progress under the direction of the International Geodetic Association, and which is expected to yield the most reliable value ever yet determined in absolute units.

Other connections of varying degrees of accuracy had previously existed between these six stations. The new measures furnish direct connections of a very high degree of accuracy. These six stations have directly or indirectly been connected by various observations with nearly all the gravity stations of the world.

The work of deducing from the numerous connections between the gravity measures of various countries the best absolute values of gravity at the many points of observation scattered over the whole globe is peculiarly the duty of the International Geodetic Association, and is being performed systematically by that organization. In this investigation the gravity observations of 1900 furnish important new evidence.

The special value of these gravity measures of 1900 to the Coast and Geodetic Survey lies in the fact that they furnish the means of reducing accurately to absolute units all the relative measures made in the United States with the half-second pendulums during recent years. These values have up to the present time been reduced approximately to absolute units by assuming that the value of gravity at the Coast and Geodetic Survey Office is 980.098 dynes. This approximate value was adopted in 1892 and depends upon an absolute determination of gravity at Hoboken, N. J., and three comparisons of Hoboken with Washington by relative measures with three different sets of pendulums, and finally an absolute determination at Washington in 1889–90. In 1894 Mr. Putnam derived twenty-nine different values for gravity at Washington by utilizing all the connections available at that time between Washington and various stations at which absolute measures had been made by various observers from 1792 to date. The mean of these values was 980.107. As the individual determinations showed a wide range, 0.147, the value 980.098 cited above was retained. From the relative observations of 1900, combined with the preliminary published absolute value of gravity at Potsdam from the observations which are still in progress, the value of gravity at Washington is 980.111. This differs by one part in 77,000 from the approximate value adopted in 1892, and by only one part in 250,000 from the mean of the 29 values deduced in 1894.

JOHN F. HAYFORD.

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*THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.*

THE first conversazione of the Institute was held at Columbia University on the evening of April 12th. About 1,500 ladies and gentlemen attended and enjoyed a most pleasing entertainment. Through the courtesy of the University authorities every facility in the way of space, current supply and assistance in preparing exhibits was placed at the disposal of the exhibitors, so that the many new devices, etc., were shown in actual operation. The list of exhibitors was long and the character of the apparatus extremely varied, as might be expected from a function held under the auspices of a society which represents the connecting link between pure science and commercial engineering. Many of the names included are well known in scientific circles, but the exhibits were in every case novel and have created a standard which will tax the energies of the Institute to the utmost to repeat in future conversaziones. Many notable persons were present as guests of the Institute, among them President Low and numerous professors of Columbia. President Low was accompanied by Baron von Holleben the German Ambassador to this

country. Mr. Thomas A. Edison was among the distinguished electricians present, while a great number of colleges were represented by exhibitors and guests, Vassar sending a contingent of a dozen students interested in natural science.

Dr. Michael I. Pupin exhibited the original apparatus used in developing the recent invention for the improvement of long-distance land and ocean telephony which has recently been bought by the American Telephone Company. Mr. Peter Cooper Hewitt showed numerous samples of his recently invented high efficiency lamps. In these lamps mercury vapor is used instead of a filament, the lamp consisting of a long, cylindrical glass tube. At the bottom of each is some mercury, from which, when the current of electricity has passed through it, issues the vapor and a most peculiar colored light is emitted. It is half purple, half green. This is a disadvantage, but it can be obviated by the use of counteracting colored shades. In a room near the Hewitt lights were the akouphone and akoulalion invented by Mr. M. R. Hutchison. They are microtelephonic instruments, so constructed as to reproduce and intensify sounds and still preserve their quality, and many successful experiments were made upon deaf mutes, in which they were taught many new words during the evening. One of the largest lecture rooms of the university had been set aside for the use of Mr. Nicola Tesla, where he showed numerous interesting experiments with high-frequency currents.

Much interest was shown in the exhibit of European Nernst lamps, made by Mr. William J. Hammer, who also showed Weldemar Paulsen's new telephonograph and telegraphone, loaned by Lemvig Fog and Emil S. Hagemann of Copenhagen, Denmark.

These instruments receive telephone messages in the absence of the recipient and record them on a kind of magnetic phonograph, which repeats them when the one for whom they are intended returns.

Another exhibit of Mr. Hammer's was a collection of aëronautical pictures, comprising photographs of Professor S. P. Langley's aërodrome, Sir Hiram S. Maxim's flying machine, Santos-Dumont's dirigible airship, and Count Zeppelin's balloon; together with the balloon tests made during the Aëronautical Congress, at the Paris Exposition of 1900, and by the Aëro Club of France. Most of these photographs were taken by the exhibitor. Prof. S. P. Langley exhibited his latest form of bolometer for spectrum analysis and showed many drawings and diagrams of the principles and results obtained.

Professor W. S. Franklin exhibited a magnesia arc lamp, an electrolytic lamp on the Nernst principle, operating on 1,000 volts.

Professor Francis C. Crocker showed magnetic liquids, with apparatus in operation for showing the magnetic properties of liquids and for measuring their permeability, and Mr. Martin P. Rice, a new X-ray apparatus employing a modified form of Wehnelt interrupter. Radiographing of alternating currents was shown in a large room which could be darkened at will. The exhibitors were Professor Harris J. Ryan and Professor J. O. Phelon, and their method secured stationary and continuous diagrams of alternating current values by records made from the radiographs of a rapidly rotating cathode ray, the rotation being caused by the action of the current.

Professor Elihu Thomson had a most interesting exhibit consisting of a dynamo static machine and a new rotary electrical apparatus. The former contained a small direct-current motor, the windings of which were tapped and connected to two rings, giving a primary alternating current for the operation of a step-up transformer which gave a secondary current of about 20,000

volts, being capable, however, of regulation through a wide range. The tops of the alternating current waves of high potential obtained from this secondary transformer were used to charge a number of glass plate condensers in parallel. The rotating frame synchronously driven with the motor made the connection to the condensers periodically and in synchronism with the alternating current. The connection by the rotating frame is alternately in parallel and in series, the condenser plates being charged to 15,000 volts with ten in parallel, giving 150,000 volts when connected in series. The machine therefore furnishes from low pressure direct current, high potential discharges of definite polarity at the discharged terminals. The new rotary electrical apparatus consisted of an iron sphere heavily electroplated with copper and mounted so that it may revolve on any axis or in any plane. Surrounding this sphere were three coils in planes at right angles to each other. By suitably energizing these coils with polyphase current the sphere was made to revolve on any axis or in any direction, thus illustrating a three dimension polyphase system. This apparatus shows in a very satisfactory manner the principles of the gyroscope and Bohnenberger sphere.

Professor Thomson also exhibited an aluminum disc mounted on a shaft free to rotate, and having applied to it in special ways alternating current magnetic fields, the rotations of the disc involving interesting paradoxes which the visitors were asked to explain.

Mr. E. V. Baillard showed the Parker-Baillard bridge for measuring low electrical resistances for general work and standardization and an ingenious faradmeter for the direct measurement of capacity. Some interesting spark experiments, showing oscillating discharges occurring rapidly during the same half wave, and proving that a short circuit in a high potential current containing inductances and capacity ruptures itself instantly, were shown by Mr. W. S. Andrews who also exhibited a luminous aluminum cell giving beautiful effects.

Among the many other exhibits were various forms of storage batteries by Mr. Elmer A. Sperry, Mr. Herbert Lloyd, Mr. A. S. Hubbard and Messrs. Frank Perret, J. A. Barrett, and W. H. Meadowcroft. Mr. H. R. Palmer showed a fac-simile picture telegraph in operation, Mr. Otto T. Louis an electric furnace and an ohmmeter. A specimen of the standard United States Army field telephone and telegraph kit used in the Cuban and Philippine campaigns, and wireless telegraphy as improved by the Government, were in charge of Col. Samuel Reber, U. S. A.

W. C. ANDREWS.

## SCIENTIFIC BOOKS.

*Erinnerungen aus meinem Leben.* Von A. KÖLLIKER. Leipzig. 1899. 8vo. Pp. x + 399.

This work of the veteran celebrated histologist is much more than an autobiography, since it includes a number of original contributions to science, with which the anatomist and embryologist must necessarily acquaint themselves.

The first part is strictly biographical, giving a general account of the author's life, which passed without exciting elements along academic paths. Kölliker was born at Zürich, in Switzerland, on July 6, 1817, the elder of two children. He dwells somewhat upon the recollections of his boyhood, recalling with pleasure a few boyish escapades. He early displayed great fondness for nature; he loved the mountains and made collections of plants and minerals, and therefore was led naturally to the study of medicine. But practice had no allurements for him, especially since he soon fell under the spell of the microscope, as a revealing instrument, in the employment of which he has spent his long life. In the summer of 1839 he went to Bonn, hearing there medical lectures in Latin, and the autumn of the same year he passed to Berlin and came under the