it is their function merely to teach the students and are realizing that they have the greater responsibility of training them how to educate themselves. Too long the colleges have had the idea that its students were not capable of directed study but that everything had to be explained and given to them. We are beginning to realize that our college students have unexpected potentialities for work of high quality and independence and that what the colleges have to do is to give them a responsible part in their own education. The conception of a degree as an indication that the student has merely satisfied the requirements of a set of isolated courses is being modified. We are proceeding slowly to this new point of view and even now many a college curriculum contains a great variety of courses introduced without reference to any well-thought-out plan of their relationship to the training of the student. If to the function of teaching there is to be added that of guidance, the faculties of our colleges will need more and more teachers who have the scholarly attitude and an understanding of research. This means that a teacher will be judged not by his degrees but by what he has become in the process of qualifying for these degrees. Undergraduates are capable of carrying on investigations of a subject and, in many cases where they are expected to do it, the students declare that it is the most interesting experience of their college career. The students must be under the guidance of men experienced in this technique. Even if the research which teachers are doing themselves is not fundamental or of great intrinsic merit, it may well be that its effect upon their attitude toward their students is of great value. Can a live teacher be keeping up in his subject without being faced with questions to be investigated and feel an irresistible urge to seek and to find?

A graduate school does not have to be big in order to be good, any more than it is good because it is small. It is not the question of a large variety of courses in any subject nor of the number of higher degrees granted. The fundamental question is what kind of scholars are produced. Education is not effected by legislation but by opportunity. Rules and restrictions limit the able and unduly encourage the mediocre. For in graduate work, as in many other human activities, "the letter killeth, but the spirit giveth life."

HOW TO VIEW THE SCIENCE MUSEUM

By Dr. F. B. JEWETT

PRESIDENT OF THE NEW YORK MUSEUM OF SCIENCE AND INDUSTRY

THE function of the New York Museum of Science and Industry is well stated in the paragraph from the will of Mr. Henry R. Towne. Mr. Towne saw the necessity in our mechanistic world of some agency capable of imparting to those who are not scientists and engineers an insight at once into the power as well as the limitations of technology when applied to the peaceful arts. The dynamic museum featuring both the history and the present status of science and industry seems clearly indicated as that agency.

Such museums are newest in the family of institutions devoted to display. That they are late comers is not because men have only recently had the wit to create them. It is because until recently science, both fundamental and applied, has not provided us with a sufficient panorama to make such a display especially significant. So long as the things of science and particularly those which entered into our daily lives were few and largely unrelated, it would have been difficult, if not impossible, to use them as exhibits in a museum of technology should be used. There would have been too many gaps to make the road plain to any except the expert.

However, because of the tremendous acceleration of scientific research during the past fifty years and the flood of new applications of science which has poured in on us in consequence, we have come recently to recognize that a great revolution is occurring. We find ourselves in a world where many of our most powerful tools are tools with which man has had little or no real experience. True, we know how to use them in a material sense, but as to their ultimate effect on our tribal affairs we are still quite in the dark. We have tried vainly to control them by consulting the experience bequeathed to us by the fathers and we have found that they would not be controlled by the wisdom of that experience alone. They were part and parcel of a new order which demanded a broader understanding on our part.

Fortunately for us, as new things have multiplied and new difficulties have arisen, it has become apparent that these revolutionary things of science in whatever field they may touch our lives are all branches of a common trunk and that if we would control the branches we must know something of the trunk. It is always easiest to reason accurately from the particular to the general. The mass of us must come to have some knowledge of certain fundamentals of science and the scientific relationships which control much of the world we live in, if as a group we are to

avoid chasing forever those perpetual motion phantoms which we have chased so often in the recent past. We don't need to become scientists or engineers to form a fair judgment on broad policy matters. We do, however, need to have some group understanding of the fundamental laws of, say, modern transportation machinery and of the further possibilities and limitations of the science which underlies it, if we are to set up satisfactory rules governing transportation in the national interest.

It was with the idea of facilitating the acquisition of this simple fundamental knowledge of science as applied to industry that the original Museum of Science and Industry was started. It was not designed as a place where people could see a great heterogeneous collection of marvelous scientific engines or processes and thereby satisfy a jaded curiosity. Nor was it designed as a place where those who would become skilled in some particular field of science or engineering could come and acquire all that they sought. In a word, the museum was not designed to be a substitute either for the circus or the college, technical school or university. It was designed as a place in which could be displayed in simple logical sequence some of the more important applications of science to industry and human intercourse.

In such a museum there are three main objectives underlying the exhibits: (1) To show clearly to the non-scientific person the fundamental principle which runs through every stage of development of a science application from its first primitive appearance to its latest refined embodiment; (2) To emphasize the fact that even this latest embodiment is but a transitory stage in a continuously expanding evolution; (3) So far as is now possible, to bring home to the non-scientific a realization that every department of science is devoted to the portrayal of a common nature. No sharp lines of demarcation exist and progress in every field is made by using the same mental processes and following the same rigorous course in proceeding from the known to the unknown.

These three objectives have the common purpose of seeking to impress vividly the idea that the applications of science involve something much more of concern to society than mere material results. At the present time we are so surrounded with amazing applications of science which we have not fully assimilated and the imminence of more is so great that the most elemental dictates of self-interest should impel us to the broadest possible group understanding of the possibilities and limitations of science. Without a much better understanding than we now have we will continue to be the victims of every crazy wind that blows—the dupes alike of ignorant or selfish politicians and of equally ignorant or selfish promoters. It will be a slow process at best and many educational methods will need to be employed. Among them museums of science and industry established where population is dense will be powerful agents—powerful because they can present essential matter simply and vividly; powerful because they can bring together in one place and in an orderly panorama the normally scattered elements of a common problem.

Turning now to the more immediate service which a museum of science and industry can be to the industrial area in which it is located, it can, I think, be taken as axiomatic that industry flourishes best and the community has the highest average standard of living where all who are concerned with industry, from the lowliest workman to the chief executive, have the highest average understanding of the problems involved in industry. If proof of this were needed one has only to turn to the very general establishment by technical industries of out-of-hour courses of instruction and other methods of making available to all employees elementary information about the technical parts of the business. Such courses are not established and maintained merely for the cultural enjoyment of those who take them, but rather because of a well-established belief that the industry and all concerned in it profit in a material way by raising the level of understanding.

While it is true that the introduction of intricate automatic machinery into countries of low intellectual development and low living standards has created a serious problem for countries where such machinery originated, it is equally true that the mere introduction of such machines does not establish complete parity. In countries like our own I feel convinced that in the years ahead we will have to do considerably more in the direction of broad industrial education, especially in those industries which have arisen out of the practical application of scientific research, if we are to maintain a spread in living standards compared to lower standard countries.

If this conclusion is valid and I think it is, then every industry which is concerned about its permanent well-being and, more particularly, every industrial community must be continuously on the alert to raise the average understanding of its people. There is no single method by which this can be done nor can it be done once and for all in a short time. Many tools must be employed and the process must be unceasing. Further, in a process so gradual we can rarely expect to notice sudden or marked improvements.

Among the educational tools to be employed museums of science and industry loom large because of the characteristics enumerated earlier. Every industrial community of sufficient size can well afford to maintain such a museum and every industry in the

community can afford to lend its support—both, if you wish, from the most sordid of material self-interest motives. Museums of this kind are the cheapest as well as the most effective way of disseminating certain kinds of basic information. Nor need the museums be of a common size or a common pattern. Each one can be fitted to the particular needs of its own community.

Further, no industry, large or small, can long escape being cited before the bar of public opinion as to some phase of its operations. When that time comes, if we feel we have a just case, we will wish for a public jury that has some understanding of our problems and not one moved wholly by its emotions.

Just now we are obviously in the midst of a revolution many of the roots of which are in the results of applied science. With most of the officially advocated proposals to rectify our situation and with the time elements talked of I am entirely out of sympathy. To me their proponents seem grossly ignorant of the economic forces inherent in applied science; of the limitations of human beings and their essential conservatism as to the established order of life no matter what they may do occasionally in periods of blind rage.

The waves of our present turmoil will not subside into the new order for years to come. In so far as the storm which created them involves the results of applied science, the oil of a wider understanding of what science can and can not do will accelerate the return to more quiet and prosperous conditions. In this a museum of science and industry can play a powerful rôle. In my judgment, we will get more of real value and results from this than from chasing phantoms of trying to turn the pages of life backward or of seeking plenty through destruction. To me such proposals are the proposals of ignorance and of a philosophy of defeatism which does scant justice to human intelligence.

OBITUARY

LEOPOLDO A. FAUSTINO

THE news of the untimely death on November 8, of Dr. Leopoldo A. Faustino, assistant director of the Bureau of Science in the Philippines and formerly geologist and paleontologist in the division of mines of that bureau, has just reached me, and I hasten to contribute a few words of appreciation of this Filipino scientist. Young Faustino was an assistant in the mining division when I was serving a second term of service as chief of that division in 1920–22. He had some years previously finished his undergraduate work at Ohio State, and realizing his promise, I urged him to go to Stanford University for work toward his doctorate. As Faustino was particularly interested in the corals of the Philippines, he was urged by the late Professor J. P. Smith to spend some time in Washington with Dr. T. Wayland Vaughan, who guided him in this special field. Finally his work on Philippine corals resulted in the doctor's degree at Stanford University.

His publications mark the first signal contributions by any one of his race to the geology of the Far East which have come to my attention. He was one of the foremost in that group of young Filipino leaders of a new order. Dr. Faustino had an unusual appreciation and understanding of the efforts being made by the United States in his native land, and of all the young men I knew over there, he more nearly thought and spoke like an American. He was singularly modest and conservative in his scientific opinions and was greatly liked by his American colleagues.

It is too early to appraise the work of Faustino and his Filipino associates, but we dare say that long after many of their more publicized compatriots have been forgotten, the influence of these young scientists, representatives of a new order in the Far East, will be felt.

I feel that the young Philippine commonwealth has suffered an untimely loss in the passing of this able young scientist, and I know that I have lost a genuine friend.

WARREN D. SMITH

RECENT DEATHS

DR. SAMUEL AVERY, research professor of chemistry at the University of Nebraska, died on January 25, at the age of seventy-one years. Dr. Avery was chancellor of the university from 1908 to 1927. Previously he had been professor and head of the department of chemistry.

DR. ELWOOD MEAD, since 1924 U. S. Commissioner of Reclamation, died on January 26, at the age of seventy-eight years.

DR. GEORGE GELLHORN, professor of clinical obstetrics at the School of Medicine of Washington University, St. Louis, died on January 25, at the age of sixty-five years.

THE death is announced on January 18, at the age of sixty-one years, of Dr. Hollis Godfrey, consulting engineer, of Duxbury, Mass. From 1906 to 1910 Dr. Godfrey was head of the department of science in the School of Practical Arts in Boston and from 1913 to 1921 president of the Drexel Institute, Philadelphia.