Chicago's 1933 World's Fair—has been published by Williams and Wilkins. The title is "The Queen of the Sciences" and the author is Dr. E. T. Bell, professor of mathematics at the California Institute of Technology. The books in the series will be written in a non-technical style. Each will deal with some phase of the advance of science and invention during the past century. The series will be published, one book at a time, throughout 1932 and the early part of 1933. The books will average from 25,000 to 30,000 words each. The program includes a book on the automobile, giving an insight into the industry and its effects on society, by Mr. C. F. Kettering, of the General Motors Corporation; a book on communication—radio, telephone, telegraph—by Major-General Squier; on astronomy by Dr. R. H. Baker, of the University of Illinois; on chemistry by Dr. L. V. Redman, of the Bakelite Corporation; on steel and its relation to people, by Dr. G. M. Eaton; on electrochemistry, by Dr. G. L. Mantell, and on development of the evolutionary theory, by Dr. H. H. Newman.

The Experiment Station Record reports that because of the financial depression, reductions were made by the last Nebraska legislature in appropriations for most of the expending agencies of the state. The direct tax appropriation for the University of Nebraska was reduced approximately 5 per cent. as compared with two years ago, and of this amount the station assumed approximately 4 per cent. of its direct tax appropriation. The revolving funds made up of cash receipts have also been reduced by the lower prices received for farm products. Provision was made, however, for some building, the College of Agriculture being allotted $15,000 for cottages for the North Platte Substation and $75,000 for rebuilding the animal husbandry building, partially destroyed by fire during the spring, while a special appropriation of $20,000 was made for a shop building at the Curtis School of Agriculture.

ACCORDING to *Museum News*, the Greater St. Louis Museum of Natural History, which was incorporated October 30, 1930, is planning to erect a building and has had plans drawn by W. P. Manske and associates. It will provide quarters for departments of astronomy, including a planetarium, geology, zoology, anthropology and related subjects. The first three floors of the building are planned to house exhibits of the above-mentioned subjects in natural settings. On the fourth and fifth floors the plan places scientific collections, laboratories and curators' offices. The fourth floor also provides for an extensive library on the natural sciences. The planetarium will be on the fifth floor. The ground floor is to have a lecture hall with a seating capacity of 800; also a cafeteria and kitchen. The exhibit floors will be inclined so that no stairways nor elevators will be required, although these will be available for those who desire to use them. It is proposed to erect the museum building on the Memorial Plaza, a downtown location, covering a block 300 feet square. The building will cost approximately three million dollars and the museum association will seek a bond issue for this purpose. Mr. Hermann Schwarz is president of the organization and Mr. Edwin P. Meiners is secretary-treasurer.

DISCUSSION

IS THE EMBRYO SAC A MEGASPORE?

SEVENTY-FIVE years and over seems a long time for a misconception of fundamental importance to have been persistently associated with one of the most classic contributions to the science of botany. Yet such an anomaly exists in connection with Hofmeister's comparative researches of the middle of the last century—researches which paved the way in the plant world for the reception of the biological principles that Darwin announced a few years later. When Hofmeister established homology between the free-sporing condition in the vascular cryptogams and the seed habit of the higher forms he unfortunately chose for comparison with the seed plants certain of the heterosporous forms of the vascular cryptogams. His points of comparison are interesting from the fact that difference in size of spore, the basic feature of heterospory as ordinarily understood, is not one of them. Even in the figures that he used to illustrate his work there is no hint that he regarded difference in size of the spores in the seed plants as important. In fact, Hofmeister seems to have carefully avoided, whether intentionally or not, any reference to the embryo sac as being a large spore, stating his epoch-making generalization simply as follows: "Der Embryosack der Coniferen lässt sich betrachten als eine Spore, welche von ihrem Sporangium umschlossen bleibt." Since Hofmeister's time, however, it has been universally assumed among botanists that the ovule does contain a big spore (*mega-* or *macro*-spore) and that the seed plants are heterosporous with regard to size, some botanists even going so far as to suggest that the larger the female spore the greater the chance of its being retained. The anomaly of this situation would have been long ago apparent had any one taken the trouble to measure and compare the size of the male and female spores in the seed plants, since the pollen or male spores are in some cases even larger than the female spores, and when the reverse is the case the difference

is insignificant when compared with that in the heterosporous vascular cryptogam where the large spore may be as much as 30,000 times the bulk of the small one.

If excuse be sought for not making measurements where size is concerned it may perhaps be found in two things. The female spore of the seed plants (the embryo sac initial cell) does not look like a spore since it has a very thin wall, no storage products (such as starch, oil, etc.), and is in intimate contact with surrounding nutrient cells. In the second place, it does not long remain a spore, soon undergoing prothallial development and increasing very rapidly in size. The large size at this stage of development does undoubtedly tend to make one assume that the spore must originally have been large, without troubling to measure it. How different, however, is the true megasporous conditions. Nearly all, if not the whole, increase in size of the megaspore over the microspore occurs before prothallial development begins, and the food supply from the mother plant is stored in the spore, where it is protected against the vicissitudes of the free-sporing habit of the resting stage by a thick suberized coat. It can get no further supply from the mother plant, either during prothallial or embryonic development, whether the spore be shed at once or retained longer in the sporangium. In contrast to this, the enclosed spore of the seed plants starts out small, grows rapidly while undergoing its prothallial and embryonic development, and finally ceases growth and comes to its resting or storage stage only when the ovule has matured into the seed.

It is not intended in this statement to go farther into the *proof* that the seed plants are homosporous[1] but to refer briefly to some of the anomalous statements that are included in our text-books because of the assumption that the enclosed spore of the seed plants is a megaspore. In the first place the classic text-book choice for comparison with the seed plants is selaginella, although very often in some other part of the same text there is found a statement that the fern ancestry of the seed plants has been demonstrated beyond doubt. Perhaps if the text-book is an advanced one there may even be a statement that it is the eusporangiate ferns that show more relationship to the seed plants, the author often considering it necessary to apologize for drawing attention to these facts as the eusporangiate ferns are all homosporous, while the *Leptosporangiatae* contain many heterosporous forms.

[1] Those who desire measurements and further proof can find them in the writer's article on "Evolution of the Seed Habit in Plants," in the Transactions of the Royal Society of Canada. Third series, Vol. xxi, 1927, pp. 229–272.

In the text-book of the future, even if the author is still a confirmed megasporist, may we not at least ask that he insert a drawing to scale of the male and female spores of the seed plant, to give substantial and convincing visible proof of his view. He might also add to the ordinary comparison of seed plants and eusporangiate ferns a reference to such things as the similarity in mode of food absorption, organization and orientation of the embryo in the gymnosperms and certain of these eusporangiate forms. Perhaps an illustration of these pertinent features might be included, even if the ubiquitous figure of selaginella had to be omitted.

R. B. THOMSON

DEPARTMENT OF BOTANY,
UNIVERSITY OF TORONTO

WORK AND BODILY FATIGUE

THE text-book of physics, which I studied as a high-school student, said that no work was done in carrying a load along a level path. I knew this was incorrect because as a boy I had carried large forkfuls of hay along the loft floor of the barn, to be thrown down to the cows and horses below, and had become weary in well-doing.

A similar concept of work holds in the statement that no work is done in holding a mass out at arm's length. Just let any one who believes this statement hold a kilogram mass in this fashion for eight hours (union labor) and see if he thinks he has not been doing work! What is the discrepancy between these statements in our physics text-books and our experiences in life? Is it not fair to say that they should check with each other?

The Milwaukee Road has electrified its railway over the Rocky Mountains. Powerful electric motors draw the heavy trains up one side of the range and by a so-called regenerative braking system, much of the energy used in going up is recovered on the down grade. "This is accomplished by reversing the usual function of the electric motors, utilizing the momentum of the train to drive them as generators." (Quoted from "Running Trains with Running Water," published by C. M. St. P. and P. Ry.). In harmony with our physics text-books, no work is done

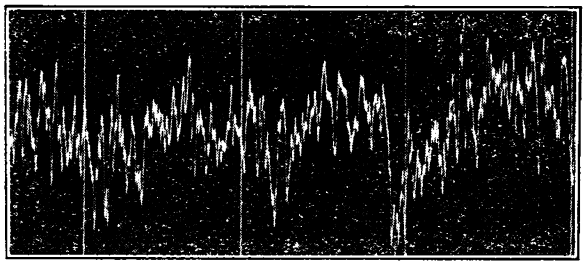

FIG. 1