SCIENCE

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CONTENTS

The Brooklyn Botanic Garden:—

The Social, Educational and Scientific Value of Botanic Gardens: PROFESSOR JOHN MERLE COULTER 643

Ideals and Opportunities for a Botanic Garden: DR. C. STUART GAGER 648

The Scientific Work of the Bureau of Fisheries: DR. H. M. SMITH 653

Scientific Events:—

Concerning the Manufacture of Phthalic Acid and Phthalic Anhydride; The Crocker Land Expedition; Applied Psychology at the Carnegie Institute of Technology 654

Scientific Notes and News 656

University and Educational News 659

Discussion and Correspondence:—

Heritage and Habitus: DR. HENRY FAIRFIELD OSBORN. *Scientific Meetings in War Times:* COLIN G. FINK 660

The Proceedings of the National Academy of Sciences: PROFESSOR EDWIN BIDWELL WILSON 661

The Decimal Point: PROFESSOR LOUIS C. KARPINSKI 663

The Shortage of Platinum 665

Special Articles:—

Is the House of Tcuhu the Minoan Labyrinth? PROFESSOR HAROLD SELLERS COLTON. 667

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THE SOCIAL, EDUCATIONAL, AND SCIENTIFIC VALUE OF BOTANIC GARDENS[1]

IT is a noteworthy fact that the United States is beginning to appreciate botanic gardens. This appreciation may be relatively superficial as yet, but the superficial is usually the preliminary step that leads to the fundamental. The desirability of botanic gardens was not obvious when large areas in a state of nature were available to almost every one; but when we developed congested populations in cities and made artificial most of our open areas, the thought of botanic gardens began to take form.

Those of you who have traveled in Europe must have been impressed by the multiplicity of such gardens. They began there in the form of monastic gardens, in which the so-called "simples," used in primitive medicine, were cultivated. Then they came out into the open as city gardens, chiefly for the enjoyment of the people and to beautify the city. Finally, they became also scientific, and gradually led to such great establishments as the botanic gardens at Rome, Geneva, and Paris, the great modern gardens on the outskirts of Berlin and Munich, and that greatest of all garden establishments, the Kew Gardens of London. These are but conspicuous illustrations of what almost every European city had developed before we began to think of garden establishments.

I wish to speak of three conspicuous con-

[1] Address delivered at the dedication of the laboratory building and plant houses of the Brooklyn Botanic Garden, April 19, 1917.

tributions that such an establishment can make, not all of which are appreciated as they should be. There is no better audience for this purpose than the friends and supporters of the Brooklyn Botanic Garden, which has achieved more in certain directions than any other garden in the country. I wish you to realize, not only that your support is justified, but also that perhaps you have builded better than you knew. I shall speak of these three contributions in what I conceive to be the inverse order of their importance, in the sense that the superficial, however desirable, is less important than the fundamental.

1. The first is the *social* contribution. "Social" is a very inclusive word. Anything that contributes to the welfare of a community, in any way, is a social contribution. In this sense, the results of education and of religion are also social. I am using the word in no such general sense, however, but simply to include the betterment of city conditions for living.

A botanic garden is a social contribution because it is one answer to the problem of congestion. It is not sufficient to have open spaces, even when those spaces are beautified as parks. There can not be too many of these, but something more is needed. I wonder if you all appreciate what the touch of nature means. It is something more than open space for breathing. It is a kind of elixir that helps men to be *men*. The garden is a museum of nature, not merely an area left to nature. In it there are assembled the representatives of many regions, so that it gives a world contact. It is a great service to give any community the opportunity of such a contact.

The contact with nature presently develops the contact of interest, and interests outside the routine of living, when these interests are worth while, are both curative and stimulating. Then when interest is awakened, and plants are examined as individuals, and not merely as a general population, the wonders of plant life begin to appear. I wonder how many know why leaves are green and flowers colored; why some plants are trees and others herbs; why some trail and climb, and others stand erect. All of this vegetation is the natural covering of the earth, which cities have eliminated. It is the covering that makes your lives and all life possible. I should say, therefore, that the mere presence of a botanic garden in a city is like having the spirit of nature as a guest, and all who become acquainted with this spirit are the better for it.

There is nothing more artificial than city life, and therefore nothing more abnormal. Some are able now and then to renew their contact with the natural and normal, but most are not. A botanic garden brings to the many a touch of what only the few can secure for themselves. You have doubtless developed some very definite and effective ways of expressing the social contribution of this garden to the life and welfare of this community. But to me, speaking in general terms, the conspicuous *social* contribution is to provide the opportunity, and see to it that all the people take advantage of it.

2. The second is the *educational* contribution. It is this contribution to the community that you have developed with remarkable success. Nature is a great teacher when she really comes in contact with the pupil. The notion is too prevalent that knowledge comes from books; that one can read *about* nature and acquire knowledge *of* nature. One might just as well try to acquire knowledge of business by reading about business. Knowledge comes from experience, from contact. We

must distinguish between *knowledge* and *information*. Knowledge is first-hand, obtained from actual contact with the material. Information is second-hand, hearsay, coming from no actual experience. Reading *about* nature, therefore, brings information; contact *with* nature brings knowledge. To serve a community by bringing its children into contact with nature is a great educational service.

Perhaps the most significant contact with nature is the handling of plants. We are seeking now for an army of people with some experience in handling plants; for more people who will cultivate plants wherever space permits. You have been made to realize, in these days of testing our resources, that the most important material problem we are facing as a nation is the problem of food-production and conservation. Food-production has lagged far behind population, and this increasing gap must be closed up. Our science of transportation has far outstripped our science of food-production, so that we have come to depend not only upon a diminishing food supply, but also upon transporting that supply across a continent. To learn to grow plants and to grow them everywhere, especially near our great centers of population, is a crying need.

The development of home gardens, therefore, is not merely a service for social betterment that all recognize, but it is becoming more and more a public necessity. Any institution that gives you and your children this training is not merely an educational institution, but also a public benefactor. A Botanic Garden doing such work is like a power house, radiating energy throughout the community. Such training is an equipment which not only enriches life, but it is also an equipment for service. In providing such an opportunity, a city can do nothing better for its young people and its homes, and through them for itself.

These two contributions, social and educational, seem very obvious, but the third contribution needs fuller explanation.

3. The third is the *scientific* contribution. This I regard as your great opportunity, and I wish to help you realize it. We are a very practical people, and unless we can see immediate returns from an investment, we decline to undertake it. Very few people appreciate what it has taken to make things practical. We speak of fundamental science and practical science; sometimes we call these two phases pure science and applied science. The general impression is that pure science holds no relation to public welfare, and that applied science serves our needs. You should know that all applied science depends upon pure science; that there would be nothing to apply unless pure science had discovered it. If we had only applied science, it would soon become sterile. It is pure or fundamental science that keeps applied science alive, that makes progress possible. For example, if Faraday had not worked in pure science, Edison would have had no basis for his wonderful inventions. And so it is throughout the whole range of the practical things we are using to-day. To neglect pure science and support only applied science would be like wanting children and eliminating parents. When I hear those who are regarded as practical men lauding our practical achievements, which certainly deserve praise, but speaking lightly of work in fundamental research, I think of them as those who would praise the practical electric light and forget the impractical, because unseen, power house. Scientific research is the power house that generates all the energy we apply in developing what may be called the machinery of our civilization.

I wish now to indicate, by a single illustration, how such an institution as this may become a great laboratory for public service. My illustration is intended only to indicate how fundamental research is of the greatest service to public welfare, a source of energy to be called upon and applied as needs arise. It is not intended to indicate the specific kind of work that any given garden should undertake; this may well vary, but it is a good illustration of the value of research work in general.

I have indicated the problem of food production that our nation is facing to-day. In some way our food production must overtake our population. Over a century ago certain men were speculating about evolution. The subject of evolution was not a science, because men were *meditating* rather than *investigating*. Certainly nothing could have seemed farther removed from general human interest than this speculation. About a century ago speculation about evolution merged into the science of evolution when men began to observe the facts upon which such a theory could be based. For a century, observation and inference went on until they had reached the limit of usefulness. Near the beginning of this century, men concluded that the only way to secure further progress was to test by experiment whether one kind of plant could actually produce another kind. In observing the behavior of plants in breeding, they began to uncover the laws of heredity; and as knowledge of these laws increased, it became evident that this knowledge could be applied to the practical handling of plants, and what we call our revolution in agriculture followed. It is a far cry from a speculation about evolution to the solution of our food problem, but the continuity is unbroken. It is by such essential and generally unrecognized service that scientific research is contributing to human welfare. I wish to be more specific and to indicate some of the ways in which science has solved this food problem.

Through scientific work in the study of heredity, we have learned to multiply the races of our useful plants so that they may fit in more exactly to the variable conditions in which plants must be grown. It is a curious fact that we have been blind so long to the teaching of nature that conditions for plants are not the same everywhere. We have always realized that the natural vegetation of this country is not a monotonous covering. Every change in vegetation indicates a special set of conditions for plant growth, and yet we have been trying to grow the same races of plants everywhere. The result has been that we have gotten maximum returns from some areas, minimum returns from others, and medium returns from the rest. Our total result has been an average. By multiplying races of plants to fit conditions more closely, our total result will not be an *average,* but a *maximum* everywhere. This one suggestion of science will double our production.

One of the most destructive enemies of our crops is drought. On the average our production is cut in half by this enemy. Scientific investigation has shown that it is possible to develop drought-resistant races of all our useful plants. This means the possibility, not only of insuring our crops against drought where they are now cultivated, but also of increasing enormously the area of cultivation, by adding the so-called arid regions of perpetual drought.

Another destructive enemy of our valuable crops is disease. The government has expended millions of dollars in the study of plant diseases, in the hope of reducing the loss. The scientific work of recent years has shown that it is possible to breed disease-resistant races. Plants, like human

beings, differ in their susceptibility to diseases. Some are immune, and others are susceptible. This means that we can cultivate immune races and let the susceptibles perish. We can not handle human diseases in this way. Before what we speak of as the wonderful advance of medicine, we were unconsciously practising selection of the human race for immunity. The susceptibles disappeared and the immunes survived. Now medicine has been so successful that it saves the susceptibles and keeps them mixed with the immunes, so that our human problem is more difficult than it used to be. But we have no such sentiment about plants, and we can cultivate immunity and eliminate susceptibility.

I am told by those who are trained in collecting such statistics that if these suggestions of scientific research can be generally applied, our food production will overtake our population. It is in such ways that the results of science find application. This is not merely a local service, but a national service, and in such a time as this it is a patriotic service.

May I call your attention to the work of the National Research Council in connection with your opportunity. This council has been appointed by the National Academy of Science at the request of President Wilson. Its purpose is to bring into cooperation all of our scientific equipment in an attack upon the problems we are facing. This week we have been canvassing the problems that need immediate attention, and they are to be assigned to various research centers, where properly trained men and adequate equipment are available. I want to include this institution in these assignments. Your opportunity is an unusual one, for already you have many things that are needed. You have the opportunity to respond to this call from your country, and to see to it that research is properly provided for. Such research work not only provides what are called the sinews of war, when war becomes necessary, but it also means progress and power in time of peace. It is this opportunity that led me to say earlier in this address that perhaps you have builded better than you knew.

Do not be misled into thinking that only those problems should be attacked that have been developed by some immediate need. Research is like the exploration of a new country. It must be traversed throughout; all trails must be followed and mapped. Some trails will lead to rich lands and valuable mines; others will not. No one can tell until everything has been explored. Your research work here should mean an exploration of nature as represented by plants, and there is no more important region of nature. The more we know about plants, the more intelligent we become in handling them. I have known scientific explorers who discovered a new country and mapped it, but no one at the time recognized it as good for anything. Years afterwards it was discovered that it was rich in possibilities.

Years ago an Austrian monk, working in his monastery garden, discovered some interesting behavior in the plants he was breeding. He recorded his facts and his conclusions in an obscure journal, and no one paid any attention to it. What could be expected from a monk pottering in his garden? Years afterwards, the contribution was discovered, and to-day it is the basis of most of our work in the study of heredity, and this in turn has made our agriculture scientific. No one knows what may turn up in a garden like this one of yours. It is a gold mine of opportunity. See to it that it is cultivated.

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