concentrate in the area of both space science and applied physics. The curriculum includes about 40 courses in the disciplines of space science, applied physics, fluid mechanics, and aerospace engineering, leading to the master's and doctor's degrees.

A National Standard Reference Data System has been established by the Federal Council for Science and Technology, and responsibility for its administration has been assigned to the National Bureau of Standards. The system will provide critically evaluated data in the physical sciences

on a national basis, centralizing a large part of the present data-compiling activities of a number of Government agencies. NSRDS will be conducted as a decentralized operation across the country, with central coordination by NBS. As presently planned, the program will consist of three parts: an input from scientists in many different locations, a central source of the evaluated data at NBS, and an output system geared to the needs of the country's scientists and engineers.

Development of a robot typesetter for scientific publications will be one object of research by the American Chemical Society under a recent grant from the National Science Foundation. Use of automation to speed up the exchange of scientific information also will be explored. Purpose of the project is to develop a computer system for automatic typesetting of complex scientific material. A key feature will be the transfer by computer of scientific information onto tapes.



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American Society of Mechanical Engineers	WILLIAM G. ALLEN
Helminthological Society of Washington	DOYS A. SHORB
American Society for Microbiology	HOWARD REYNOLDS
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Institute of Food Technologists	RICHARD P. FARROW
American Ceramic Society	J. J. DIAMOND
Electrochemical Society	Delegate not appointed

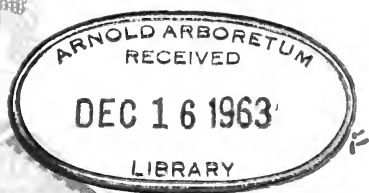
*Delegates continue in office until new selections are made by the respective affiliated societies.

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Research—A Vital Factor in A Food Regulatory Program*

Oral L. Kline

Assistant Commissioner for Science, Food and Drug Administration

It is a privilege to have a part in paying tribute to the National Canners Association Laboratories on this 50th anniversary. We note with pride that the organization at this advanced age is in good health, and one wonders whether or not this state of optimum nutrition is the result of association with the right kinds of foods. In any case, this organization has flourished and has been extremely useful, not only to the canning industry but also to those organizations with which it has developed an admirable state of cooperation.

The keynote of this cooperation, of course, is scientific research. In our complex age, with advancements in science, and with the application of new scientific developments in the food and drug industries, it is essential that we learn to deal with these complex problems not only from the standpoint of production and utilization, but also from the standpoint of evaluation of safety, utility, and effectiveness in the interest of the consumers of food and drug products. It is clear that an effective research program is a vital factor in the enforcement of regulations that pertain to the production, standardization, and distribution of foods.

I should like to take particular note here of the fine cooperation that has existed between the canning industry and its Association and the Food and Drug Administration. This began even before there was a National Canners Association Laboratory. In a large cooperative experiment begun

about 1910 to answer the question of whether tin and iron in canned foods were hazards, we had a unification of effort on the part of the can manufacturers, the food canners, and the old Bureau of Chemistry of the Department of Agriculture. In this cooperative effort, large numbers of packs of a variety of foods were prepared and examined annually over a period of several years to produce information that culminated in a report demonstrating clearly that tin and iron in canned foods were not poisonous and that this was not a serious problem. During this extensive cooperative effort, it became quite apparent to the canned foods industry that well-equipped laboratories capable of carrying out the kinds of complex methodology involved in the demonstration of safety, and in working out the details of improvement of technology and quality of canned foods, were essential to the service of the canning industry. This was an important factor, I am sure, in the formation of this laboratory service.

Cooperation with the old Bureau of Chemistry, which at that time was responsible for enforcement of the Pure Food and Drug Law, was further in evidence in the appointment of Dr. Bigelow, then assistant chief of the Bureau of Chemistry, as the first director of the laboratory. Further example of the cooperation at the scientific and investigational level between this laboratory and the Food and Drug Administration was related to the development of acceptable standards of quality under the McNary-Mapes Amendment of 1930. The NCA was the first to overcome an obstructionist attitude in the application of this

* An address presented at the 50th anniversary celebration of the National Canners Association Research Laboratories on May 22, 1963, in Washington.

Amendment to standards of quality, and it was soon learned that the required labeling of foods as substandard eliminated such foods from the market and improved the general quality of the canned food supply. In the investigational effort to provide objective tests to determine quality, the chemists of the National Canners Association Laboratories and of the Food and Drug Administration joined forces in their broad inspection program. Through this cooperation, standards of acceptable quality were formulated.

What are the problems that we face today that are directly related to the food canning process? Perhaps the most immediate has to do with the concern over pesticide residue contamination of our food supply. You are all aware of the report to the President submitted in recent days by a special committee assigned to evaluate the pesticide contamination from a total environmental standpoint. Recommendations for further research suggest that additional research needs to be accomplished in several areas. With respect to food pesticide residues, we have established approximately 2500 tolerances on 130 chemicals. These tolerances have been based on some knowledge of the toxicity of each of these compounds learned from pharmacological experimentation. In the preparation of food for canning, there is a legal requirement that such foods be treated in a manner to reduce residues so far as possible. In a very preliminary evaluation of the residue content of canned foods, it is quite clear that in the preparation for canning, considerable reduction of the pesticide residue content can be and is being accomplished. Although more information is desirable, the indications are that canned foods contribute only to a very small degree to the pesticide residue content of our food supply.

The Food and Drug Administration has, as a program for this fiscal year, the analysis of 25,000 food samples for pesticide residue content. This constitutes a sampling of approximately 1 percent of the raw agricultural product shipments that

move across State lines each year. As of the first of May, our program of examination of this large sampling is on schedule. Nearly 200 of our chemists are spending full time on this analytical program. The results of these analyses will give us a basis for determining whether the coverage should be increased, and will tell us whether there are certain geographical areas or certain classes of foods that may be of lesser importance in the program.

Also, we have developed considerable improvement in methodology during this extensive effort to the point that, in the continuation of the program next year, our analytical data will provide more quantitative information. Research and methodology pertaining to pesticide residues have developed rapidly in many laboratories in this country. It has been through the best kind of cooperation that we have been able to establish to such a remarkable degree the chemistry, and in some cases the metabolic fate, of these compounds, and methods of extraction and identification in their measurement. The newer instrumentation has given us the tools for the rapid advances that have been made.

In other studies, the ultimate goal of a long-range FDA research program on staphylococcal food poisoning has been the detection of the agent in food products. The problem has been attacked successfully using serological methods, and has resulted in: (1) the identification of two types of enterotoxin, one of which predominates in food poisoning outbreaks in the United States; (2) simplified procedures for determining the ability of staphylococci to produce these poisons; and (3) methods for the detection of trace amounts of the enterotoxins in foods. The serological procedure used in these studies is a modification of a gel diffusion test, in which the toxin and its antibody form precipitates which can be identified by comparison with reference lines of precipitation. The reaction takes place in a thin film of agar in which lines of precipitation are formed as a result of diffusion of toxin and antibody

toward each other from localized sites. The most recent development in this research is our ability to prepare extracts from meat containing the enterotoxin, which are further purified in ion exchange columns to give a solution that can be tested by the diffusion technique. Application of the test to other food materials is still under study.

For a long time, the food industry has been alert to contamination of foods with molds. Such contamination is regarded as an indication of an inferior quality that is not suitable for food use. Recent events have emphasized the importance of attention to mold contamination of our food supply. About a year and a half ago, we were informed by the Department of Agriculture of an outbreak of a disease affecting young turkeys in England. At that time we thought there was a connection between this disease and the "chick edema factor" which our laboratories have been studying for a number of years. The British soon discovered, however, that the causative factor was a metabolite of a mold, *Aspergillus flavus* Link, which had grown on peanuts imported from Africa. Arrangements were made to obtain some of the cultures, which we grew under our conditions. We were able to reproduce the disease syndromes described by the British, as well as to grow the molds on a number of different strains as substrates.

The cultures grown on wheat were found to produce rather potent material, readily purified by our capable chemists, who then were able to make a preparation shown by biological test to contain about 50 percent of crude aflatoxin. We learned that workers at Massachusetts Institute of Technology also were attempting to isolate the components of aflatoxin to determine their structure. They had obtained only milligram amounts, and we had available gram quantities. We furnished this group approximately 200 milligrams of our relatively potent preparation, and after about six weeks of concerted effort, utilizing nuclear magnetic resonance and a few

check syntheses, the MIT group was able to announce the structure of aflatoxin B and G as difuranocoumarin compounds.

We think this demonstrates remarkable cooperation among laboratories: the Central Veterinary Laboratory at Weybridge, which furnished the culture; Food and Drug Administration laboratory at Washington, which performed the preliminary isolation; and Department of Nutrition and Food Science of MIT at Cambridge, which did the final purification and identification.

During this time we also initiated a survey of the low-grade peanuts utilized for animal feed in this country, and collected samples of moldy grains that our inspectors might encounter. We are pleased to note that of several dozen samples so far examined, we have not yet encountered the presence of the toxin. We are continuing our analysis of samples, as well as research into the development of relatively rapid chemical methods for the identification of aflatoxin.

This work also suggests an entirely new area of investigation of other potential toxic agents produced by molds. Perhaps a number of unexplained epidemics among animals may be attributed to this type of contamination.

Limited time does not permit me to develop further examples of our research projects which are developing in several subject areas. In nutrition, for example, studies of trace minerals that have nutritive value reveal interrelationships and antagonisms. These are studied in model systems, using the red blood cell of humans and animals to determine the conditions of absorption through cell membranes. Results are used in designing further animal studies. In pharmacology we have the development of new methods for measuring safety of food additives by determining effects of a specific compound injected into the incubating chick embryo and noting effects upon its development. In food research there are studies of changes in the composition of fats resulting from prolonged heating. These go to the isolation

and measurement of the urea filtrate fatty acids and their effects in animal metabolism. In pharmaceutical chemistry we are concerned with the identification and structure of known compounds through comparison of their spectral absorption curves with standard curves of known compounds. Mechanized procedures permit a large number of comparisons to be made in a few minutes. It is important that our research program be broad in scope in view of the great variety of enforcement problems with which we must deal.

The status of the research program of the Food and Drug Administration has been markedly improved in recent years with an increase in financial support for this purpose. Although in its beginnings the Food and Drug Administration was an enforcement organization with attached analytical laboratories, it was soon recognized that scientific development and methodology were essential to the enforcement process. Over the years we have been striving for an integrated operation in which the research and control scientists, working side by side, contribute to each others' effectiveness.

Last fall a Citizens Advisory Committee, after a lengthy review of the structure and function of the Food and Drug Administration, submitted a report in which the scientific aspects were evaluated. This also emphasized the need for a strong research program which would be effective in providing leadership in methodology and in the determination of safety and effectiveness of the great variety of compounds that come within the purview of the Food, Drug, and Cosmetic Act. Such a scientific organization has been developed, and is being enlarged. In it, long term projects are carried out with continuity to a final conclusion.

We also have a group of scientists involved in development and improvement of methodology on a relatively short-term project basis, who can be called upon for assistance when emergency situations and outbreaks occur that require immediate scientific staff attention. We must have sufficient staff to apply new methods in a program of validation by application of procedures to a variety of sample situations.

The knowledge derived from this program is then put to use in the major part of our analytical effort throughout our 18 district laboratories. Such a scientific organization must be closely associated with, and must be an integral part of, the enforcement program. Knowledge of new problems must flow freely from the grass roots experience in the day-to-day sample analyses, and from the experience and knowledge of the enforcement officers. Scientific information produced must be made available and useful to the enforcement officers who deal daily with the industry and the public. Our scientific organization has been developed from the application of these aims, and provides the basis for anticipating new scientific developments and for determining the hazards that may result from new technology. It also provides the scientific progress needed in maintaining an up-to-date analytical program for our enforcement purposes.

We have learned well that research is truly a vital factor in a food regulatory program. The National Canners Association Laboratories have clearly demonstrated that research is a vital factor in the development of sound food production and processing programs. We look forward with interest and satisfaction to another 50 years of effectively working together.



On the Vagrancy Of Scientific Information

Woodrow C. Jacobs

Director, National Oceanographic Data Center

This evening I shall give attention to the ever-increasing magnitude of the problems that confront all those of us who are involved in one way or another with the acquisition, storage, processing, and dissemination of scientific information. I feel that most of our problems have a common base, no matter what scientific discipline we represent and regardless of whether the organization with which we are associated calls itself a science library, a scientific information center, or a data center. In the latter case, I am not quite certain in my own mind that there is really any basic difference between these three types of facilities as far as the user is concerned.

The commodity we are dealing with is scientific information; and when the scientist wants this information, he wants it presented in the form most efficient and most economical for his use. In some cases the format is the printed page bound in hard-backed cover; in other cases it is a series of reports or manuscripts. In still other cases the format is a graph, map, a series of photographs, a tabulation sheet, or a computer tape. In some of the sciences, where the quantitative approach has so far been defined, the scientific information may even take the form of an actual specimen of some sort. In the cases of these sciences, the primary information center may actually be a museum of some type.

The point I am trying to make here is the fact that the distinction between a science library, a scientific information center, a data center, and, in some cases, a collection of scientific objects, is a distinction

affected largely by the people who have created and who maintain the facilities and not by the scientist who uses them.

I hasten to emphasize that as far as libraries are concerned, I am referring only to the scientific and technical library and not to the libraries of the world's literature that are maintained, for cultural, educational, and/or recreational purposes. In the cases of these collections, the hard-backed volume certainly has the right to exist on its own literary merits and should not be forced to justify itself on the basis of the "bits" of information contained between its covers.

In recent years we have heard a great deal about the growing crisis in communication between scientists and engineers—abandonment of long-accustomed habits in the handling and dissemination of scientific information. The crisis results from the simple fact that the results of research and development are being produced in such volume that the traditional information systems cannot cope with it. Even the most optimistic admit that the *information loss* due to inadequate communication is tremendous and that the excess research costs, represented by duplication of research efforts, run into hundreds of millions of dollars per year; the most pessimistic even forecast an almost complete breakdown of our national scientific research effort if the communication problem is not solved within the very near future.

I am not implying by any means that nothing is being done to attempt to solve the problem. An increasing number of scientific and engineering societies, industrial organizations, university groups, and Government agencies are devoting attention

* Speech before the Hydrographic Branch of the Research Society of America, June 7, 1962.

to science information matters. The study of scientific information retrieval and communication systems has become so important, in fact, that the field has become recognized as one of the established scientific disciplines in its own right. Some idea of the national prominence that has been acquired by the activity is provided by the fact that one of the Senate subcommittees, under the able chairmanship of one of our most prominent Senators, is devoting vigorous attention to the subject. This subcommittee expects to "launch a series of Federal legislative and administrative actions of a far reaching nature" to help strengthen our information, documentation, and communication programs.

Nevertheless, as I examine unselected samples of the exceedingly extensive literature that deals with the problem of the collection, retrieval, and communication of scientific information, I become somewhat concerned—concerned not with the fact that the literature on the subject is not extensive enough—but concerned more with the fact that so little of it seems to lead anywhere. I have the uneasy feeling, almost a subconscious feeling, that perhaps *the whole point of the problem is being missed*.

Most of the attempts at solution that I have examined have concerned themselves with improving the speed and efficiency with which the *published* results of research can be abstracted, retrieved from the library files, and delivered to the scientist for his perusal. As I view the problem, there are two things missing from this picture. In the first place, they all appear to assume that the scientist will be able to read or at least personally examine the information that is communicated to him. I feel obliged to point out in this connection that our systems for the rapid and efficient retrieval and transmission of information already possess a capacity that exceeds by many, many orders of magnitude the personal digestive capacity of the scientist, even if the information is presented to him in the most highly condensed

form possible (and here I am using the word "scientist" in the collective sense).

We have systems in daily household use that are capable of retrieving, transmitting, and displaying an amount of information corresponding to that contained in the current edition of the Encyclopedia Britannica in approximately 2½ minutes. An example of such device is the ordinary color TV set in your living room. Since this device is able to receive and display about 70 million bits of information per second, it means that your TV set could display non-repetitive information at a rate so fast that you would not even see it, let alone read or examine it.

The second factor that seems to be missing from the picture of the information problem, as it is most often presented, has to do with the apparent narrow definition of the phrase, "scientific information." The usual connotation is that scientific information is the published results of scientific research. But what about the vast quantities of unpublished, unorganized scientific facts that result from observation or experiment and which are the raw products that go into and make up scientific research? And what about the basic scientific experimental or observational data that have already contributed in part to research but have, themselves, never been published? I would suspect that the largest fraction of the scientific information that exists today falls into one or the other of these categories. *And this fraction is only destined to become larger—never smaller.*

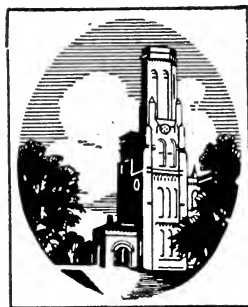
According to the language of *information theory*, the basic unit of measure for information is the "bit" (short for binary digit) which is, in reality, a unit of choice, such as yes or no. The measure of total information, therefore, is the minimum number of binary digits that are necessary to distinguish the transmitted information from all other possible messages. Scientific knowledge results only when these "bits" of information are organized in some intelligent fashion. In this sense, a data center might therefore be defined as the

basic or primitive form of a scientific library or information center—or we might facetiously reverse the line of reasoning and simply state that a data center is a library or information center that has been “torn to bits.”

It is my personal conviction that if science is to survive and prosper, it must pay increasing attention to the concepts contained in *information theory*. In place of devoting our primary effort toward developing systems for the abstracting and rapid retrieval of published scientific information, let us attempt to introduce system, logic, and efficiency into our information-producing effort as well. The only long-term solution to this tremendous problem is to begin to take some steps that are long overdue—to approach the problem in the *total scientific sense* rather than as a problem simply for the scientific information retrieval and processing experts. This will mean the bringing together of the research scientist, the observational instrument designer, the experimental equipment fabricator, the information specialist, the data processing and communication expert, and perhaps others, for the purpose of developing an economical and efficient scientific information-producing as well as information-using system. And lest this statement be misconstrued, let me emphasize that I am not proposing that the system be one to be covered by law, agreement, or legislation; it will of necessity be of the type that would be considered a major scientific development itself if it were ever accomplished. But the total scientific information problem will not be solved unless we direct a significant research and development effort toward it.



THE BROWNSTONE TOWER



An interesting human custom, common to scientists and laymen everywhere, is the celebration of anniversaries, as if mere survival of a person or organization for one or more years were unexpected and worthy of notice and congratulations. Anniversary years divisible by five are regarded as more significant than the others, and the old boys are expected to return to their alma maters for class reunions every fifth year. The significance increases by multiples of five—2, 5, 10, 15; and when 20 x 5, or 100, is reached the celebrators are inclined to knock themselves out in their eagerness to magnify the name of their institution. So it was before and during the celebration of the centennial of the National Academy of Sciences here in Washington, which took place October 21-24.

The director of the celebration was Detlev W. Bronk, past-president of the Academy. The general manager of the staff effort to realize Dr. Bronk's plans was John S. Coleman, who distributed responsibility for parts of the program to the younger professional members of the staff. Mr. Coleman is a fellow of the Washington Academy of Sciences.

The celebration was staged primarily for the members of the National Academy of Sciences, but to make it extraordinarily significant many scientific organizations at home and abroad were invited to send delegates as guests of the Academy. The Washington Academy of Sciences was not overlooked and was represented by President Van Evera, who wrote the following greetings from WAS to President Frederick Seitz, of NAS.

Dear Dr. Seitz:

On behalf of the Fellows and Members of the Washington Academy of Sciences, I would like to extend our best wishes to the National Academy of Sciences on the occasion of its Hundredth Anniversary Celebration.

Living as most of us do in the environs of the home of the Academy, we are in a unique position to know of the good works of the Academy and of the many fine qualities of its members.

For these reasons, we take particular pleasure in extending our congratulations and in expressing the hope that the next hundred years will see an exponential growth in the esteem in which the Academy is held by the people of America.

Sincerely,
B. D. Van Evera

During the celebration Dr. Van Evera was accompanied by Mrs. Van Evera. Francois Frenkiel, president-elect of WAS and current president of the Philosophical Society of Washington, represented the latter. He was accompanied by Mrs. Frenkiel.

The plans called for an invitational scientific program, a convocation in Constitution Hall, an Academy dinner, a special program for the ladies, trips to scientific institutions and other places of interest, and various receptions. It was desired that the members, delegates, and guests, who might have numbered up to 1,000, should have comfortable facilities to meet one another and to eat lunch in the Academy's building. Therefore more space was needed than is normally available here. It was provided by clearing the rooms on the first floor surrounding the Great Hall and by removing the stage from the latter. This made it possible for people to move freely into the room behind the Great Hall and out of the building through the back door. In order to serve lunch to the visitors, a colorful tent was erected in the parking lot behind the building and was connected to the latter by means of a covered ramp. This solved the space problem, making it possible to use the rooms within for registration, exhibits, lounges, etc.

Most of the registration took place on Monday morning, October 21. The delegates were escorted to the foyer in the

west wing, where they met Dr. Seitz and Dr. Bronk and presented the greetings of the organizations they represented. The scientific sessions began on Monday afternoon in the auditorium of the Department of State, about two blocks from the Academy. These sessions were not open to the public, but were well attended. On Monday evening there was a black tie reception in the Academy building, followed by a buffet supper. Food was served in the tent, Great Hall, and Lecture Room. It was possible to circulate and talk without discomfort, and in the tent one could sit down at tables around the periphery. All through the centennial celebration the weather was warm, calm, and generally sunny. It was not necessary to use the space heater that was installed to warm the tent. After supper at the Academy the crowd was taken in buses to the National Gallery of Art, where the members, delegates, and guests had an opportunity to meet Chief Justice Warren, chairman of the Board of Trustees, John Walker, director of the Gallery, and Leonard Carmichael, secretary of the Smithsonian Institution. These three, with their wives, formed a receiving line in the East Garden Court. Meanwhile, the colorful Marine Band Orchestra was playing in the rotunda, and a small instrumental ensemble was playing in the Garden Court. The visitors had an opportunity to see the exhibits on the main floor in relative privacy.

On Tuesday a scientific session was held in the morning, lunch was served in the tent, or pavilion, and in the afternoon the convocation was held in Constitution Hall. It was arranged for the members of the Academy, delegates, and guests to wear their academic robes and to march into Constitution Hall while the large audience, already present, stood at attention. The Air Force Band played a processional march until all were seated. On the stage were certain officers and members of the Council of the Academy: Roger Revelle, Kenneth B. Raper, Harrison Brown, Father Hesburgh, Detlev W. Bronk, Frederick Seitz, J. A. Stratton, A. N. Richards (pres-

dent of the Academy preceding Dr. Bronk), George B. Kistiakowsky, W. Barry Wood, Jr., and Tracy M. Sonneborn. At 4 o'clock President Kennedy entered from the stage door, bringing with him Jerome Wiesner and President Paz of Bolivia, all three in academic robes. The President finished his speech at 4:30. At the end of the convocation those who were invited walked over to the Pan American Union, where more food and refreshments were provided. The reception by Secretary of State and Mrs. Rusk was limited to foreign delegates and their American escorts.

On Wednesday there was a scientific session in the morning and another in the afternoon, with a donors' luncheon in the tent, in honor of those individuals and corporations that had contributed to the building fund of the Academy. At the same time, the ladies attended a luncheon sponsored by Mrs. Seitz in the Benjamin Franklin room of the Department of State. That evening, the big event was the centennial banquet at the Statler-Hilton Hotel. A seating list both alphabetical and by numbered tables, together with a diagram, had been printed and was distributed to the members and guests preceding the dinner, which was attended by more than 750 persons. Dr. Bronk, the toastmaster, called upon four leaders of science and education to speak on behalf of the academies of science, the universities, the learned societies of the United States, and international organizations of science.

On Thursday, members of the Academy, delegates, and guests were given opportunity to visit the scientific institutions of their choice in the Washington area, and in the late afternoon to visit Mount Vernon after the tourists had departed. The Mount

Vernon trip was taken by 75 people, who watched President Seitz place a wreath in the tomb of George Washington and met in the mansion the regent of the Mount Vernon Ladies Association, which is responsible for the care and management of the estate.

A tremendous effort was made by some of the younger members of the staff to cause the events described above to run smoothly and pleasantly. I should like to mention particularly the transformation of the first floor of the Academy into a beautiful reception area. The floor of the Great Hall was sanded and thoroughly cleaned, oriental rugs were laid in the hall, and comfortable furniture was installed. Flowers were placed in suitable locations. The Lecture Room was converted into a coffee lounge with tables where people could sit and talk at any time. The Board Room became a center for the ladies and their activities. The Library was devoted to the exhibition of greetings brought by the delegates, and to other exhibits significant in the development of science during the past century. In the Reading Room was a fine display of selected publications of the Academy-Research Council. The charter of the Academy and its medals were at last displayed with adequate illumination. In the halls and elsewhere were display cases showing holograph selections of notes and letters of famous scientists. At night the Academy building was illuminated by floodlights.

After the event, I felt happy to have played a small part in it, both as host and as guest. When the Washington Academy of Sciences holds its centennial in 1998, I shall not be here.

—Frank L. Campbell



Academy Proceedings

BYLAWS OF THE WASHINGTON ACADEMY OF SCIENCES

(Last Revised in September 1963)

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: members, fellows 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.

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.

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.

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.

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.

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.

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.

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.

Section 11. Former members or fellows who resigned in good standing may be reinstated upon application to the Secretary and approval by the Board of Managers. No reconsideration of the applicant's qualifications need be made by the Membership Committee in these cases.

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 the 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.

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.

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

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 reinstatement.

ARTICLE IV—OFFICERS

Section 1. The officers of the Academy shall be a President, a President-elect, a Secretary, and a Treasurer. All shall be chosen from resident fellows of the Academy.

Section 2. The President shall appoint all committees and such non-elective officers as are needed 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 Presi-

dent-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. An Editor shall be in charge of all activities connected with the Academy's publications. He shall be nominated by the Executive Committee and appointed by the President for an indefinite term subject to annual review by the Board of Managers. The Editor shall serve as a member of the Board.

Section 7. An Archivist may be appointed by the President. If appointed, he 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.

Section 8. All officers and chairmen of standing committees shall submit annual reports at the January meeting of the Board of Managers.

Section 9. 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 10. 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 or more, will not be counted. The Committee of Tellers shall count the votes and report the results at the annual meeting of the Academy.

Section 11. 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, and the Editor. 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. 9). 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, Sect. 10, 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—COOPERATION

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
Washington Section of Institute of Food Technologists
Baltimore-Washington Section of the American Ceramic Society
Washington-Baltimore Section of the Electrochemical 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 Delegate to the Academy who is a resident member or fellow of the Academy.

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 roll call, and the complete roll call shall be entered in the minutes of the meeting.

ACT OF INCORPORATION OF THE WASHINGTON ACADEMY OF SCIENCES

We, the undersigned, persons of full age and citizens of the United States, and a majority being citizens of the District of Columbia, pursuant to and in conformity with sections 545 to 552, inclusive, of the Revised Statutes of the United States relating to the District of Columbia, as amended by an Act of Congress entitled "An Act to amend the Revised Statutes of the United States relating to the District of Columbia and for other purposes," approved April 23, 1884, hereby associate ourselves together as a society or body corporate and certify in writing:

1. That the name of the society is the WASHINGTON ACADEMY OF SCIENCES.
2. That the term for which it is organized is nine hundred and ninety-nine years.
3. That its particular business and objects are the promotion of science, with power:
 - a. To acquire, hold, and convey real estate and other property and to establish general and special funds.
 - b. To hold meetings.
 - c. To publish and distribute documents.
 - d. To conduct lectures.
 - e. To conduct, endow, or assist investigation in any department of science.
 - f. To acquire and maintain a library.
 - g. And, in general, to transact any business pertinent to an academy of sciences.

4. That the affairs, funds, and property of the corporation shall be in general charge of a Board of Managers, the number of whose members for the first year shall be nineteen, all of whom shall be chosen from among the members of the Academy.

Witness our hands and seals this 18th day of February, 1898:

(Signed) J. R. Eastman
F. W. Clarke
C. K. Gilbert
Arnold Hague
L. O. Howard
W. J. McGee
C. Hart Merriam

J. W. Powell
Geo. M. Sternberg
H. N. Stokes
Charles D. Walcott
Lester F. Ward
Frank Baker
Bernard R. Green

BOARD OF MANAGERS MEETING NOTES

October Meeting

The Board of Managers held its 558th meeting on October 8 at the National Academy of Sciences, with President Van Evera presiding.

The minutes of the 557th meeting were approved with minor corrections.

Announcements. Dr. Van Evera introduced J. Murray Mitchell, who is replacing Morris Tepper as delegate from the American Meteorological Society, and George Dickson, who is replacing Gerhard M. Brauer as delegate from the International Association for Dental Research. He also announced that Martin A. Mason would replace Carl I. Aslakson as representative of the Washington Society of Engineers.

Dr. Van Evera announced that in recent mail balloting, the membership had ratified the proposed revision of Article IV of the ByLaws, by a vote of 402 *for* and 4 *against*; also, that affiliation of the Washington-Baltimore Section of the Electrochemical Society had been approved by a vote of 402 *for* and 2 *against*.

Meetings. Chairman Robbins reported that the program for the regular meeting of October 17 would consist of a debate on the subject, "The Nature of the Lunar Maria," between Ralph B. Baldwin and John A. O'Keefe, at the Carnegie Institution auditorium. On November 21, in the Cosmos Club assembly hall, I. E. Wallen, assistant director for oceanography at the National Museum, would speak on the International

Indian Ocean Expedition. And on December 19, at the Naval Observatory, William Markowitz would discuss "Timekeeping: Two Centuries after Harrison," preceded by an open house to view Harrison's Timekeeper No. 4 and modern timekeepers.

Membership. In the absence of Chairman Hobbs, Dr. McPherson announced that the Committee had one application for fellowship and eight for membership, which would be presented at the November meeting of the Board.

Grants-in-aid. Chairman McPherson presented two proposals for grants-in-aid, as follows: Howard Ozer, \$131.90 for a study of the effects of pesticides on fish; and James Steakley, \$38.30 for continuation of an investigation on salamanders. Both grants were approved by the Board.

Treasurer. Treasurer Henderson reported (1) balances of \$6,171.83 for the Academy, \$1,171.83 (plus savings) for the Junior Academy, and \$6,256.20 for the Joint Board; (2) that he would consider with the Executive Committee a culling of the list of those who receive the Journal free, including some out-of-town emeritus members; (3) that the Academy office had been moved from the first floor of the Carnegie Institution to larger quarters on an upper floor; and (4) that forms had been prepared for presentation to the Internal Revenue Service, to establish income tax exemption status for the Academy.

Editor. Editor Detwiler announced that the September (directory) issue of the Journal had been printed and was in the mail. He distributed advance copies to the

Board, and discussed the features of the directory. He explained that the directory was not intended to answer all questions concerning members and fellows, but only to indicate where each works and his field of scientific interest. Also, this issue should be considered a pilot issue to determine the practicability of issuing a joint directory at a reasonable cost. Cost figures would not be available until the November Board meeting, at which time it should be possible to consider what contributions to the cost would be appropriate from the Academy's four affiliates whose membership directories were included in this issue (Entomological Society of Washington, Botanical Society of Washington, International Association for Dental Research, and Institute of Food Technologists).

Mr. Detwiler also stated that the revised Bylaws would be printed in the October issue of the Journal. The secretary and treasurer indicated an interest in having a supply of reprints of the Bylaws.

New business. Dr. Van Evera indicated that he would discuss with the Executive Committee the idea of holding the monthly Board meetings on the same night as the general Academy meetings, before dinner.

Secretary Irving brought up the case of Leo Friedman, who was elected a fellow of the Academy on June 4, 1962, but because of unusual circumstances did not pay his dues until recently, well after the three-month deadline mentioned in the Bylaws. The Board agreed that under the circumstances, Dr. Friedman should be considered as fully elected to fellowship.



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 L. PARADISO
Chemical Society of Washington	LEO SCHUBERT
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	MARTIN A. MASON
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	GEORGE DICKSON
Institute of the Aerospace Sciences	FRANCOIS N. FRENKIEL
American Meteorological Society	J. MURRAY MITCHELL, JR.
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
American Ceramic Society	J. J. DIAMOND
Electrochemical Society	Delegate not appointed

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

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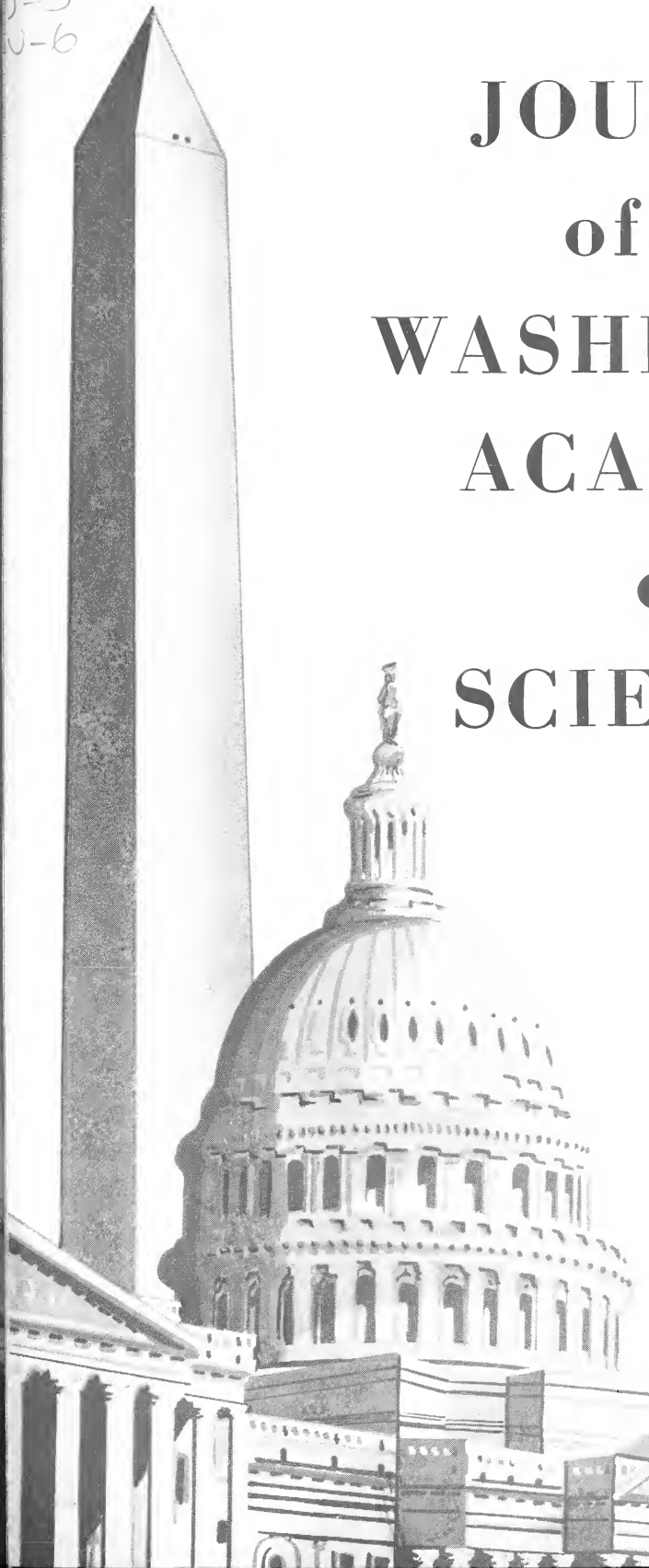
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JOURNAL OF THE WASHINGTON ACADEMY OF SCIENCES

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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.

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New Values for the Physical Constants*

Recommended by NAS-NRC

A new, consistent set of values for the physical constants has been recommended by the Committee on Fundamental Constants of the National Academy of Sciences-National Research Council. The work of this committee is a continuation of the work of an earlier NAS-NRC committee.

The National Bureau of Standards has adopted these values for use in all NBS publications, except where for some special reason the author is required to use others. No doubt these constants will have additional wide use. It is anticipated that the International Union of Pure and Applied Chemistry and the International Union of Pure and Applied Physics will encourage their employment on an international basis.

Previous to this action of the NAS-NRC Committee, several lists of "best values" for the physical constants were available. The current issue of the Smithsonian physical tables, for example, lists three separate sets of values. The individual research worker is then forced to make a choice as to which list he is going to follow.

Uniformity and consistency in the use of such values are necessary for an adequate exchange of information among scientists. For example, the Faraday constant is given by $F = N_{\Delta}e$. Different values for all three of these constants appear in the various tables, but in order to satisfy the equation it is necessary that all values be taken from the same consistent set.

The members of the NAS-NRC Committee are J. A. Bearden, E. R. Cohen, J. W. M.

* A Summary Technical Report (STR-2927) of the National Bureau of Standards, prepared as a preprint of an article in the October 1963 issue of the NBS Technical News Bulletin.

DuMond, L. P. McCullough, N. Ramsey, F. D. Rossini, J. S. Thomsen, G. Waddington, and Alvin G. McNish, chairman. Many of these individuals have been very active in the development of consistent sets of constants over the past few years.

The Committee reports: "In arriving at these values the Committee had available a large amount of experimental information not all of which appeared to be of consistent reliability and accuracy. In some cases where experiments were suspected of having significant errors and the results were discrepant with other experimental results believed to be of greater reliability, the data were rejected. Inclusion of these rejected data would have altered the values in the table somewhat but not greatly."

The results of several recent experimental researches of the National Bureau of Standards have been of great importance in establishing the new values. These were the new determinations of the gyromagnetic ratio, of the electrochemical equivalent of silver, the relative abundance of the isotopes of silver, and the value of the absolute ampere. A full report of the calculations and considerations entering into this new set of values was discussed by J. W. M. DuMond and E. R. Cohen at the Second International Conference on Nuclidic Masses in Vienna, in July 1963 (to be published in the Conference Proceedings).

The new values of the constants are given in Table 2. The uncertainties assigned represent established limits of error; namely, three standard errors based on standard deviations assigned to the data retained for input to the least-squares adjustment. Those calculated from the residuals of the

final least-square adjustment are even smaller. It is therefore unlikely that the true value of any of the constants differs from the value given in the table by as much as the stated uncertainty. The uncertainties in constants computed from elemental ones may be either greater or less than is obtained by a simple combination of the elemental uncertainties because of the correlation among the elemental constants introduced by the least-squares adjustment (see ref. DuMond and Cohen). The values are based upon the assumption

that the acceleration of gravity is correctly given by adding -0.013 gal to the value of g given in the Potsdam system. All the values unified where pertinent are referred to the system of atomic masses in which the atomic mass of the atom of the nuclide ^{12}C is assigned the numerical value 12 exactly. Symbols recommended by the Commission on Symbols, Units, and Nomenclature (SUN Commission) of the International Union of Pure and Applied Physics are employed. (See June 1962 *Physics Today*.)

TABLE 1. *Defined values and equivalents*

Meter.....	(m)	1 650 763.73 wavelengths in vacuo of the unperturbed transition $2p_{10}-5d_5$ in ^{86}Kr
Kilogram.....	(kg)	mass of the international kilogram at Sèvres, France
Second.....	(s)	1/31 556 925.974 7 of the tropical year at 12 ^b ET, 0 January 1900
Degree Kelvin.....	(°K)	defined in the thermodynamic scale by assigning 273.16 °K to the triple point of water (freezing point, 273.15 °K=0 °C)
Unified atomic mass unit.....	(u)	1/12 the mass of an atom of the ^{12}C nuclide
Mole.....	(mol)	amount of substance containing the same number of atoms as 12g of pure ^{12}C
Standard acceleration of free fall.....	(g_n)	9.806 65 m s ⁻² , 980.665 cm s ⁻²
Normal atmospheric pressure.....	(atm)	101 325 N m ⁻² , 1 013 250 dyn cm ⁻²
Thermochemical calorie.....	(cal _{th})	4.1840 J, 4.1840×10 ⁷ erg
International Steam Table calorie.....	(cal _{IT})	4.1868 J, 4.1868×10 ⁷ erg
Liter.....	(l)	0.001 000 028 m ³ , 1 000.028 cm ³ (recommended by CIPM, 1950)
Inch.....	(in.)	0.0254 m, 2.54 cm
Pound (avd.).....	(lb)	0.453 592 37 kg, 453.592 37 g

TABLE 3. *Energy conversion factors*

	Formula	Factor	Error limit	Conversion			
				Système International (MKSA)		Centimeter-gram-second (CGS)	
Electron-volt.....	eV	1. 60210	7	×10 ⁻¹⁹	J(eV) ⁻¹	×10 ⁻¹²	erg(eV) ⁻¹
Energy associated with							
Unified atomic mass unit.....	c^2/Ne	9. 31478	15	10 ⁸	eV u ⁻¹	10 ⁸	eV u ⁻¹
Proton mass.....	$m_p c^2/c$	9. 38256	15	10 ⁸	eV m_p^{-1}	10 ⁸	eV m_p^{-1}
Neutron mass.....	$m_n c^2/c$	9. 39550	15	10 ⁸	eV m_n^{-1}	10 ⁸	eV m_n^{-1}
Electron mass.....	$m_e c^2/c$	5. 11006	5	10 ⁵	eV m_e^{-1}	10 ⁵	eV m_e^{-1}
Cycle.....	e/h	2. 41804	7	10 ¹⁴	Hz(eV) ⁻¹	10 ¹⁴	s ⁻¹ (eV) ⁻¹
Wavelength.....	ch/c	1. 23981	4	10 ⁻⁶	eV m	10 ⁻⁴	eV cm
Wave number.....	c/ch	8. 06573	23	10 ⁵	m ⁻¹ (eV) ⁻¹	10 ⁵	cm ⁻¹ (eV) ⁻¹
°K.....	e/k	1. 16049	16	10 ⁴	°K(eV) ⁻¹	10 ⁴	°K(eV) ⁻¹

TABLE 2. Adjusted values of constants

Constant	Symbol	Value	Est. † error limit	Unit			
				Système International (MKSA)		Centimeter-gram-second (CGS)	
Speed of light in vacuum.....	c	2.997925	3	$\times 10^8$	$m\ s^{-1}$	$\times 10^{10}$	$cm\ s^{-1}$
Elementary charge.....	e	1.60210	7	10^{-19}	C	10^{-20}	$cm^{1/2}g^{1/2}\ s^{-1}\ *$
		4.80298	20			10^{-10}	$cm^{3/2}g^{1/2}s^{-1}\ †$
Avogadro constant.....	N_A	6.02252	28	10^{23}	mol^{-1}	10^{23}	mol^{-1}
Electron rest mass.....	m_e	9.1091	4	10^{-31}	kg	10^{-28}	g
		5.48597	9	10^{-4}	u	10^{-4}	u
Proton rest mass.....	m_p	1.67252	8	10^{-27}	kg	10^{-24}	g
		1.00727663	24	10^0	u	10^0	u
Neutron rest mass.....	m_n	1.67482	8	10^{-27}	kg	10^{-24}	g
		1.0086654	13	10^0	u	10^0	u
Faraday constant.....	F	9.64870	16	10^8	C mol ⁻¹	10^9	$cm^{1/2}g^{1/2}mol^{-1}\ *$
		2.89261	5			10^{14}	$cm^{3/2}g^{1/2}s^{-1}mol^{-1}\ †$
Planck constant.....	h	6.6256	5	10^{-34}	J s	10^{-27}	erg s
	h	1.05450	7	10^{-34}	J s	10^{-27}	erg s
Fine structure constant.....	α	7.29720	10			10^{-3}	
	$1/\alpha$	1.370388	19			10^2	
	$\alpha/2\pi$	1.161385	16	10^{-3}		10^{-3}	
	α^2	5.32492	14	10^{-5}		10^{-5}	
Charge to mass ratio for electron	e/m_e	1.758796	19	10^{11}	C kg ⁻¹	10^7	$cm^{1/2}g^{-1/2}\ *$
		5.27274	6			10^{17}	$cm^{3/2}g^{-1/2}s^{-1}\ †$
Quantum-charge ratio.....	h/e	4.13556	12	10^{-15}	J s C ⁻¹	10^{-7}	$cm^{3/2}g^{1/2}s^{-1}\ *$
		1.37947	4			10^{17}	$cm^{1/2}g^{1/2}\ †$
Compton wavelength of electron...	λ_C	2.42621	6	10^{-12}	m	10^{-10}	cm
	$\lambda_C/2\pi$	3.86144	9	10^{-13}	m	10^{-11}	cm
Compton wavelength of proton....	$\lambda_{C,p}$	1.32140	4	10^{-15}	m	10^{-13}	cm
	$\lambda_{C,p}/2\pi$	2.10307	6	10^{-16}	m	10^{-14}	cm
Rydberg constant.....	R_∞	1.0973731	3	10^7	m ⁻¹	10^8	cm ⁻¹
Bohr radius.....	a_0	5.29167	7	10^{-11}	m	10^{-9}	cm
Electron radius.....	r_e	2.81777	11	10^{-15}	m	10^{-13}	cm
	r_e^2	7.9398	6	10^{-30}	m ²	10^{-26}	cm ²
Thomson cross section.....	$8\pi r_e^2/3$	6.6516	5	10^{-29}	m ²	10^{-25}	cm ²
Gyromagnetic ratio of proton.....	γ	2.67519	2	10^8	rad s ⁻¹ T ⁻¹	10^8	rad s ⁻¹ G ^{-1}\ *}
	$\gamma/2\pi$	4.25770	3	10^7	Hz T ⁻¹	10^8	s ⁻¹ G ^{-1}\ *}
(uncorrected for diamagnetism, H ₂ O)	γ'	2.67512	2	10^8	rad s ⁻¹ T ⁻¹	10^8	rad s ⁻¹ G ^{-1}\ *}
	$\gamma'/2\pi$	4.25759	3	10^7	Hz T ⁻¹	10^8	s ⁻¹ G ^{-1}\ *}
Bohr magneton.....	μ_B	9.2732	6	10^{-24}	J T ⁻¹	10^{-21}	erg G ^{-1}\ *}
Nuclear magneton.....	μ_N	5.0505	4	10^{-27}	J T ⁻¹	10^{-24}	erg G ^{-1}\ *}
Proton moment.....	μ_p	1.41049	13	10^{-26}	J T ⁻¹	10^{-23}	erg G ^{-1}\ *}
	μ_p/μ_N	2.79276	7	10^0		10^0	
(uncorrected for diamagnetism, H ₂ O)	μ'_p/μ_N	2.79268	7	10^0		10^0	
Anomalous electron moment corr.	$(\mu_e/\mu_0) - 1$	1.159615	15	10^{-3}		10^{-3}	
Zeeman splitting constant.....	μ_B/hc	4.66858	4	10^1	m ⁻¹ T ⁻¹	10^{-5}	cm ⁻¹ G ^{-1}\ *}
Gas constant.....	R	8.3143	12	10^8	J °K ⁻¹ mol ⁻¹	10^7	erg °K ⁻¹ mol ⁻¹
Normal volume perfect gas.....	l_0	2.24136	30	10^{-2}	m ³ mol ⁻¹	10^4	cm ³ mol ⁻¹
Boltzmann constant.....	k	1.38054	18	10^{-23}	J °K ⁻¹	10^{-16}	erg °K ⁻¹
First radiation constant ($2\pi hc^2$)	c_1	3.7405	3	10^{-8}	W m ²	10^{-5}	erg cm ² s ⁻¹
Second radiation constant.....	c_2	1.43879	19	10^{-2}	m °K	10^0	cm °K
Wien displacement constant.....	b	2.8978	4	10^{-3}	m °K	10^{-1}	cm °K
Stefan-Boltzmann constant.....	σ	5.6697	29	10^{-8}	W m ⁻² °K ⁻⁴	10^{-5}	erg cm ⁻² s ⁻¹ °K ⁻⁴
Gravitational constant.....	G	6.670	15	10^{-11}	N m ² kg ⁻²	10^{-8}	dyn cm ² g ⁻²

†Based on 3 std. dev. applied to last digits in preceding column. *Electromagnetic system. †Electrostatic system.
C—coulomb J—joule Hz—hertz W—watt N—newton T—tesla G—gauss

Note: In Table 2, the MKSA unit for the first radiation constant (fifth line from bottom) should read 3×10^{-16} instead of 3×10^{-8} .



Enough Life in the Life Sciences?*

Harve J. Carlson

Assistant Director for the Biological and Medical Sciences, National Science Foundation

I am honored that you have asked a scientist-administrator to address you this evening. It has been observed that *scientists* sometimes view scientist-administrators as intellectually second-class citizens, a classification that such people as a group accept with some diffidence. At least, I believe I am safe in saying the majority of this group came up through the ranks of working scientists before they added the administrative duties. True scientist-administrators, however, shortly begin to fall behind in the race to keep abreast of the sweeping advances in even their own special fields of scientific competence, and they freely admit it.

Scientist-administrators in a Federal granting agency have the privilege of viewing a rather broad segment of the on-going scientific activity from a comparative point of view. Perhaps they are looking at the scientific structure from the outside in, whereas the working scientist is looking at it from the inside out. From any angle it is difficult to see any considerable portion of it, of course. As a scientist-administrator myself, let me call attention to a miscellany of the problems that apply particularly to the biological segment of the scientific community—problems that most of us here have to face in one way or another to some degree.

Communication in Science

Warren Weaver, in a notable essay in *Goals for Americans*, writes, "We are just

* An after-dinner address at the annual meeting of the Division of Biology and Agriculture, National Academy of Sciences—National Research Council, in the Assembly Hall of the Cosmos Club, Washington, on April 9, 1963.

in the process of gaining a scientific picture of the total ascent of life. By far more vast and significant than the Darwinian view, this modern evolutionary doctrine begins with the elementary particles of the nuclear physicist and moves through the whole range of the atomic and molecular world up to the nucleic acids which, in their capacity to reproduce pattern and to pass on coded information, seem capable of forming the primitive basis for a living organism. From this point it is conceivable to move on to the gene, the chromosome, the cell, and ultimately human life. Whether or not man is the present climax of this ascent is itself now under question: for we have radar-listening devices, directed at inconceivably distant parts of the cosmos, seeking to determine whether there are other and possibly more advanced beings *there*, trying to communicate with earth-bound man.

"When the sights are set as high as this, the view transcends all the compartments of science. This is not, in any exclusive sense, physics or biology or chemistry or astronomy. This is the whole of science, engaged with a problem of majestic dimensions.

"The sweep and the depth of such a view of matter, man, and the universe fairly suggest what science really is—not a trivial business of tricky hardware, not the phony bubbling retorts of the advertisements, not strange men with white coats or beards, but the response, at once poetic and analytical, of man's creative mind to the challenge of the mystery of matter and life."

We live in the Golden Age of Science, and the impact of the unprecedented worldwide scientific research effort is evident all

about us, from the expanded public awareness of its role in our lives as learned from the daily press and other news media, with their dramatically stepped-up reporting in this field, to the wider sector occupied by science in most phases of human activity, from politics to business, from production to education. The general public often finds it difficult to distinguish between so-called "basic research" and so-called "applied research" or even between *basic research* and *development*. A number of people have trouble distinguishing between science and technology. For them the scientist is a man on a laboratory somewhere, most familiarly in a college or university. But to most people the scientist is a less familiar figure than a merchant or banker or lawyer, and to that extent he is less understood. When a person does meet a scientist it is too often difficult to understand the nature of his work in any detail because the language of the scientist is unfamiliar. Too many scientists have failed to learn how to communicate lucidly with the layman on scientific topics. This is regrettable, but still more harm results to science from the fact that scientists do a poor job of communicating clearly with each other.

The communication problem among scientists becomes the more critical as the volume of publication steadily mounts. To keep abreast of the tide calls for vast amounts of reading and intercommunication. Much of what the scientist takes in is in abstract form and much more he misses altogether. Making the masses of accumulating scientific data machine-retrievable has become the principal concern of increasing numbers of specialists. The difficulties in communication too often show up in research proposals hopefully forwarded by scientists to funding agencies. Carefully chosen reviewers from among the nation's elite in the field of interest of the applicant may find the description of the proposed research unclear or inadequate. One is tempted to question whether a scientist who offers a rather hazy account of

the research program he wishes to pursue can possibly be a good risk for support in the hope that important research results and ideas may follow.

The scientist-administrator has *his* share of difficulties with this communication problem because he is exposed to a sampling of the intricacies of first one area of science, then another, and then still another not only within successive days, but more frequently within the hours of a single day. He never has time to get onto a plane of complete familiarity with many of these, and yet he must do his best to grasp the subject matter sufficiently to be able to make informed judgments on the relative merits of projects and the relative worthiness of investigators as well. He is somewhat in the position of a chief buyer for a large, top-quality department store. He must carry a complete stock of goods, not just a few popular lines, and he makes his selection with a view to satisfying the needs of a varied clientele who demand the best. He knows that certain kinds of goods will command a solid sale season after season, others will be highly popular for a short time. A good buyer takes a number of flyers in novel items that encompass worthwhile novel features in the expectation of a favorable public response, and he must keep on his shelves the out-sizes and extreme designs that will be demanded by only a small fraction of his clientele. Furthermore, he must do all this on a budget, too.

I should like to speak from the point of view of one of the biologist-administrators at the National Science Foundation, showing you how the life sciences look to us at present and how the Biological and Medical Sciences Division of the Foundation contributes to the furtherance of this field. Since we know you share our aims, we should like to see how our assessment agrees with yours, and determine how we can work together to keep the basic research portion of the biological front as a whole moving steadily forward. The biological sciences, even as all the others, are

so completely interconnected and interdependent it is essential that the entire front advance. We should be defeating our own purposes to encourage, or indeed to permit, narrow sub-fields of biology far ahead of all the rest. The biologist-administrator in a Federal granting agency is more than vaguely aware of some responsibilities of this kind that fall to him.

Biology as a Science

The original, now completely outmoded, concept of biology was that it is a purely descriptive science—descriptive, for example, of the kind, form, function, and habitat of organisms. Biology has often been taught, furthermore, as a detailed classification of all those things directly seen or observed through the microscope. But before long biological data were subjected to analysis and reorganization, and they also led to theorizing. Now there appeared a whole new set of life sciences. Relating descriptive material to time led to the theory of evolution and phylogeny; relating it to the surrounding led to ecology, or environmental biology. Consideration of variation and the transmission of characters led to the emergence of genetics, and the organic changes connected with growth, to developmental biology. As biologists began to probe the mysteries of living materials through experiment, the horizons of biology expanded appreciably. Such a discipline as cytology, for instance, has been immeasurably enriched by diverting some of the sole attention from chromosomes and stainable inclusions in the individual cell to the intricate chemical processes going on *in vivo*. The discovery of the function of the nucleic acids, the study of the template mechanism of heredity, the synthesis of biologically important substances, the working out of the pathway of carbon in photosynthesis, and now the inclusion of space biology are among current examples of important contributions to the growing perspective of biology.

One is reminded here of Philip Handler's pertinent observation, "A living cell is a most unlikely object." At the stage of

development of biology we have been discussing, researchers would have agreed willingly with Handler, for they didn't know at all how the structure or the salt gradient of the cell was maintained. To answer such questions, scientists had to turn to the field of biochemistry, and more particularly, metabolism.

Fortunately, the human mind's need to know is boundless, and things, of course did not end here. Having lined out many of the marvellously complicated metabolic pathways, we had to try to find out what intriguing structures or molecules could carry out these reactions. Also, how is a cell wall made up, that it can maintain this unit of life as an entity? One of our newer fields, molecular biology, has provided the opportunity of obtaining answers to such questions.

Now when the fine structure of chromosomes became known, as well as much of the biochemistry related thereto, the geneticists took a new look at their science. Their resultant reorientation has provided us with some of the most exciting scientific news of the recent past. And now the development and regulatory researchers are starting to apply this modern work to their specialties. The results cannot fail to lead to tremendous advances of our understanding of life itself!

Now that the biologist has demonstrated that practically every phase of activity within a living cell is amenable to analysis and understanding, whether it be that of a single-celled organism, a bird, or a spinach leaf, the attractiveness is enhanced of studying the minutiae of the life processes in man himself. Such studies are multiplying rapidly, and we are now able to orient some of our experiments around new techniques recently acquired from physics, mathematics, and even engineering, thus adding new tools to our array for exploring a field of such sophistication that most people have shied away from a real attempt to conquer it. We are witnessing an interesting phenomenon at this time, as mathematical biophysicists, electronic engi-

neers, computer experts, and others with backgrounds in the physical sciences seek opportunities to apply their technical knowledge to biological problems in the living cell—and particularly to problems of human biology.

Many decades of research have shown us that the transformations of energy which occur within the animal body follow the laws that are applicable to the physical world. This achievement has made it possible to understand life itself, in terms of the physical behavior of the materials of which living things are made. We are better able to understand the constant input of energy required for each cell to remain alive, and the forces that prevent that cell, containing macromolecules and concentrations of various salts markedly different from those of the same salts in the fluid outside the cell, from achieving equilibrium with its environment. And we recognize now, in a general way, how chemical energy (originally in carbohydrate and fat) can be used to perform the various kinds of useful work that takes place in the living cell or animal.

Man's achievement, in elucidating the processes within living cells whereby plants and animals work out their different compositions from the relatively few materials which they take up or ingest, is remarkable. This story is now known in its broader outlines, and the main trend of research appears to shift from tracing metabolic pathways and identifying the chemical building blocks of the cell to the complex enzyme story, the organization of the encoded genetic information in DNA and RNA, and how the various proteins that the cell produces accomplish their functions. The principles of all this are becoming increasingly clear. We know that the term "life" as applied to a plant means the same thing as "life" applied to an animal. But though we understand in a fundamental sense how each cell lives, we still must determine how it performs its special functions. The simpler life processes are becoming understood, but we

have a long way to go with something as complex as a nervous system or indeed a brain. Mention of the latter reminds us of the senses and the emotions. Here the psychologists or psychobiologists are very busy, attacking the multiple problems of this vast area from every conceivable approach. Probably the major contributions of the behavioral sciences are still to come far in the future.

Hybrid Disciplines

My random comments on the biological scene lead up to the important recent changes caused by the appearance of new hybrid sciences such as biochemistry, biophysics, cybernetics, and others. It is going to require the attention of phytobiophysicists, for instance, to determine the way in which light energy is transduced into chemistry in the photosynthetic process. These hybrid sciences are built by teams of workers who bring together an assemblage of talent from different disciplines to accomplish a given task or indeed to promote a whole field. The research team is an important scientific development essential to the solution of many of our deeper problems. We are glad we have them. On the other hand, we know it is equally important to preserve the freedom of the imaginative individual worker, so that he can move unhindered down any path where his scientific curiosity leads him. We know so little about the conditions of creativity, we must be sure we do not stifle the budding opportunities for it.

Federal Support for the Life Sciences

Now, have I given you an unbalanced picture of basic research in the life sciences today? By my brief mention of a few highlights, have I left the impression that for biology this is essentially it? I hope not, for if I have, the impression is of course a false one, and this audience is not one to whom I need to point this out. I want you to know that these Washington-based scientist-administrators do take a broader view than that. We know that any move to assign priorities in science or to judge

its worth on the basis of flashy results would be most unwise. It is the advance of science as a whole that we seek.

Biology is a subject of tremendous width and depth and we all must do it justice. I like the following comment from a recent article by George Gaylord Simpson, in which he weighs biology with the physical sciences as follows:

"The life sciences are not only much more complicated than the physical sciences, they are also much broader in significance, and they penetrate much farther into the exploration of the universe than do the physical sciences. They require and embrace the data and *all* the explanatory principles of the physical sciences and then go far beyond that to embody many other data and additional explanatory principles that are no less—that are, in a sense, even more—scientific."

The National Science Foundation, in its Division of Biological and Medical Sciences, reviews requests for support of basic research over the entire gamut of the life sciences that I have mentioned, from biochemistry and biophysics to environmental biology and systematics—from structure to function—from distribution to social behavior and learning. Successful applicants range from Nobel laureates to fledgling Ph.D's, and even to a rare high school teacher.

We recognize the need on the national level of increasing our scientific manpower. Numerous statistics have been cited by speakers and writers to indicate that the nation was slipping in this regard during the last decade. I trust that support of his research through Federal funds has not been a significant factor in some apparent failure on the part of many a research scientist to train an adequate number of replacements of his own kind to meet the nation's needs!

In the National Science Foundation we support not only all aspects of basic research, including conferences, travel to meetings, publication, supply of equipment and assistance, but we also put substantial amounts of money into facilities, such as graduate laboratories, research buildings of all sorts, substantial research tools, oceanographic vessels for marine biology, and other specialized biological facilities. Other extensive programs in the Foundation support training and educational aspects of biology with which I trust you are more or less familiar, but about which we can easily give you more information at another time.

Many sources of funds contribute to the support of science—funds from individuals or groups, private foundations, industry, educational institutions, and local, state, and Federal governments. All represent investments in science—investments that have brought to our society rich returns many times greater than the original cost. We believe in such investment for the future, too, for science will continue to yield a profitable return into the distant future.

In a recent report of the President's Science Advisory Committee one reads this statement: "But we should not emphasize only the material returns of scientific investment. Science yields a return also in the quality and humanity of our civilization. Science is not merely an inducement to progress, it is an affirmation of man's respect for nature and a way to the fulfillment of some of his highest capacities. Science is enriching, but at its best it is much more: it is enlarging to the spirit. This higher value is one we should never leave out of account in our desire to reassure ourselves that science 'pays'."



Molecular Theory of Gas Properties*

Edward A. Mason

Professor of Physics, Institute for Molecular Physics, University of Maryland

The molecular theory of gas properties is a very old subject, which can be traced through the kinetic theory of gases back to the ancient Greeks if one has a mind to do so. Despite its age, the subject still involves many important and interesting problems. This is one of its great charms—that it is still possible to do interesting and useful things in one of the physical sciences without fantastically expensive equipment backed up by an army of technicians. Another great charm of the subject is that it is based on a very simple physical picture—great hordes of molecules dashing wildly in all directions and colliding with one another, but on the average carrying with them some quantity of interest, such as energy, momentum, or mass. This is the molecular picture of the experimental quantities called respectively heat conductivity, viscosity, and diffusion. Although the mathematical analysis at times becomes forbiddingly complicated, this simple physical picture is really always there, more or less hidden by mathematics.

Recently there has been a considerable revival of interest in the molecular theory of gas properties, due no doubt to pressing engineering needs. It is now all too common to encounter gases at extreme conditions of temperature and pressure, and important to have some idea of their properties. Obvious examples would be the gases

in a rocket exhaust, the hot air in the shock wave of a supersonic vehicle, and the gases diffusing through the porous graphite of a nuclear reactor. It is at present too difficult to measure many of the important properties with accuracy, and so one is forced to turn back to the molecular theory.

The key point in the understanding of gas properties is the molecular collisions themselves, which are controlled by the forces between the molecules. The reason is that the collisions force the molecular trajectories into tortuous shapes, and so control the rate of transport. The earliest work pictured molecules as small, rigid elastic billiard balls, but was unable to push the mathematical analysis beyond the point of giving more than rather crude answers. The modern definitive work by Chapman and Enskog in the second decade of this century essentially solved the mathematical problem, but still had to consider all molecules as spherical (even though not rigid) and without internal structure. Strictly, this applies only to gases such as neon and argon.

Recent work has extended this picture in several directions. First, what happens when the molecules are really highly reactive fragments with free valences? These occur in abundance in high-temperature gases, and the forces between them turn out to be quite complex (1). Second, what happens when molecules have "shape"—that is, when the forces depend on the orientation of the molecules? The best example of this behavior comes from the polar gases, which have permanent electric moments (water is the most famous polar molecule) (2). Third, what happens when mole-

* At the annual dinner meeting on February 21, 1963, Dr. Mason received the Academy's 1962 achievement award in the physical sciences, "for his many outstanding contributions to the molecular theory of gas properties." The present brief statement, prepared at the Journal's request, summarizes the status of the field in which the award was given.

cules can change their internal energy of rotation and vibration on collision—that is, when collisions are inelastic? This is obviously closely tied to the problem of molecular shape. The mathematical theory involved gives truly hair-raising formulas that not even the fastest modern computer could handle; but if we fall back on the simple physical picture of molecules in motion and scrutinize the formulas with this in mind, we find that much of the complication in the formulas has no important physical consequences and can be discarded, and the parts that are important can be evaluated by other types of experiments (3).

Finally, it is interesting that many perplexing problems in the diffusion of gases in porous media (catalyst pellets, nuclear reactor materials) can be understood through the kinetic theory of gases by a

simple change in the point of view. If the porous medium is regarded as a cloud of dust particles held fixed in space, we can treat the dust particles as giant molecules and hence just the heaviest component in the gas mixture. This enables the kinetic theory to be taken over wholesale, and provides an explanation of some previously puzzling observations (4).

References

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Academy Proceedings

December Meeting

(477th Meeting of the Washington Academy of Sciences)



- SPEAKER:** WILLIAM MARKOWITZ
Director of the Time Service Division, Naval Observatory
- SUBJECT:** FROM HARRISON NUMBER 4 TO THE ATOMIC CLOCK: 200 YEARS OF TIME-KEEPING
- TIME:** THURSDAY, DECEMBER 19, 1963
7:30 P.M.
- PLACE:** NAVAL OBSERVATORY
Massachusetts Avenue at 34th Street, N.W.

Photograph by courtesy of U. S. Navy.

(From 7:30 to 8:00 p.m. there will be an exhibit of Harrison No. 4 and modern timepieces in the Administration Building and Simon Newcomb Laboratory. Dr. Markowitz will speak in the Auditorium, beginning at 8:15.)

Abstract of Address—In 1759 John Harrison constructed a timekeeper which is perhaps the most famous achievement in horology. Harrison No. 4, as this forerunner of the modern marine chronometer is called, gained for its maker a prize of 20,000 pounds offered by the British Parliament in 1714. This sum, enormous for those days, was paid for solving the very urgent problem of finding longitude at sea. Through a generous loan by the British Admiralty, Harrison No. 4 is on exhibition at the U. S. Naval Observatory, where it is kept running and where it will remain until about February 1964. The succeeding two centuries have seen the development of improved techniques of time measurement, and now the most precise physical measurements that can be made are in the field of time. The Naval Observatory determines three kinds of time—universal, ephemeris, and atomic. The first two are obtained by astronomical observation, the last from the atomic clock. The first precise atomic clock was constructed in 1955 in England. Quartz-crystal clocks have been perfected. They are used along with atomic clocks in the control of transmission of time and frequency of high precision, such as VLF and Loran-C. Time intervals may be measured to 1 part in 10^{12} . Nuclear clocks, such as those derived from radioactive decay of uranium²³⁸ and carbon¹⁴, also have been developed. These provide time scales for dating events that occurred in the recent past as well as those in remote cosmological eras.

The Speaker—William Markowitz was born in 1907. He studied at the University of Chicago, receiving the B.S., M.S., and Ph.D. degrees in astronomy in 1927, 1929, and 1931, respectively. He joined the Time Service Division of the Naval Observatory in

1936 and became its director in 1953. He designed the dual-rate moon camera used in determining the fundamental frequency of atomic clocks. He is the author of numerous scientific articles and of reference articles in encyclopedias. Dr. Markowitz was president of the Commission on Time of the International Astronomical Union, 1955 to 1961, and has been president of the Section on Astronomical and Satellite Geodesy of the International Association of Geodesy since 1960. He is a member of the Study Group for the Definition of the Second of the International Bureau of Weights and Measures, and of the Study Group on Time and Frequency of the International Consultative Committee for Radio. He serves on several study panels of the National Academy of Sciences.

JOINT BOARD ON SCIENCE EDUCATION

Career Conference

The Joint Board's third annual conference on careers in science and engineering was held at the University of Maryland on November 18. Those who attended, about a hundred in number, considered it the most successful of the guidance conferences yet held by JBSE.

The morning session featured a thought-provoking address by Robert J. Lacklen, director of personnel at NASA, on "Factors Affecting Career Choices in Science and Engineering." Mr. Lacklen described efforts made by NASA to correlate both career choice and career satisfactions of its 25,000 employees with such factors as academic records. For example, he described a "biographical inventory" approach that NASA has been sponsoring, that has the highest correlation yet noted. The study will be published in the near future.

The afternoon featured panel discussions on careers in engineering, physical science, and biological science. Panelists and their fields were:

Engineering: Ralph I. Cole, Melpar; Leonard T. Crook, Board of Engineers; F. T. Marvis, Maryland; L. K. Downing, Howard.

Physical Science: W. J. Thaler, Georgetown; R. W. Mebs, NBS.

Biological Science: J. P. E. Morrison, National Museum; I. E. Wallen, National Museum; R. Van Norman, NSF.

Biology Conference

Before this issue reaches its readers, the

Joint Board's annual conference on the teaching of high school biology will have been held at Montgomery Junior College in an all-day session on December 7. The Biological Society of Washington served as cosponsor for the event, and assisted in program arrangements.

The major agenda items were directed toward identifying local resources for biology teaching, and discussion of several important problems of modern biology. To these ends, the following papers were scheduled for presentation:

"Biology in the Smithsonian," by Linda S. Gordon, Smithsonian Institution Services.

"Impact of Man's Chemicals on Biology," by John L. Buckley, Fish and Wildlife Service.

"Backyard Biology," by J. P. E. Morrison, assistant curator in the National Museum.

"Everyday Genetics: How to Present Its Concepts to High School Pupils," by Sumner Burhoe, American University.

Local biology teachers, university instructors, and practicing biologists were invited to attend. As in the case of all JBSE science conferences, ample time was allowed for discussion of the presentations.

New Film Strip Available

The Joint Board office has obtained a film strip and tape recording of the highlights of the 1963 Junior Science and Humanities Symposium. This coordinated program contains excerpts of all addresses presented at the Symposium, and descriptions of the various activities. Running time

is about 30 minutes. It is available on free loan.

The Board also has complete tape recordings of every talk and address presented at the Symposium. While these are not illustrated, it is believed that they will be of interest, especially to the schools of the student speakers.

Additional information on this material may be obtained by calling the JBSE office (NO 7-3661), from 9 a.m. to 1:00 p.m.

New Science Supervisor

The Archdiocese of Washington recently announced the appointment of Rev. John J. McGarraghy as assistant director of education for Catholic schools, with responsibility for supervision of science instruction. He replaces Rev. Francis Heidig, who had served in this capacity since 1958.

Father McGarraghy is no newcomer to the local scene. He was born and educated in Washington, attending Gonzaga High School and Georgetown University. He received the A.B. degree from St. Mary's Seminary in Baltimore, and is currently a candidate for a master's degree at Catholic University. He was ordained during the past year.

Father McGarraghy brings to his new assignment a fresh outlook and a deep appreciation of current problems in science education. Presently he is acquainting himself with the methods, curriculum, and personnel of the departments of science throughout the Archdiocese.

Although assigned to St. Francis de Sales Parish, based at 2021 Rhode Island Ave., N.W., Father McGarraghy will spend most of his time at the Diocesan Educational Headquarters, 1721 Rhode Island Avenue, N.W., where he will carry forward the outstanding work in the field of science education developed by his able predecessor, Father Heidig.

—*John K. Taylor*



WASHINGTON JUNIOR ACADEMY OF SCIENCES

The WJAS Christmas Convention will be held on December 30 at Georgetown University. The program will consist of concurrent lectures in physics, chemistry, biology, and mathematics; a banquet; a slide presentation on the year's activities; and an address by John D. Nicolaides, special assistant to the director of the Office of Space Sciences and Applications.

Membership to Vote On Officers for 1964

The Academy's Nominating Committee, headed by Ralph D. Myers as delegate from the Philosophical Society, met on October 8 to select the following candidates for office in 1964:

For president-elect, Leo Schubert of American University.

For secretary: George W. Irving, Jr. (the present incumbent), of the Agricultural Research Service.

For treasurer: Malcolm C. Henderson (the present incumbent), of Catholic University.

For manager-at-large, 1964-66 (two to be elected): Allen L. Alexander (NRL), Michael Goldberg (retired), Marion W. Parker (USDA), and Francis Reichelderfer (retired).

These candidates, together with any independent nominations that may have been made before December 1, will be voted upon by the membership during December, by mail ballot as usual.

The successful candidates will take office at the close of the annual meeting in January. At this time, current President-elect Francois Frenkiel will automatically assume the presidency.

Previously-elected managers-at-large who will continue in office during 1964 are Russell B. Stevens and Harold H. Shepard (class of 1962-64) and John K. Taylor and Mary L. Robbins (class of 1963-65).

Science in Washington

CALENDAR OF EVENTS

December 10—Washington History of Science Club

Arthur Levine, NASA Goddard Theoretical Space Institute, "A History of U. S. Aeronautical Research Policy, 1915-1958."

Conference Room (105), Archives Building. 6:00 p.m.

December 11—University of Maryland Zoology Colloquium

H. Hoffman, NIH, "Inheritance of Serum Proteins in the Mouse."

Room 405 McKeldin Library, University of Maryland. 4:00 p.m.

December 12—Chemical Society of Washington

Two concurrent lectures. (1) Frank H. Westheimer, Harvard University, "The Mechanism of the Enzymatic Decarboxylation of Acetoacetic Acid." (2) Briggs J. White, FBI Laboratories, "Recent Advances in the Field of Scientific Crime Detection."

Walter Reed Army Institute of Research. 8:15 p.m.

December 12—Entomological Society of Washington

Regular meeting. Speakers: Kenneth D. Quarterman, PHS; William M. Upholt, PHS; and Douglas J. Gould, Walter Reed Hospital. Subject to be announced.

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

December 17—Georgetown University, James Curley Lectures in Science

Rev. Ernan McMullin, University of Notre Dame, "The Limitations of Science."

Gaston Hall, Georgetown University. 8:30 p.m.

Annual Christmas Lectures Announced

The Philosophical Society of Washington has announced that the 12th annual Christmas Lectures for high school and advanced junior high school students and their teachers will be held at Lisner Auditorium, George Washington University, on December 17 and 18 at 8:00 p.m. Richard B. Kershner, head of the Space Division at the Applied Physics Laboratory of Johns Hopkins University, will deliver the lectures.

On December 17 Dr. Kershner will speak on "Artificial Satellites: What Makes Them Work?" He will discuss orbital mechanics, electrical power systems (including solar and nuclear power), thermal problems, Doppler and optical tracking systems, and radiation problems associated with the natural and artificial Van Allen belts.

The second talk on December 18 is entitled, "Artificial Satellites: What Can They Do for Us?" Dr. Kershner will point out that within this decade man can expect to benefit from a global satellite communication system for telephony, long-range radio communications, and worldwide television programming; satellite navigation systems to guide navigators on ships and airplanes; and a network of weather satellites to probe the vagaries of the weather.

Prior to World War II, Dr. Kershner was a mathematics teacher at Wisconsin and Johns Hopkins Universities; and later he engaged in applied research on rockets and missiles. The Navy Department gave him two distinguished public service awards for his contributions to the Terrier Guided-missile Weapon System and the Polaris Intermediate Range Ballistic Missile System. At present he is principally concerned with the development of a

gravity gradient satellite stabilization system, probing the ionosphere, and determining what is the size and shape of the earth.

Tickets for the Christmas Lectures may be obtained free by writing to Mary E. Warga, executive secretary of the Optical Society of America, at 1155 16th St., N.W., Washington 6. A self-addressed stamped envelope should be enclosed with the request.

The arrangements committee for the Christmas Lectures is composed of Albert M. Stone of the Applied Physics Laboratory (chairman); Dr. Warga; Nelson T. Grisamore of George Washington University; Elliott W. Montroll of the Institute for Defense Analyses; and George T. Rado of the Naval Research Laboratory.

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, Federal Center Building, Hyattsville, Md.

AGRICULTURE DEPARTMENT

On October 14, **C. W. Whittaker** was the principal speaker at a dinner attended by members of a slag seminar sponsored by U. S. Steel, and held at the Eutaw Inn near University Park, Pa. Dr. Whittaker spoke on the subject, "Blast Furnace Slag in Agriculture."

R. L. Steere reports that his oldest daughter, Sue, has returned to Michigan for her third year, where she is specializing in chemistry; and that his second daughter, Janet, is in her first year at Oberlin.

A. M. Pommer has been elected to membership in the Royal Society of Health, and to associate membership in the D. C. Section of the Society of Experimental Biology and Medicine. As chairman of the Biochemical Analysis Committee, Instrumental Society of America, he organized a session on air force bio-instrumentation in

the aerospace age at the first National ISA Biomedical Sciences Instrumentation Symposium held at Los Angeles June 18. He is the author of Geological Survey Professional Paper 386-C, "Relation Between Dual Acidity and Structure of H-Montmorillonite," published last July.

Victor R. Boswell spent about a week in late October, in London and other points in southern England, as a member of a team visiting vegetable research and testing stations and participating in a series of conferences with research and control personnel and with commercial seedsmen, vegetable processors, and growers of the United Kingdom on varietal and seed problems of mutual interest to the United States and the United Kingdom.

C. H. Hoffmann, assistant director of the Entomology Research Division, was guest speaker at the annual meeting of the Arizona Agricultural Chemicals Association, held at Scottsdale, Ariz., October 14. He spoke on "New Concepts in Insect Control."

Edward H. Graham, who has been serving as director of plant technology for the Soil Conservation Service, has been appointed special assistant to the administrator for international programs of SCS.

Kenneth A. Haines will be an associate on the U. S. Delegation to an FAO Conference that will be held in Rome, November 16 to December 5.

Erwin L. LeClerc attended the Fifth International Biometrics Conference held at Cambridge University, during the period of September 9-13.

Calvin Golumbic attended the Second National Conference on Wheat Utilization Research in Peoria, Ill., October 28-30.

L. D. Christenson is author of "Tropical Fruit-fly Menace," one of four scientific papers prepared especially for the appendix to the 1962 annual report of the Smithsonian Institution.

CATHOLIC UNIVERSITY

In the summer of 1963, **Arthème A. Dutilly** of CU's Arctic Institute made his

31st botanical exploration in the Arctic and Subarctic. This last trip was an exploration along the Romaine River from Knob Lake, Ungava, to the St. Lawrence Gulf, involving 400 miles by canoe through 70 rapids and 43 portages. Five hundred and thirty sheets of plants were collected. This exploration completed the traverse of Ungava Peninsula, from Fort Chimo, Ungava Bay, to the St. Lawrence Gulf. Reverend Dutilly is the author of two recent CU publications, "Exploration botanique des rivières Swampy Bay et Caniapiscaw" and "Contribution a la Flore du Versant Sud de la Baie James, Quebec-Ontario."

Frank A. Biberstein, professor of civil engineering, is co-author with Associate Professor Michael Chi of a book, "Theory of Prestressed Concrete," recently published by Prentice-Hall.

Paul J. Claffey, professor of civil engineering, presented a paper, "Planning Rapid Rail Service for Intra-urban Service," at the Eleventh Pan American Railway Congress in Mexico City, October 21. On November 6 Dr. Claffey participated in a panel discussion on "The Engineering Characteristics of Modern Rapid Transit Systems," sponsored by the National Capital Section of the American Society of Civil Engineers.

HARRIS RESEARCH LABORATORIES

Anthony M. Schwartz, assistant director, is the recipient of the Society of Cosmetic Chemists Medal Award for 1963. The award was presented to Dr. Schwartz at the annual meeting of the Society in New York City on December 3, for outstanding contributions in the field of cosmetic science.

John Menkart gave a talk on "Morphology and Physical Properties of Keratin Fibers" before the Polymer Topical Group of the Chemical Society of Washington on October 30.

John Krasny and **John Menkart** attended the fall meeting of the Fiber Society in Absecon, N. J., October 23-25.

Lyman Fourt attended the American Society for Testing Materials meeting in New York, October 13-15. Dr. Fourt is chairman of the Subcommittee on Chemical and Performance Tests.

NATIONAL BUREAU OF STANDARDS

Recent talks by staff members have included the following:

R. K. Cook: "The Control of Noise in Homes"—Home Manufacturers Association, Atlanta, Ga.

T. B. Douglas: "The Dropping-Type Calorimeter"—Thermal Conductivity Conference, sponsored by Oak Ridge National Laboratory, Gatlinburg, Tenn.

C. Eisenhart: "Realistic Evaluation of the Precision and Accuracy of Instrument Calibration Systems"—9th Conference on the Design of Experiments in Army Research, Development and Testing, U. S. Army Missile Command, Redstone Arsenal, Huntsville, Ala.

H. J. Keegan: "Absorption Spectra of the First Transition Series in Phosphate Glasses"—Optical Society of America, Chicago, Ill.

J. R. McNesby: "Vacuum Ultraviolet Photochemistry of Hydrocarbons"—Lehigh University, Bethlehem, Pa.

G. A. Moore: "Direct Quantitative Analysis of Microstructures by a Digital Computer"—Computer Applications in Quantitative Metallography, American Society for Metals (World Congress), Cleveland, Ohio.

C. O. Muehlhause: "Proposed Experiment to Observe n-n Scattering"—American Physical Society, Argonne National Laboratory, Argonne, Ill.

G. C. Paffenbarger: "Research and the Saving of Teeth"—American Dental Association, Atlantic City, N.J.

H. E. Robinson: "The Current Status of Thermal Conductivity Reference Standards at the National Bureau of Standards"—Invitational Conference on Thermal Conductivity, Oak Ridge National Laboratory, Gatlinburg, Tenn.

L. S. Taylor: "Radiation Protection in Medical Practice" and "Radiation Hazards in Civil Defense"—Koontz County Civil Defense Organization, Beaumont, Tex.

W. J. Youden: "Picking Winners and Losers"—Allied Chemical Corporation, Morristown, N. J., and Virginia Teachers Association; and "The Evolution of Designed Experiments"—Scientific Computing Symposium Statistics, Thomas J. Watson Research Center, Yorktown Heights, N. Y.

NATIONAL INSTITUTES OF HEALTH

Clem O. Miller has been appointed coordinator of scientific committees for the Food and Drug Administration. Dr. Miller had been executive secretary of the Division of Chemistry and Chemical Technology, NAS-NRC, for the last five years.

An annual award has been established by **Frank J. McClure**, chief of the Laboratory of Biochemistry, National Institutes of Dental Research, to commemorate H. Trendley Dean's renowned contributions in dental research and epidemiology.

Bernard B. Brodie, chief of the National Heart Institute's Laboratory of Chemical Pharmacology, has received the Torald Sollman Award in Pharmacology.

Speakers at the recent Gordon Research Conference on Toxicology and Safety Evaluations included **James A. Shannon**, **Carl R. Brewer**, and **David P. Rall**.

NATIONAL RESEARCH COUNCIL

Paul E. Johnson has been appointed by the Department of Agriculture to the Food Science Mission, composed of six U. S. food scientists and public health experts. It will study food health regulations in Europe in November and December, and will participate in the European-American Symposium on Agricultural Trade at the U. S. Food and Agricultural Exhibition in Amsterdam.

NAVAL RESEARCH LABORATORY

Drs. Isabella and Jerome Karle attended a meeting of the International Union of Crystallography in Rome during September. They discussed the new symbolic addition procedure for phase determination which has been found to be quite simple and rapid. Jerome Karle was *rapporteur* for a session on new methods for phase determination. He is head of the Diffraction Branch, Optics Division.

L. S. Birks is the author of a new book entitled, "Electron Probe Microanalysis," published this year by Interscience Publishers. Mr. Birks is head of the X-ray Optics Branch, Optics Division.

UNIVERSITY OF MARYLAND

J. R. Shakeshaft of Cambridge University is a visiting professor of astronomy for the fall semester of 1963. He is in the United States under the sponsorship of the American Astronomical Society. While here he will teach an advanced course entitled, "Special Topics in Modern Astronomy: Radio Sources."

DEATHS

Frank Lee Howard died October 16 after a brief illness. He was chief of the Pure Substances Section at the National Bureau of Standards, and had been with the Bureau since 1937. During World War II he conducted research to improve aviation gasoline. More recently he had studied jet fuels and the phenomena of combustion. Dr. Howard was born in Pueblo, Colo., but spent most of his life in Hyattsville and Silver Spring, Md. He received the B.S. degree from the University of Maryland in 1934 and the Ph.D. degree from the same university in 1938. In 1949 he was given the Department of Commerce Meritorious Service Award.

SCIENCE AND DEVELOPMENT

An electron probe, designed by the Geological Survey to microanalyze rocks and minerals, is being used to study a human disease. Isidore Adler, designer of the instrument, and A. J. Tousumis, a biomedical researcher at George Washington University, used the probe to map the distribution of copper granules in the cornea of the eye of persons affected with Wilson's disease. In this disease, copper accumulates in excess in the brain, liver, kidney, and around the cornea. The clinician frequently observes the early symptoms of the disease by examining the cornea. Since only a microscopic amount of copper is involved, medical researchers had no accurate method, prior to the probe, for measuring it. Even radioactive tracers were inadequate. The probe uses a magnetically focused beam only one micron

wide. When it strikes a sample surface it causes the emission of X-rays, whose wavelengths characterize the elements present, and whose intensities show the concentrations. The beam is not destructive to tissue, and samples can be analyzed in place.

A reorganization of the Food and Drug Administration was announced on November 2. Scientific functions were upgraded in the reorganization. A new position of associate commissioner, to be filled by a scientist, was created. He will give leadership to the programs and functions concerned with medicine, science, and research. Two new bureaus were established in place of the present Bureau of Biological and Physical Science. One, the Bureau of Scientific Research, will support FDA's basic mission of consumer protection. The other will be the Bureau of Scientific Standards and Evaluation, which will handle safety clearance functions in regard to pesticides, food additives, and colors, and develop scientific data for setting standards and tolerances. Enforcement activities will be consolidated in a single Bureau of Regulatory Compliance. Educational functions will be emphasized by creation of a new Bureau of Education and Voluntary Compliance. All positions involved in the reorganization are in the career Civil Service.

The Geological Survey reports that the water situation in eastern United

States is not as dry as in the 1930's. Although stream flows and wells were lower than normal in October, they were not as low as in previous droughts. The Potomac River above Washington's Chain Bridge had a flow of 890 cubic feet per second in October. This was the lowest October average flow since 1941 and the third lowest for October on record. Two of 14 wells measured in Maryland, in the Potomac River basin, were at record lows, but the others were not as low as in some earlier years.

A new means of detecting staphylococcal poisoning in food has been developed by the Food and Drug Administration. It was reported by Ezra P. Casman and Reginald W. Bennett of FDA's Division of Microbiology at the 91st annual meeting of the American Public Health Association on November 13. The method is scientifically accurate and more rapid and reliable than the expensive animal tests that have been used. Minute quantities of toxin can be detected by the new method. The food sample is prepared in an electric blender and the toxin is extracted in a glass tube containing certain chemicals. The toxin is removed from the chemical and concentrated and identified by applying it with type A antitoxin to a gel medium. The characteristics of the line that is formed where the two meet make positive identification possible.







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 L. PARADISO
Chemical Society of Washington	LEO SCHUBERT
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	MARTIN A. MASON
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	GEORGE DICKSON
Institute of the Aerospace Sciences	FRANCOIS N. FRENKIEL
American Meteorological Society	J. MURRAY MITCHELL, JR.
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
American Ceramic Society	J. J. DIAMOND
Electrochemical Society	Delegate not appointed

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

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