SCIENCE

VOL. 87 FRIDAY, APRIL 1, 1938 No. 2257

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal
Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

PANDEMIC BOTANY[1]

By Dr. C. STUART GAGER

DIRECTOR, BROOKLYN BOTANIC GARDEN

IN his "Life and Letters of Sir Joseph Dalton Hooker," Leonard Huxley tells us that early in 1867 Sir Joseph "was urged" to accept nomination at the next meeting of the British Association for the presidency for 1868. Whether any American botanist ever had to be "urged" to accept the presidency of the Botanical Society of America "deponent sayeth not." In fact, there is no historical record that any such method of securing a president for this society was ever tried. The method is that of the botanist in search of material for study. He goes out into a field of unsuspecting plants, seizes the one he wishes, puts it into his vasculum and closes the lid. Later, in the laboratory, he brings out the plant, makes longitudinal and cross sections, peels off the epidermis, soaks some of it in chloral hydrate to make it transparent and by various other ruthless details of technique compels the plant to disclose its most intimate and personal characteristics. Everything so disclosed is embodied in a "contribution to knowledge" and published where all the world may read.

So the committee on nominations of this society meets in secret conclave and decides on a few names, as soldiers are drafted for war. To safeguard the principle of democracy (still dear to science), the entire membership is urged to do likewise. From the preliminary list of victims so chosen the plebiscite of the society makes the final choice of one. He is not "urged" nor even invited; he is notified. A careful search of the literature of this subject has failed to disclose a single instance of a botanist so lacking in unselfish patriotism as to refuse to serve his botanical country in her time of presidential need.

And then comes the laboratory treatment, in all the brilliant setting of an annual dinner, when the *retiring* president is compelled to advance and, like the

[1] Address of the retiring president of the Botanical Society of America, given at the "Dinner for all Botanists" at Indianapolis, on December 29, 1937.

plant (sectioned and made transparent), he is forced to disclose to the botanical world, in a presidential swan song, his weak as well as his strong points as a man, a botanist and, alas, as an orator.

But to return to Sir Joseph Hooker. He wrote to Darwin as follows:

> The fact is that I have an insuperable aversion to high places; the acceptance would have been bad dreams in anticipation for 18 months, and a downright surgical operation at the end of it! I believe I inherit this from my father who would never put himself forward, or be put forward, and I am sure it paid in the end.

But there was a more urgent reason why Hooker shrank from a presidency. "I was also actuated," he says, "by the fact that I can see no way to a good Address"! But, says Huxley, "he had to yield to the insistence of all the botanists he respected, and . . . 'in a state of deep dejection,' bids Darwin pity him."

In May he wrote to Darwin:

> Perhaps when this Norwich meeting is over I shall feel more at ease. I would give 100 guineas that it were over, even with a failure, a fiasco, or worse. The address is *nowhere* yet, and I look on its prospects with a loathing that cannot be uttered.

In another letter to Darwin he wrote:

> I get more and more unhappy about the Address as the time draws on. Nothing on earth would induce me to do a thing so *damned indelicate* as to force such a position on an unwilling soul. Science might go to the Devil before I would do so by an enemy even. You see I am working myself up to the starting point. . . . And after all, should a President's Address be a 'scientific thesis'? I think not.

Three months later (in July), after having begun to work on his "Address," he wrote again to Darwin:

> I do not intend to show any part of the address to my wife, from the conviction that she would burn it all. . . . I have concluded the rough sketch of what I shall say (if not hissed down), for by George I would hiss anybody who would eruct such stuff as I have written under any other circumstances than a Presidential martyrdom.

This, then, is what we are this moment in the midst of—a "presidential martyrdom."

At the service in the Norwich Cathedral, on the Sunday following Hooker's address, the anthem, we are told, was specially chosen for him:

> What though I trace each herb and flower,
> That drinks the morning dew,
> Did I not own Jehovah's power,
> How vain were all I knew.

"This," wrote Sir Joseph, "brought tears to my eyes!"

The addresses of the retiring presidents of this society have dealt with an interesting and commendable variety of topics. I do not recall one that has dealt definitely and directly with the problem of botany serving the public or with botanical institutions. Coming down to the present moment, should a president's address be a "scientific thesis?" "I think not," said Hooker—three honeyed words to a retiring president consigned by fate to spend the larger part of his professional career in administration instead of investigation! I have heard the contrary opinion expressed with emphasis by members of this society.

These addresses are among the best opportunities that science has of interpreting itself to the world at large—of helping the lay public to appreciate its larger grasp, its major problems, its significant results, its social values and, above all, its method of thought and work; and botanical science—that is, "pure science," has still not completed its task of interpreting and "selling" itself to the general public, from whom in last analysis, must come both its moral and financial support. If any one should question this statement let him ask himself how many botanical foundations there are comparable in the initial expenditure and the amount of the permanent funds, with what has been done during the past forty years for geology, or for astronomy in the construction and endowment of planetariums for instruction and observatories for research.

By this time it must be evident to all that this address is not to be devoted to presenting the scientific results of research. But research has other than scientific results and applied results. I refer to the impression made by scientific research and researchers on intelligent laymen. What impression is it making on the world outside of its own circle?

So far as concerns inventions—telephone, radio, x-ray therapeutics and a myriad others resulting from the application of research—there can be no question. The impression is profound and profoundly favorable. But what impression are research *per se* and researchers (as distinguished from invention and inventors) making on such groups as writers, editors, educators, educational administrators and those of other professions?

I happened to be present at the meeting of the British Association, in 1927, when the Bishop of Ripon, in the Parish Church of Leeds, made the startling suggestion for a moratorium on all research in science for a term of years, until the scientific and educational world had an opportunity to digest and assimilate what had been accomplished to date. I quote from the newspaper report of the bishop's sermon:

> Dare I even suggest, at the risk of being lynched by some of my hearers, that the sum of human happiness, outside of scientific circles, would not necessarily be re-

duced if for, say ten years, every physical and chemical laboratory were closed and the patient and resourceful energy displayed in them transferred to recovering the lost art of getting together and finding a formula for making the ends meet in the scale of human life?

It would give 99 per cent of us who are non-scientific some chance of assimilating the revolutionary knowledge which in the first quarter of this century one per cent of the explorers have acquired. The one per cent would have leisure to read up on one another's work; and all of us might go meanwhile in tardy quest of that wisdom which is other than and greater than knowledge and without which knowledge may be a curse.

As things stand today, we could get on without further additions for the present to our knowledge of nature. We cannot get on without a change of mind in man.

We could hardly believe the headlines in the morning paper featuring the bishop's radical proposal. One might as well suggest "New Deal" legislation by Congress providing that water should no longer run down hill. For researchers engage in research (that is, those worth considering in such a discussion as this do) for the same reason that streams flow; for the same reason that lawyers become lawyers and not doctors, or that physicians become physicians and not bankers—because it is their nature to do it. It might be rational to propose that Congress pass no more laws for a decade, but not to propose that Congressmen cease to be politicians.

I have just implied that there are researchers not worth considering in such a discussion as this. We are all familiar with them—scientific hewers of wood and drawers of water, who would make excellent teachers if they could feel secure in devoting the best of their energies and talents to teaching, but whose chief inspiration to research is the knowledge that, as a rule, advancement in our higher educational institutions comes not, strange as it may seem, by engaging in formal education, but by the augmentation of knowledge.

If circumstances had compelled Isaac Newton or Charles Darwin or Louis Pasteur or the great Linnaeus to spend most of their time and energy with large classes in introductory courses, the loss to science would have been greater than the gain to education. On the other hand, if our universities would encourage and reward many on their scientific faculties to do just that, the loss to science would be negligible and the gain to education incalculable.

There are a few cases, such as Louis Agassiz and Sir J. J. Thomson, where outstanding ability in both research and classroom teaching are combined in one individual. But are not such cases as Agassiz and Thomson the exception rather than the rule? On the other side of the picture is Professor Mason B. Thomas, professor of botany in Wabash College from 1891 to 1912, and known to all the older botanists as one of the greatest teachers of botany America has produced. What a pity it would have been for Thomas, with his pedagogical gifts, to have made his classroom work secondary to such research as he probably would have done, with his heart and soul in teaching. By giving the best of himself to his classes he became the inspirer of investigators as well as of other teachers; he inspired many to become botanists, and rendered a major service to the science.

I can never forget how my own initial enthusiasm in a certain branch of botany was almost completely and permanently killed by a college professor who was more interested in his own research than in the class of which I was a member. Of course, in the process of advancing science, wood has to be hewn and water has to be drawn, but what a pity to have it done by young men and women who might be so much more valuable to their university, and so much happier, by deliberately subordinating research, for which they have only mediocre ability, to teaching for which they have a natural aptitude and enthusiasm.

We have all had graduate students who have mastered the current technique of research, but have never shown the slightest originality in the formulation of problems or the improvement of procedure. It is a disservice to encourage them in research, or to lead them to feel that teaching is secondary to investigation, in importance or satisfactions, if only their inclination and their gifts are in that direction. It was Sir J. J. Thomson, whose success as a teacher has already been noted, who once said, "No one but a blockhead ever researched except for fun."

But my intention is not primarily to advance my own ideas. As Diogenes went about with his lamp to seek an honest man, so I have been going about with a mirror to catch reflections of what honest critics are thinking and saying about us as investigators and teachers of science.

An editorial in *Nature* ten years ago (August 13, 1927, p. 215), but valid to-day, pointed out that the tendency to emphasize the value of applied science is closely related to the tendency to confuse instruction in science with technical training. It is the former which has value in preparing young people to take their place effectively in meeting the broad problems which confront society. It is essential, says the writer, that students

> should have a general knowledge of the scope and aims of science, as well as of scientific method, and *the mode in which science envisages and attacks its problems.* It is, however, beyond all question that it should be a general knowledge on broad lines; a specialized training in some highly technical branch of science is neither needed, nor indeed is it desirable. . . . We doubt, however, whether

much of the science teaching in schools, either primary or secondary, could be regarded as science for citizenship instead of science for specialists, and we would welcome a movement which would broaden its scope and change its character.

Last February President Keppel, of the Carnegie Corporation, called attention to the general ignorance of science—of the problems, interests, aims and methods of the investigators in so-called "pure" science and the resulting need of a new type of education, especially in the realm of adult education. Commenting on this, an editorial in the *New York Times* of February 22, 1937, continues as follows:

> No professor of English cherishes the illusion that he is training future poets or essayists. To inculcate a love of good books, to broaden the cultural horizon—that is his aim. But the physicists and chemists and other professors of science teach as if they were bent on graduating professional jugglers of atoms and genes. Conceding that there must be some laboratory work, some instruction in the scientific method, it is, after all, the cultural aspect of science that Dr. Keppel has in mind.
>
> There should be a correlation of the sciences, a systematic revelation of the manner in which the human mind has progressed in its thinking about matter, trees, animals, stars, the universe of life. . . . If college graduates had this broader cultural outlook, we would have more science in the newspapers and even better presentations. . . . If educators would forget that science was not made for scientists alone, Dr. Keppel's dream of generally inculcating the spirit and idealism of science would become a reality soon enough, with the press the most potent of educational allies.

If the editorial writer, just quoted, had been more closely in touch with the progress of science-teaching in our universities he would not, perhaps, have referred to Dr. Keppel's comment as a "dream," for progress toward the ideal he urges has, during the past twenty-five years, at least in botanical teaching, been very much of a reality. The introduction of "orientation courses" in the various sciences is a long stride in that direction. But we have still a long way to go.

For example: When I speak of teaching science I have in mind something much more fundamental than passing on to younger learners the facts about the world of matter and energy and life, important as that is; something which is a much more urgent social need. Briefly stated, it is not merely teaching science, but education through science. The two are not necessarily synonymous.

But current progress in this matter has overtaken the preparation of this address. On December 2, after the above paragraphs were written, Dr. S. Ralph Powers, director of the Bureau of Educational Research of Teachers College, Columbia University, presented to a group of students and faculty members a plan for revising the program of high-school education with science as the central motive. Dr. Sears, professor of botany at the University of Oklahoma, is one of the members of the bureau. The plan involves teaching students "to understand the social responsibilities entailed by scientific advance," so that they may "be able to deal more intelligently with their duties in a modern democracy."

Possibly educators are more alive to the failures of science as a means of education and to its possibilities in that line than are scientists themselves. Again may I hold the mirror up to reflect what those outside the ranks of science are feeling and thinking? In his address at the seventy-third annual convocation of the University of the State of New York, at Albany last October, Mr. Lewis Mumford, author, noted that, among the serious conditions that society faces to-day, "one of the worst is the fact that the increase of scientific knowledge and rational insight [that is, among scientists] has not in itself created a more rationally ordered world. . . . Just the opposite of this has happened. The ordinary man is less capable of understanding and directing in accordance with rational calculations and human judgments the world in which he lives."

To what extent is this "serious condition that society faces to-day" attributable to faulty scientific teaching? Perhaps not at all; perhaps only in part. But at least here is a challenge which should have the serious consideration of every teacher of science. A retiring college president, when asked to state the most important lesson he had learned in his long life as an educator, is reported to have said: "That the human mind has infinite capacities for resisting the introduction of wisdom." Perhaps the teachers of science are confronted with an almost insuperable obstacle to conferring on society what it most needs. This appears all the more likely when we realize that the compulsory education laws of most of our states have filled our high schools and colleges with thousands of young people who have the ability to memorize, but little if any ability to think. The percentage is large; a recent writer has placed it at more than 50 per cent.

The principal of one of the large high schools in New York City recently told me that there are numerous pupils in all the New York high schools who can not read well enough to read the assigned lessons in their text-books. This results because the school law requires all of high-school age to attend school, and promotions to successively higher grades must inexorably go on, without regard to scholastic accomplishment, in order to make room for those promoted from the grades below. The most skilled teacher that ever lived could hardly teach pupils how to think who are catapulted into high school on such a basis and often

against their wishes. Many of them pass on to clutter up the classrooms of the freshman year in college.

But let us again hold up the mirror and see what the non-scientific world is saying about science. In his Elihu Root lecture, at the Carnegie Institution of Washington, on "The Influence of Science and Research on Current Thought," in December, 1934, President Angell, of Yale, referred to the general ignorance of our contemporaries concerning the scientific principles underlying the myriad inventions in use in daily life—the telephone, phonograph, gasoline motor, electric light, radio. The principles which these devices embody, he notes, are not only utterly unknown but unintelligible to the great mass of their beneficiaries.

Adding to the illustrations of President Angell, chosen from physical science, we may cite the enjoyment by the masses of the horticultural varieties of flowers and fruits, major agricultural crops such as cotton, corn and wheat, improved both for quality and yield per acre by applying the principles of botanical science. Yet the vast majority of the masses has little, if any, conception of the scientific method of thought and work by which, and only by which, those principles were established.

The serious proportions in which this ignorance of what science has to teach may manifest itself in the practical affairs of daily life is illustrated by the attempts of governmental officials to determine a year in advance, by legislative enactment, the size of our major agricultural crops, apparently wholly ignoring the uncertain but inevitable factors of plant diseases, insect pests, drought and other vicissitudes of nature.

But when we reply to the indictments of science-teaching we must, of course, remember that not every one studies science in college nor is interested in it; and the results of trying to teach people what they are not interested in can hardly be expected to be very substantial, nor to carry over to life after graduation. And I suspect that the failure of science, since it was accepted into the college curriculum, to reform this world is no greater than the failure of mathematics or logic or philosophy or political economy or any other subject.

However, all this does not release us from the responsibility of clearly formulating and facing the problem of our social responsibility in science-teaching and of continuing to attempt the solution so long as the problem exists.

But the responsibilities of scientists are three-fold—to extend knowledge by investigation, to give formal instruction in schools and to enlighten the general public by popularizing. What do our laymen critics say about popularizing?

A professor of philosophy in Princeton University, Dr. Stace, had an article in the *Atlantic Monthly* for December, 1936, entitled, "The Snobbishness of the Learned." He begins with the story of "a very well-known living writer," who submitted the manuscript of a popular book on a branch of modern science to a fellow expert, who commended it, and then said, "But why do you waste your time writing stuff of this sort?" Dr. Stace then expresses his own thought as follows:

> The impression that philosophical and scientific ideas can not be expressed in plain language to plain people is . . . in large measure due to the fact that philosophers and men of science have not, as a rule, the wit to do it. It is due in plain terms to the stupidity of learned men. . . . They lack, too, that human sympathy with simple people which is also essential if the teachings of science and philosophy are to be made available to the many. . . . The real ground for the disfavor in which popular writing is held among experts is to be found elsewhere. It is rooted in class prejudices. The learned think themselves superior to the common herd. They are a priestly caste imbued with the snobbishness that is characteristic of caste systems.

Toward the end of his article Dr. Stace refers to "the pure popularizer" as "performing an absolutely vital function in the intellectual progress of mankind." Furthermore, he urges that *all* scientific writing, "even of the most original, learned, and abstruse kinds, should aim at being popular *as far as possible.*" This aim is to be sought by avoiding unnecessary scientific jargon.

But let us get a glimpse of what the outside world thinks of research in science. The English magazine, *Nineteenth Century,* for July, 1936, has an article entitled, "A Modern Idea of a University," by Rushton Coulborn, Ph.D. From this I quote as follows:

> To-day teaching in our universities has become definitely subsidiary to research and it is the purpose of this article to show that the dominion of research over teaching is the chief cause of the intellectual anaemia of the universities.
>
> The research tide began to flow in the later seventeenth century, when it was first recognized in England and France that the collection of information about natural phenomena was of national importance. . . . The first influence of this process upon the ancient universities was paralytic. They entered upon a decline from which they scarcely showed signs of emergence until the nineteenth century. As they emerged their reviving energies were directed progressively more and more toward the development of the sciences, with their characteristic method of quantitative research. This not to the exclusions of the humanities, but ultimately toward a great advancement of the place of the sciences in learning.
>
> Creative thought is difficult, and, to the great majority of humanity, impossible. Research, however, in a very real sense, is easy. The choice of direction for research *can* be an act of genius if it consists in the creation of an imaginative hypothesis, to be tested thereafter by the

research itself. But the actual research, in whatsoever field, requires only patience, dexterity and exactness. And it is lamentably true that research *may* be undertaken without any preceding act of creation. No genius is required to perceive merely where there lies something unknown. In an age when the frontiers of knowledge are being advanced in all directions, every student, by placing himself for a moment upon the frontier, can look out into an uncharted area. But it remains true that only an able man can divine, from his frontier station, whether he is gazing into a land of promise or merely into the back of beyond. . . . The ordinary, undistinguished individual can, on the other hand, usually be trained to patience, dexterity and exactness in early education. . . . Hence a very large number of ordinary people are available to do research. In this sense research is easy.

It almost appears that research has made the academic world safe for democracy. An army of excellent but very ordinary persons is carrying research further and further into the pettyfogging and unimportant.

The vast majority of university teachers are to-day primarily researchers, and the havoc they have wrought in undergraduate studies is wide-spread. . . . It is the function of the teacher to interest and to inspire, but the numbing influence of research upon character is the very thing to destroy the teacher's ability to discharge this function. . . .

These are the men who have turned lectures into an annual repetition of deceased ideas, or into a cold compound of trivialities drawn from their own and their colleagues' research. As a result much disgraceful cant is talked nowadays in depreciation of lectures as a medium of instruction. The fact remains that Nature designed the lecture to be the most direct stimulus to thought since it is eminently the *milieu* in which emotion enters into and illuminates understanding. Much of the hollowness of the "clash of minds" to-day is attributable to the drying up of the rhetorical, inspirational side of academic education.

The danger is that research should be considered to be the business of the leaders of thought. For the second-class scientist, economist, or historian research offers a living. There should be properly equipped laboratories for research both in the humanities and in the sciences. They should be equipped with permanent full-time staffs, conducting themselves entirely as clerks—since the work is essentially clerical—and not partly as teachers. . . . University teachers themselves should be asked to make recommendations to the research directors, indicating the subjects upon which they desire information. The researchers, in turn, should make reports to the teachers of the material they think to be available, but here the connection should cease.[2]

To give such a long quotation is justified by its amazing character, and its evidence of what the intellectual world outside of science is thinking of *us*. I am not presenting it as embodying my own ideas; far from it. But for how large a group Dr. Coulborn is spokesman we can not be sure, and such comment as I have quoted, in a magazine of contemporary thought of such standing as the *Nineteenth Century,* can hardly be passed over with merely a smile, for what the outside world is thinking and saying of science-teaching and research must always be a matter of serious concern to scientists.

But Dr. Coulborn is not the only contemporary writer who is saying things like this. Let us turn the mirror on a critic in our own ranks. At the opening of the school of medicine of Columbia University, last September, Dr. Nolan D. C. Lewis, director of the New York Psychiatric Institute, addressed the 200 incoming students as follows: "Sometimes I think men are needed who can arrange in synthesis the facts already discovered more than we need new facts."

I next hold the mirror up to the world of college presidents and deans, and catch the following reflection of a recent address by Dr. Glenn Frank, formerly president of the University of Wisconsin:

> The future of America is in the hands of two men—the investigator and the interpreter. . . . And we have an ample supply of investigators, but there is a shortage of readable and responsible interpreters, men who can effectively play mediator between specialist and layman. . . . Science owes its effective ministry as much to the interpretative mind as to the creative mind. . . . Rarely do the genius for exploration and the genius for exposition meet in the same mind. . . . The investigator advances knowledge. The interpreter advances progress. . . . A dozen fields of thought are to-day congested with knowledge that the physical and social sciences have unearthed, and the whole tone and temper of American life can be lifted by putting this knowledge into general circulation. But where are the interpreters with the training and the willingness to think their way through this knowledge and translate it into the language of the street? I raise the recruiting trumpet for the interpreters.

Said Dean Lyon, of the University of Minnesota Medical School, discussing "Teaching and Research" in a recent number of the Sigma Xi *Quarterly* (December, 1936): "What the world needs is not less science, but more knowledge of what science is and what it can and can not do. What the world needs is more and better teaching."

The quotations in this address seem important enough, or at least interesting enough, to bring to the attention of this audience, because they are not isolated utterances, but fair random samples of current opinion.

We have been holding the mirror up to contemporary thought to see what the critics are thinking and saying of us as scientific investigators and teachers. Mirrors reflect everything in front of them, and we should be unfair to ourselves if we did not regard the adverse criticisms in the light of certain other

[2] This, of course, is a fairly correct picture of the organization of research in the laboratories of some of our great industries.

reflected facts. I refer, for example, to the indispensible services rendered to government and to humanity by such institutions as the Greenwich Observatory and Kew Gardens in England, and the Bureau of Standards, the Department of Agriculture, the Agricultural Experiment Stations in the United States—services which depend upon a continuing program of scientific research.

The Union of Soviet Socialist Republics began by overthrowing much that was considered fundamental in the old régime, but it did not overthrow science. Lenin, Stalin and other leaders saw in the beginning that no substantial progress could be made except with science, organized primarily, not for the sake of science, it is true, but for the service of government. An editorial on this in the *New York Times* for November 21, 1937, stated that "the successive Five Year Plans could not be carried out without the aid of physicists, chemists, biologists, and engineers. Hence the 40,000 scientists employed in the various research institutes—2,179 in the 51 laboratories under the direction of the Academy of Sciences alone. . . ." As the editorial states, the Academy of Sciences is as much a part of the government as our Department of Agriculture.

Such considerations as these reveal the sheer nonsense of the proposal for a ten-year moratorium on scientific research, but they also support the prevailing but erroneous impression that it is only applied science, rather than science in education, that has social value.

But we should also realize the danger of science being dominated by the state, which, as in Russia and also in Germany (if we may rely on Associated Press dispatches), is liable to approve freedom of inquiry only when its results are in harmony with current political doctrine. Witness, for example, the denunciation of genetics by Lyssenko because the political philosophy of Karl Marx teaches that all members of the proletariat are equal. Science for politics is quite as futile as science for science's sake.

I have entitled this address "Pandemic Botany"—that is, botany for all the people whose interest in plant life may be encouraged or initially aroused. And, as most presidential addresses before the Botanical Society have dealt with the major enthusiasms of the speakers, I have thought it might not be out of place, at this time, to present, in broad outline, certain aspects of my own major enthusiasm, namely, the work of the Brooklyn Botanic Garden, as a concrete illustration of the organization of a program of botanical research and education for "Everyman."

In developing this institution the underlying thought has been, "Anything scientific or educational based upon plant life," beginning with children's gardens and studies in preparation for them, and culminating in a program of botanical research. There is one intentional gap in the plan, for advanced courses of university type are not included, since the Botanic Garden grants no degrees, and there is little or no demand for such courses except from candidates for a degree.

Aside from labeled objects placed on public exhibit, the most common educational device of museums and botanic gardens is the public lecture, usually illustrated and usually offered free. For reasons too numerous to be stated here, free public lectures, each, according to the practice, dealing with a topic largely unrelated to the others, have been almost entirely eliminated at the Brooklyn Botanic Garden, especially with children. Experience has shown that lecturing to a large audience of from 500 to 1,500 children rolls up impressive figures of attendance, but yields smaller educational returns than almost any other form of juvenile instruction.

The work for both children and adults is organized in the form of courses of instruction, including laboratory and field work. In particular, the work for adults is of the nature of what has come to be technically known as "adult education."

Moreover, none of the work is offered free. Here again experience has shown that where a fee is charged, however nominal, enrolment is increased, attendance and quality of work are improved, and the merely curious, incompetent and idlers are eliminated. Charging a small fee has been specially effective in the children's work. No fee is charged to classes from the public and private schools brought to the garden by their teachers for instruction by members of the garden staff.

In addition to formal instruction the Botanic Garden, like all similar institutions, maintains a bureau of free public information on all aspects of plant life and gardening, including trade services, inter-library loan service and cooperation with departments of the city government, such as the park department, the board of health, and others.

And, of course, the labeled collections of living plants serve an educational purpose, just as the exhibits in a museum do, for the plantations of a botanic garden are essentially an outdoor museum. And a botanic garden is, or should be, the common meeting ground of horticulture and of botany as distinguished from horticulture. I have elsewhere endeavored to express the distinction between botany and horticulture by noting the difference in the place of emphasis. For the botanist the garden exists for plants; for the horticulturist plants exist for the garden. The botanist, as such, is primarily interested in plants and in all plants without any reference to a garden—non-deco-

rative plants, weeds, fungi and wild plants. The horticulturist, as such, is primarily interested in the garden, and in plants as they are useful for making a garden, or have other ornamental value or economic value. Of course, the fields of botany and of horticulture overlap, as do all the sciences, and any attempt to define a hard and fast dividing line would fail; but in the older botanic gardens the main concern appeared to be to grow the plants which the botanist wished for studying and for teaching; the problem of a beautiful garden, if it existed at all, was secondary. The justly famous Chelsea Garden, near London, especially in its earlier years, is an example. The gardens of the great English estates, Japanese landscape gardens, and, in America, such gardens as the Magnolia Gardens and the Middleton Garden near Charleston are examples of horticultural (as distinguished from botanical) gardens.

The problem of the modern botanic garden is to be educational and otherwise serviceable from the standpoint of botany and, at the same time, to be as beautiful as possible *as a garden*—to combine botanical and horticultural values; to be socially serviceable. A few lantern slides will illustrate in a partial manner one attempt to realize this ideal.

(At this point a number of colored lantern slides and two reels of motion pictures in natural color were exhibited, illustrating the plantations and various aspects of the scientific and educational work of the Brooklyn Botanic Garden.)

OBITUARY

ANDREI VASSILIEVITCH MARTYNOV

NOT long ago, very little was known of the fossil insects of the vast Russian territory in Europe and Asia. Ust Balei, on the Angara River in Siberia, had produced a series of interesting forms, and I had the pleasure of collecting insects of Tertiary age on the east coast of Siberia. But no one realized that the U. S. S. R. was in fact a happy hunting ground for the paleoentomologist, comparing not unfavorably with some productive regions in western Europe and in parts of the United States. As recently as 1927 a rich deposit of Liassic age was discovered in Ferghana, and subsequent collecting brought to light a fauna which has just been recorded in a volume of 232 pages, with many illustrations, published at Moscow and Leningrad, 1937. When I received this book not many weeks ago, I thought of its author, A. V. Martynov, and recalled my meeting with him at Leningrad in 1927. I remembered his many valuable contributions to the knowledge of recent and fossil insects, and rejoiced to think that he was going on from discovery to discovery, taking advantage of the opportunities which came to him. I recalled his vivid account of his search for insects in Permian rocks; how he hunted long without success, and eventually found two concretions, of no great size, but filled with remains of insects. One could not fail to be struck by his keenness of mind, his enthusiasm, and his perseverance. In the midst of these reflections came the melancholy news that Martynov had died on January 29, from cancer.

Martynov was born in 1879 in Central Russia. He graduated from Moscow University, and became assistant professor at Warsaw in Poland. When I met him he was in the Zoological Museum of the Academy of Sciences in Leningrad, but more recently he was transferred to the newly established Institute of Paleontology of the Academy in Moscow. He had made intensive studies of the caddis-flies (Trichoptera) in the recent fauna, but he was attracted to problems having to do with the morphology and phylogeny of insects, problems which were illuminated by the many newly discovered types in Mesozoic and late Paleozoic strata. Describing very many genera and species, which often had to be referred to entirely new groups, he was not concerned so much to record a large number of novelties as to see what they all meant for the long history of insect life and the understanding of evolution in general. We may not adopt all his views, but at the very least we must recognize the permanent value and importance of his work, which will be continually referred to by all subsequent students.

T. D. A. COCKERELL

RECENT DEATHS AND MEMORIALS

DR. DANIEL WEBSTER HERING, since 1916 professor emeritus of physics at New York University, dean of the Graduate Faculty from 1902 to 1916 and curator of the James Arthur collection of timepieces, died on March 24 at the age of eighty-eight years.

DR. PERLEY ASON ROSS, professor of physics at Stanford University, died on March 20 in his fifty-fourth year.

DR. LOUIS WILLIAM STERN, professor of psychology at Duke University and prior to the recent difficulties in Germany director of the Psychological Institute at the University of Hamburg, known for his contributions to child psychology and psychological testing, died on March 27 at the age of sixty-six years.

Nature reports the following deaths: Charles Benson, formerly deputy director of the Agricultural Department, Madras, known for his work on Indian cotton and tobacco, on March 5, aged eighty-two years;