has established by further thermodynamic arguments the existence of several new effects, among them a new kind of electro-motive force in a circuit carrying a current in which the temperature is changing.

In addition to his many contributions to the form and substance of his own special branch, Bridgman has served the broad field of science in a most significant way. His writings on the logical and philosophical foundations of science have given sensible and suggestive answers to many fundamental questions. His development of the idea of operational concepts has clearly played an important rôle in the most recent physical theories. It has been an unusual and gratifying experience to read, from his pen, scientific philosophy that is both philosophical and scientific. Such contributions could perhaps be made only by that rare person who is at the same time a gifted experimenter, an able theorist and a sensible man.

Professor Bridgman, in accepting the award, expressed his great appreciation of the high honor done him by the academy and the Comstock Committee. It was a particular pleasure that the chairman of the committee was Dr. Mason, with whom he had been closely associated in experimental work for the government during the war. He continued:

Dr. Mason has given some idea of the nature of the work already accomplished; it is of interest to indicate what in addition may be expected in the future. With regard to work under high pressure, it appears that there is an enormous amount of fine scale irregularity in the relation between pressure and volume of a number of solid substances, which may perhaps depend on a complicated interchange of electrons between the atoms. Quantum theory is just beginning to be able to handle this sort of thing, and a wealth of new experimental data may be expected to clarify our understanding of the nature of the fundamental processes. Further, there are a number of questions connected with the electrical resistance of conductors which involve measurements under pressures higher than those yet used, and these experiments are now being started.

Most of the work has been in a field not fashionable at present. This field is to be broadly characterized as concerned with the properties of matter in bulk, as opposed to the properties of matter on a small scale, atoms and electrons, with which most physicists are at present occupied. It is entirely proper that activities should be mostly concerned with a study of the submicroscopic elements of the physical world, for here are the most interesting problems, and it is here that the deepest insights are to be obtained. But the study of large-scale phenomena is also important, and it is justifiable that at least a few physicists should be occupied with it. There are two very broad purposes which may be furthered by a study of large-scale phenomena, which in principle can not be obtained from small-scale phenomena. In the first place, modern theoretical physics seems committed to the thesis that all large-scale phenomena can be completely understood in terms of the properties of the small-scale elements. A justification for this can be only empirical, and that justification has not yet been given by any means. It is entirely conceivable that large-scale matter might embody properties which the biologists would call "emergent," which can not be predicted from even an exhaustive knowledge of the properties of the isolated elements. We can never be sure of the thesis that there are no "emergent" properties until the explanation of large-scale properties is completely worked out, and for this reason it is important that our knowledge of large-scale properties be as wide as possible. In the second place, the concepts in terms of which we describe small-scale experience are themselves derived from large-scale experience, and it is therefore vital that the concepts be adequate to describe large-scale experience. These concepts were a slow growth and the result of long rumination, continual fitting and adjustment, to insure that the evolving concepts completely corresponded to all the known experimental facts. The later generations forget this slow process of growth, and accept the concepts as they find them. But the discovery of new experimental facts beyond the range of those known when the concept was crystallized should demand the reexamination of the concept to determine whether it is still adequate. Only by being everlastingly self-conscious of the experimental basis of our concepts and the possibility of necessary revision as knowledge of large-scale phenomena broadens, can we be sure that the basis for our theoretical speculations remains sound.

SCIENTIFIC NOTES AND NEWS

RESPONDING to protests against the enforced retirement of Dr. William H. Park from the New York City Health Department, Mayor O'Brien wrote recently to Dr. Park assuring him that he would be continued in service after he reached the retirement age of seventy years on December 30.

THE John Scott Medal of the City of Philadelphia has been awarded to Dr. Frank Conrad, engineer of the Westinghouse Electric and Manufacturing Company, for his research work on radio broadcasting.

THE American Association of State Highway Officials, the American Road Builders' Association and the Highway Research Board of the National Research Council announce the conferring of the George S. Bartlett Award on James H. MacDonald, formerly state highway commissioner of Connecticut and for many years treasurer of the American Road Builders' Association. The presentation will be made at the annual meeting of the Highway Research Board on December 7. Mr. MacDonald was chairman of the original State Highway Commission of Con-

necticut, which was authorized by the Legislature in 1895. On August 30, pursuant to an act of the State Legislature of Connecticut, a tablet commemorating his many years of service was unveiled at a site on Avon Mountain by Governor Wilbur L. Cross. Previous recipients of the award are: In 1931, Thomas H. MacDonald, chief, U. S. Bureau of Public Roads, and in 1932, Arthur N. Johnson, dean of engineering, University of Maryland. The award is in the form of a bronze plaque bearing a likeness of Mr. Bartlett with the words: "George S. Bartlett Award for Outstanding Contribution to Highway Progress."

PROFESSOR CHARLES A. ELLWOOD, head of the department of sociology at Duke University, was elected on October 20 in Geneva president of the International Institute of Sociology for the year 1935–36. Professor P. A. Sorokin, head of the department of sociology at Harvard University, was at the same time elected a vice-president. The institute is made up of two hundred leading sociologists of the world as members, with two hundred associates.

BYRON E. COHN, assistant professor of physics at the University of Denver, has received from the Van't Hoff Foundation a grant of 250 guilders (approximately $100), which he is to use in his study of luminescence.

THE Committee on Scientific Research of the American Medical Association has made a grant to Dr. S. S. Lichtman, of New York City, for the investigation of a new method for the estimation of bile salts in body fluids. The work will be carried out in the laboratories of the Mount Sinai Hospital, New York.

DR. JOHN BEATTIE, associate professor of anatomy in McGill University, has been appointed conservator of the museum and director of research of the Royal College of Surgeons, London, in succession to Sir Arthur Keith.

JOHN D. COFFMAN has been appointed chief forester of the newly established branch of forestry in the Office of National Parks, Buildings and Reservations in the Department of the Interior. For the past five years Mr. Coffman has been fire control expert of the National Park Service, with headquarters in Berkeley, California. For nineteen years previous to that he was a member of the U. S. Forest Service, the last twelve years of that time serving as supervisor of the California National Forest, now named the Mendocino National Forest. Mr. Coffman has been in Washington since early last April, assisting the former director Horace M. Albright and later director Arno B. Cammerer in the administration of the emergency conservation program in the national parks and monuments from the beginning of that program.

THE appointment of Henry W. Nichols as acting curator of the department of geology at the Field Museum of Natural History has been announced. Mr. Nichols was long associated with the late Dr. Oliver C. Farrington, curator of geology, who died on November 2. Mr. Nichols joined the museum staff in 1894, and during the early years of the institution served as curator of economic geology. Later, when the various divisions were consolidated into a single department of geology, he remained as associate curator. He has participated in and led a number of the museum's expeditions. In his most important field work he covered the greater part of South America collecting geological material.

RICHARD KILBOURNE, forester for the Extension Service of the University of Maryland during the last three years, has resigned to become assistant chief of planting in the forestry department of the Tennessee Valley Authority at Knoxville.

PAUL J. DAUGHENBAUGH, of the chemical research staff of the Graduate School of Yale University, has accepted a position as research chemist in the chemical research department of the Sharp and Dohme Laboratories, Philadelphia.

DR. DAVID WEEKS, associate professor of agricultural economics in the University of California and founder of the California Economic Research Council, again has been elected to the chairmanship of the organization for the ensuing year. Associated with him in the management of the program for this year are Dr. Carl Alsberg, Stanford University, and Herbert F. Ormsby, California State Chamber of Commerce, as vice-chairman and secretary, respectively. The council is setting up machinery to aid the Central Statistical Board in coordinating economic statistical data of value to economic planning.

THIRTEEN fellowships in medicine, including two renewals, for study in the United States and Europe during 1933–1934, were awarded at the fall meeting of the Medical Fellowship Board of the National Research Council, Washington, D. C., of which Dr. G. Carl Huber, dean of the Graduate School at the University of Michigan, is chairman. A list of the successful candidates follows: John A. Calhoun, Louis H. Cohen, Knox H. Finley, Smith Freeman, Champ Lyons, Edward J. G. McGrath, Carl V. Moore, Edgar J. Poth (renewal), Boris B. Rubenstein, Albert B. Sabin, Robert D. Stiehler, William Trager and Julius White (renewal). The spring meeting of the Medical Fellowship Board will be held in March, 1934, and applications to be considered at that time should be filed on or before February 1.

THE congregation of the University of Oxford has decreed to pay to Professor Arthur Thomson an annuity of £800 on his retirement from Dr. Lee's pro-

fessorship of anatomy. A. H. Smith, fellow of New College, in proposing the decree, said it related to a professor under the old statutes and in whose case, when he retired, it was necessary to provide a pension, since he did not come under the superannuation scheme. The object of the decree was to ensure that, when the time of Professor Thomson's retirement arrived, he should not be hampered by lack of adequate provision for a pension.

JASON R. SWALLEN, assistant agrostologist in the Bureau of Plant Industry, sailed on November 22 for Pará, Brazil. He will spend six months collecting and studying grasses in the states of Pará, Maranhão, Piauhy, Ceara and Rio Grande do Norte.

DR. I. A. GALLOWAY, from the Hall Institute of Research in Pathology, Sydney, Australia, is visiting the United States.

DR. ERICH WASMUND, professor of geology at the University of Kiel, has been studying the equipment and methods of the Scripps Institution of the University of California. Dr. Wasmund is about to organize at Kiel, on the shores of the Baltic Sea, connected with the North Sea by the Kiel Canal, the first oceanographic institution in Germany at which are carried on all lines of oceanographic study, such as marine biology, chemistry, physical hydrography and geology.

DR. WILLIAM WALLACE CAMPBELL, president of the National Academy of Sciences, president emeritus of the University of California and director emeritus of the Lick Observatory, was the principal speaker at the annual Carnegie Day exercises of the Carnegie Institute of Technology on November 28.

DR. ROSCOE WILFRED THATCHER, formerly president of the Massachusetts State College, Amherst, and since 1933 research professor of agricultural chemistry, was a guest lecturer at the University of Missouri on November 17. He spoke on a proposed classification of the chemical elements with respect to their functions in the nutrition of plants.

F. TRUBEE DAVISON, president of the American Museum of Natural History, will give a lecture at the museum on December 5, at 8:15 P. M., on "Collecting in Africa for the Akeley Memorial Hall."

PROFESSOR GEORGE GRANT MACCURDY, of Yale University, director of the American School of Prehistoric Research, lectured before the Brown University Chapter of Sigma Xi on November 28, his subject being "Progress in Prehistoric Research."

AT its meeting on November 23, the Geological Society of Chicago was addressed by Dr. W. H. Collins, director of the Canadian Geological Survey, on "The Behavior of Some Basic Magmas."

THE ninth annual Norman Lockyer Lecture, established by the British Science Guild as a means of periodically directing the attention of the public to the influence of science upon human progress, was given on November 23 by Professor E. V. Appleton, Wheatstone professor of physics in the University of London, on "Empire Communication." Professor Appleton also gave the first of the Friday evening discourses at the Royal Institution, speaking on the work of the second International Polar Year, 1932–33.

AN Associated Press dispatch reports that the Japanese cabinet has announced the acceptance of an offer of the Rockefeller Foundation to donate 4,000,000 yen (about $1,240,000) for the establishment of an Institute of Public Health in Tokyo, for the training of hygiene workers. The negotiations with the government are said to have been begun twelve years ago.

THE annual meeting of the American Society for Testing Materials will be held from June 25 to 29, 1934, at Atlantic City.

Industrial and Engineering Chemistry calls attention to the fact that the nomination of candidates for the fourth American Chemical Society Award in Pure Chemistry, initiated by A. C. Langmuir, must be in the hands of the secretary of the society on or before January 5, 1934.

THE Achema VII Exhibition of Chemical Apparatus and Plant, Cologne, to be held from May 18 to 27, simultaneously with that of the German Chemical Trades Association and other leading trades associations and technical societies, will deal with exhibits of an unusually wide range. A number of conferences, scientific and technical lectures, special visits, courses for students, conducted tours through the "Achema" and other parts of the exhibition, have been arranged.

THE *Experiment Station Record* reports that under a new plan adopted by the board of governors of West Virginia University the divisions of the College of Agriculture will be reorganized under a single administrative head. All resident teaching of agricultural students, farm research and extension work will be coordinated under the direction of Dr. F. D. Fromme, dean of the college and director of the station, who now also becomes director of the extension division. J. O. Knapp, district county agent for the southern counties, has been appointed assistant director of extension; Russell H. Gist, district agent for the northern counties, state leader of county agents, and C. H. Hartley, formerly assistant director of extension, state leader of boys' and girls' club work. Offices for these officials will be maintained in Mor-

gantown. It is hoped by this plan so to reduce the costs of administration of the extension program that a larger portion of the funds may be devoted to the work in the counties, while the work of the college will become more closely knit with the research and on the extension program of the university. Reorganization in the field of biology has also been undertaken. Where formerly the various branches of this subject were distributed among several colleges of the university, most phases are now being coordinated under a single directing head and combined into one division of the College of Agriculture. Dr. C. R. Orton, formerly head of the department of plant pathology, has been given charge of the new department, which embraces all basic sciences related to biology, including botany, zoology, bacteriology, plant diseases and forestry extension.

A COLLECTION of invertebrate fossils, ranging from the Cambrian period to the Cretaceous has been received at Field Museum of Natural History as a result of a field trip recently completed in Pennsylvania, New Jersey and New York by Sharat K. Roy, assistant curator of invertebrate paleontology.

DISCUSSION

LIGHTNING PROTECTION FOR TREES

THERE is a wide difference of opinion as to the value of the lightning rod as a protective device. In my own experience I have been called on a number of times for advice as to the probable value of lightning protection for buildings of various types. My recommendations have not always been the same, and in each case have been based largely on common sense as related to the following principles and observations, upon which I believe that scientists are generally agreed:

(1) The protective value of a lightning rod is in its ability to discharge continuously and so prevent an abnormal rise of potential gradient as related to an overhead cloud.

(2) Preeminent height of a structure results in a high potential gradient at its top.

(3) The points of a lightning rod should be relatively sharp to permit steady leak and suppression of the high potential gradient.

(4) Congested areas, with many buildings of approximately the same height as in cities, have been observed to be relatively free from direct lightning strokes.

The lightning rod is not a certain preventive of a direct stroke. The protective value is directly related to the rate at which the rod points discharge. If the rate of discharge is not sufficiently rapid to suppress the building up of the potential gradient, the rod will often receive the direct stroke. If the structure bearing the rod is sufficiently high, it may even seriously influence the over-all potential gradient due to the cloud, and so receive a direct stroke, thereby actually "attracting" lightning. It is my understanding that during thunder storms there is always copious evidence, both at the Washington Monument and the Empire State Building, of steady discharges from the lightning rods, and frequently there are direct strokes.

The problem in connection with the protection of trees is even more obscure. This question was presented to me a number of years ago by Mr. H. Stevenson Clopper, a well-known arborist in Maryland. Maryland has a large number of very fine trees, some of them having historic interest and association. Mr. Clopper has a wide knowledge of them. I suggested to him the simple type of installation described in the following paragraphs. This note is to give the results of its usage over a period of seventeen years.

A 5/16 inch seven-strand bare copper conductor is attached to the tree trunk by galvanized or copper nails and is extended as nearly as possible in a straight line from the ground to the highest point of the principal leader of the tree which may be safely reached by the climber. At this point it is clamped to a 4 inch limb by means of a through bolt. Some 15 inches of the conductor above the clamp are untwisted with the strands pointing diagonally upward in all directions. In cases of large trees with several leaders, the conductor is carried to the extremity of each, the several conductors being joined in good electrical connection where the leaders converge. At the ground the conductor passes into a 3/4 inch iron pipe 11 feet long and this pipe is driven 11 feet into the ground. The conductor is rigidly attached to the pipe mechanically at the bottom and is soldered to the top at the ground level. In certain cases, owing to the size and number of tree roots, the ground pipe has been placed 11 feet away from the base of the trunk. In these cases the horizontal run of the conductor is also enclosed in iron pipe and buried a few inches below the ground level. The essential elements of the plan are simply those of providing an electrical conductor with pointed ends as near as possible to the top of the tree and running in as nearly as possible a straight line to a good connection with the earth.

The first installation was in 1916 on four large