Up to within less than a week of his death, while in bed, he worked with his invaluable assistant, Miss Mary Ross Calvert, upon the text of his "Atlas of the Milky Way" from negatives taken at the Yerkes Observatory and, for some of the more southerly fields, at Mount Wilson during a stay of some months at that observatory in 1905. This atlas, which he had hoped to finish during the present year, will be published by the Carnegie Institution of Washington. His close study of these magnificent photographs led him to distinguish sharply between what he held were vacant spaces in the galaxy and those due to opaque masses of matter lying on the near side of the star clouds. His great series of triangulations with the micrometer on many of the globular clusters were continued for a quarter of a century and will be published in due time. When he began them he expected to find internal motions within a few years, but, as he measured, his universe grew larger and even with the great Yerkes telescope he was able to find the slightest traces of motion only for a very few stars. His one hobby was his orchard, where he fought valiantly and scientifically the pests which would rob him of his fruit. His eye was keenly open to terrestrial nature about him and he never wearied in telling the beauty of the swelling bud, the marvelous structure of the oak ball, the mysterious career of the *Cicada septendicem* or the adaptation of form to mode of life of the lowly chigger.

Observing with a large telescope was to him as a sacrament and with his highly varied program of observation he would persist under atmospheric conditions which compelled other observers to desist. When he lectured, as he did often and well, he was not at ease until he became so completely engulfed in the flow of his presentation that his self-consciousness left him.

More than most men, he was beloved by his fellows for his unselfish charm. We, who have lived with him for many years, miss his light footfall in the corridor, his friendly smile and his charitable counsel.

Astronomy, which gave him his greatest pleasure in life, was herself immeasurably enriched by his restless activity for nearly half a century.

OLIVER J. LEE

SCIENTIFIC EVENTS

THE HABER PROCESS[1]

THE lecture delivered by Professor F. Haber on the award of the Nobel Prize at Stockholm on June 1, 1920, is printed in *Die Naturwissenschaften* for December 8. Professor Haber dealt first with the work done on the synthesis of ammonia before his first research in 1905. Practically nothing of importance had come to light, and the very small yields at ordinary pressures did not hold out much promise of technical application.

The early experiments of Haber, like most of those which have served as the foundations of great industrial undertakings, were made with a purely scientific object, and with no technical applications in view. The results obtained, however, soon made it clear that the basis of an important technical process could be found in ammonia synthesis, and further work was undertaken with this end in sight.

In 1908 the Badische Gesellschaft placed at Haber's disposal all the means requisite for the further progress of the research on the synthesis of nitric oxide in the electric arc which he had begun in 1907, but his proposal to undertake research on the synthesis of ammonia was received with open doubts as to the potential value of the method. The nitric oxide syntheses, in cooled arcs under reduced pressure, and in flames and explosions, were not found suitable for technical application, and attention was then turned to the stone which the builders had rejected. The judgment of the technical chemists of the Badische Gesellschaft had been at fault, since ammonia synthesis was ultimately a very real solution of the problem of the economic utilization of atmospheric nitrogen.

Ramsay and Young in 1884 had found that with nitrogen and hydrogen in presence of iron at 800° C. no ammonia was produced. This was found to be incorrect, and traces of ammonia were detected. Other catalysts were tried, and from the results it was evident that an equilibrium state was attained, from which it was possible to calculate the yields at other temperatures and pressures. No further progress was made, however, since it was judged by the technical experts to be impos-

[1] From *Nature*.

sible to carry out the reaction on the large scale at the temperatures required under the very high pressures indicated by the calculations.

In 1906 measurements under pressure were for the first time carried out by Nernst and Jellinek (these are not referred to by Haber), and in 1908 Haber in conjunction with Dr. Le Rossignol began experiments at higher pressures. The work of Le Rossignol (a British subject) is spoken of with great approbation, although his part in the achievement of success has perhaps not always received full credit in some quarters. The technical chemists were still unfavorably inclined towards the process, although practical yields had now been reached. By the use of new catalysts the temperature was lowered to 500-600° under a pressure of 200 atmospheres. In 1913 the process was taken up by the Badische Gesellschaft, but an account of the main scientific results was also published. The work of Dr. Bosch speedily led to the successful introduction of the synthetic ammonia process, and in the period 1913-1920 the capacities of the German factories rose from *nil* to 35,000 tons per annum in 1914, 850,000 tons in 1918 and 1,500,000 tons in 1920.

INTERNATIONAL SCIENTIFIC COOPERATION

THREE committees appointed by the Commission on International Intellectual Cooperation of the League of Nations held sessions in Paris at the end of December, namely, the committee on bibliography, the committee on matters pertaining to universities and the committee delegated to study into the question of intellectual ownership.

A report in the *Journal* of the American Medical Association states that the committee on bibliography is engaged in the coordination of bibliographic enterprises undertaken in the various countries, with a view to avoiding duplication of effort and assuring to scientists and investigators the advantages of a complete bibliography easily accessible. The committee on university matters is dealing with various questions relative to the organization of the international congress of universities. The committee, however, recognizes the fact that political conditions will not permit the convening of such a congress at present. But it is possible to take up at once an extended inquiry into the best means of bringing about a cooperation between the universities. Opportunity is offered also for the discussion of kindred questions, such as the publication of an annual catalogue containing a list of all the courses given in the universities of the world, and the creation of a bureau of information pertaining to universities.

The committee on intellectual ownership is studying more particularly the question of the extension of authors' rights in the field of science, so as to secure to the individual scientist and the field of science represented by his country a more adequate participation in the benefits arising from the utilization of his discovery. At present the system of patents protects only the inventor of the industrial application of a scientific discovery. The mathematician, the physician, the chemist and the biologist, whose scientific discoveries made possible the invention, derive no benefit either for themselves or for their laboratories from the utilization of their works. At the instance of the chairman, M. Bergson, the committee delegated M. Ruffini, professor in the University of Turin, to draw up a plan which, subject to the approval of the commission on intellectual cooperation and the council of the League of Nations, might be used to establish the juridical principles for international protection of scientific discoveries. Such a plan might serve later as the basis for drafts of laws which, with the necessary modifications, might be presented to the parliaments of the various countries. With this object in view, M. de Torrès y Quevedo, of Madrid, was designated to study the possibilities of applying, in a practical way, the juridical principles and the suggestions for legislation contained in the document to be drawn up by Ruffini.

RESEARCH SERVICE TO THE INDUSTRIES OF MICHIGAN

UNIVERSITY extension service to the manufacturing and technical interests of the state is being introduced to the Michigan manufacturer through the issuing and distribution of a booklet explaining the purpose and facilities of this special department.

Professor A. E. White, director of this de-