

first place in animal life not to the animal like a greyhound on two legs; but to the middling lamb, or perhaps to the ubiquitous rabbit. Australia is the same island continent that it always was; there are the same indentations of coast, the same mountains and rivers, but the face of the land is different. In past years there was no town, and the country was wilderness; on the surface of the wilderness many of the living things were different; and from under the earth has come water and mineral, the existence of which was not suspected. A century hence it will be different again, and I want to see sets of maps illustrating more clearly than is now the case the changes which successive generations of men have made and are making in the face of Australia and of the whole earth.

More than half a century ago Buckle, in his "History of Civilization," wrote: "Formerly the richest countries were those in which nature was most bountiful; now the richest countries are those in which man is most active. For in our age of the world, if nature is parsimonious we know how to compensate her deficiencies. If a river is difficult to navigate, or a country difficult to traverse, an engineer can correct the error and remedy the evil. If we have no rivers we make canals; if we have no natural harbors we make artificial ones." These words have a double force at the present day and in the present surroundings, for nowhere has man been more active as a geographical agency than in Australia; and not inside Australia only, but also in regard to the relations of Australia to the outside world.

An island continent Australia is still, and always will be, on the maps. It always will be the same number of miles distant from other lands; but will these maps represent practical everyday facts? What do miles mean when it takes a perpetually dimin-

ishing time to cover them? Is it not truer to facts to measure distances, as do Swiss guides, in Stunden (hours)? What, once more, will an island continent mean if the sea is to be overlooked and overflowed? The tendency is for the world to become one; and we know perfectly well that, as far as distance is concerned, for practical purposes the geographical position of Australia has changed through the agency of scientific man. If you come to think of it, what geography has been more concerned with than anything else, directly or indirectly, is distance. It is the knowledge of other places not at our actual door that we teach in geography, how to get there, what to find when we get there, and so forth. The greatest revolution that is being worked in human life is the elimination of distance, and this elimination is going on apace. It is entering into every phase of public and private life, and is changing it more and more. The most difficult and dangerous of all Imperial problems at this moment is the color problem, and this has been entirely created by human agency, scientific agency, bringing the lands of the colored and the white men closer together. Year after year, because distance is being diminished, coming and going of men and of products is multiplying; steadily and surely the world is becoming one continent. This is what I want geographers to note and the peoples to learn. Geographers have recorded what the world is according to nature. I want them to note and teach others to note how under an all-wise Providence it is being subdued, replenished, recast and contracted by man.

CHARLES P. LUCAS

PROFESSOR HUGO KRONECKER

HUGO KRONECKER, for the last thirty years professor of physiology at the University of Berne, Switzerland, died June 6. Although

seventy-five years old, death surprised him in the midst of scientific activity. He attended the last meeting of the German Congress of Physiologists at Berlin where, on the fifth of June, he demonstrated experiments which should support the neurogenic theory of the origin of the heart beat. On his way home he stopped at Nauheim, to inspect an apparatus which he installed there for the study and use in cardiac diseases. His death came there, suddenly, like a flash—perhaps by means of the cardiac center which he discovered thirty years before.

Kronecker was one of the last of a classical period in German physiology. He was pupil, assistant and intimate friend of the master minds of that period: Helmholtz, du Bois-Reymond and Carl Ludwig. At the same time, he was master and friend of many leading physiologists of a later generation and of many countries; he was an international leader in his science.

He was born in Liegnitz, Prussia, from a well-to-do family with scientific proclivities. The celebrated mathematician Leopold Kronecker was his older brother. After finishing his general education at the Gymnasium in Liegnitz he studied medicine in Berlin, Heidelberg and Pisa (Italy). In Heidelberg he came under the special influence of Helmholtz, who introduced Kronecker into the science of physiology. The problem of muscular fatigue which Kronecker studied first under Helmholtz and which he treated in his thesis became the source of many important investigations which he carried out at various times during his scientific career. In 1865 he became assistant to Traube. This celebrated clinician was the first man to employ experimental physiology for the study of medical problems. It was probably due to the early influence of Traube that Kronecker acquired the inclination to make results, obtained in physiological studies, available for clinical medicine. On account of a temporary pulmonary affection, Traube sent him to Italy where he stayed for some time, an incident which left a mark upon Kronecker's future activities. The acquisition of the knowledge and the use of the Italian lan-

guage was unquestionably a factor in his future intimate relations with the Italian physiologists. He recovered his health and even served in the Prussian wars with Austria and France. In the Franco-Prussian war he received the iron cross for bravery. In 1868 he entered Ludwig's celebrated "Physiologische Anstalt zu Leipzig," where he remained until 1876, becoming assistant in 1871, and professor extraordinarius in 1874. In 1877 he was called to Berlin to become the head of the division of experimental physiology in the Institute of Physiology which had been recently organized by du Bois-Reymond. In 1884 he was called to Berne, where he filled the chair of physiology until the last day of his life.

Kronecker's scientific activities extended over more than half a century; his thesis appeared 1863. But the investigation which raised him to the rank of a first-class physiologist was his work on "fatigue and recovery of striated muscles" published from Ludwig's laboratory in 1872. The careful planning of the experiments, the exactness and skill with which they were executed and the sharp analysis which permitted the derivation of general laws put a classical stamp upon this piece of work; its celebrated tracings were the starting point for many future ergographic studies. The later work during his Leipzig period was mainly devoted to the cardiac muscle; some of the results found a permanent place in physiology. I may mention here the development of the "all or none" law; the loss of irritability of the cardiac muscle during systole (refractory period, Marey); the importance of inorganic salts for the heart beat (with Merunowitz and others). Of his many investigations during his Berlin period I should mention the studies which led up to the use of transfusion as a life-saving means (present-day writers do not seem to know that Kronecker was the inventor of this method); the extensive studies (with his collaborators) on the physiology of deglutition; the discovery of a coordinating center in the heart. I wish to record here the fact that Kronecker had an essential share in the development of the clinically important methods of studying blood pressure in human beings. The

first human sphygmomanometric studies are usually ascribed to Von Basch; but Von Basch carried out these studies in Kronecker's laboratory and under his direction and assistance. I can testify to that as an eye-witness.

During his long stay in Berne a great many physiological subjects were investigated in conjunction with advanced coworkers or students. The results were usually published under the name of the coworkers. In the last years of his life he was intensely interested in experiments which could throw light upon the origin of the heart beat; he was a firm believer in the neurogenic theory.

A subject in which he took a great interest in the last two decades of his life was the nature and origin of mountain disease. The Swiss government, before granting permission to build the now famous Jungfrau railroad, asked Kronecker to pass an opinion, whether going up a high mountain in a railway would be accompanied by mountain disease and other disturbances of health. This gave rise to numerous studies connected with this question. Kronecker organized a party of sixty, who ascended the Zermat Breithorn; some of the party were carried up, in order to eliminate muscular action. Circulation, respiration and other functions were then investigated. The problem was also studied in pneumatic chambers with lowered atmospheric pressure. Kronecker came to the conclusion that the syndrome of mountain disease was primarily due to mechanical causes, to a stasis in the intrapulmonary veins, brought about by rarification of the air in higher altitudes. Kronecker's publications gave rise to many international studies which caused the Italian physiologist Mosso, with the aid of Kronecker, to establish an international institute on Monte Rosa for the study of physiological phenomena in the mountains.

Kronecker was a master in physiological methods; he invented many instruments which found a permanent place in the methods of experimental physiology, of which I shall mention here only his well-known induction coil, divided in units, the "perfusion canula" and the frog heart manometer. The perfusion

canula (or its modification) has been and still is extensively used in pharmacological studies upon the frog's heart.

In the seventies, during Kronecker's stay at Leipzig, Ludwig's physiological institute was an international center for physiology and physiologists. Many English, Italian, American, Russian, Belgian, Scandinavian and French physiologists received there their training in physiology. Kronecker, who spoke many languages fluently, has been of great assistance to them. With his very kind, unselfish nature he was always ready to help them with his rare experimental skill and in every other direction. Many who worked there during that period bear witness that Kronecker was the "soul" of the laboratory. Here he formed strong bonds of a lifelong friendship with men who became later international leaders in science. I need only mention here Bowditch and Minot of the United States; Lauder Brunton, Gaskell and Schäfer of England; Alberto Mosso and Luciani of Italy; Paul Heger of Belgium and Holmgren of Sweden. Very few men had the happiness of having so many true friends as Kronecker, and few could be a truer friend than he. He had the esteem and affection of all who had the good fortune to know him well.

His international, cordial relations to so many physiologists of so many countries was not a small factor in the success of the International Congress of Physiologists, which was founded by Michael Foster and Kronecker. In his obituary of Sir Michael Foster, Gaskell states that "when the International Medical Congress met in London in 1881 he (Foster) and Kronecker together drew up a scheme for a separate International Congress of Physiology to meet every three years and a committee was formed." According to Heger the final decision, to call that Congress into being, was made by a group of physiologists who met September, 1888, in Kronecker's house in Berne. The third International Congress met in Berne under Kronecker's presidency.

Kronecker was also the chief founder and for some time the president of the Institut Marey in Paris, an international institution

for the study of physiology by the newest and most approved methods.

The Hallerianum, Kronecker's magnificent physiological laboratory in Berne, has been for years an international center for physiological investigators. English, American, Italian and Russian students went there to learn methods and to be initiated in physiological research. Well-known physiologists often worked in this laboratory, for instance Cyon, Gamgey, Heger and others. At his attractive home, presided over gracefully by Mrs. Kronecker, a cultured lady and an accomplished linguist, one often met celebrated scientists from all over the world. Kühne, Mosso, Bowditch, Schäfer and Foster were often there.

Kronecker was a foreign member of our National Academy of Sciences, of the Royal Society and of many European Academies. He had conferred upon him honorary degrees from a great many universities. In England alone he received the degree of LL.D. from the universities of Glasgow, Aberdeen, St. Andrews and Edinburgh, and the degree of D.Sc. from Cambridge.

He had pupils all over the world. Of American investigators who worked under Kronecker at one time or another I shall mention only the following: Mills, Stanley Hall, Cushing, Gies, H. C. Jackson, H. C. Wood, Jr., Cutter, Carter, Busch, Mühlberg, Mays, McGuire, Arnold and Meltzer.

Before concluding I wish to call attention to the following few incidents which bear witness to the nobility of Kronecker's character. The phenomenon of the "refractory period" which is generally ascribed to Marey, was observed and clearly described by Kronecker one year before Marey. Kronecker never made any effort for the recognition of his priority, and both physiologists remained intimate friends during their entire life. I have mentioned above that Kronecker had a share, at least equal to that of Von Basch, in being one of the first who introduced the era of studying blood pressure in human beings. But when Von Basch and others neglected to give him credit, we find Kronecker nowhere making an effort to obtain his rights.

Kronecker's studies of the nature of mountain disease was a stimulus which gave rise to researches on that subject by many other investigators, among whom I shall mention Zuntz and Loewy and A. Mosso, who came to results differing from those of Kronecker. It was, however, in Kronecker's laboratory that Loewy made the analyses of his results, and I have been a witness of the attractive scene when Mosso was introduced by Kronecker to his students to lecture on Mosso's theory of acapnia as the cause of mountain disease, a theory entirely at variance with that of his own.

Kronecker had many scientific disputes and was often energetic and perseverant in the defense of his views. But he never permitted a personal note to slip into his discussions.

Physiology lost in Kronecker a master and a leader, and numerous physiologists all over the world lost in him a noble and kind-hearted friend.

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SCIENTIFIC NOTES AND NEWS

Dr. A. PENCK, professor of geography at Berlin; Dr. F. von Luschan, professor of anthropology in the same university, and Dr. J. Walther, professor of geology and paleontology at Halle, are among the German men of science who accepted invitations to attend the Australian meeting of the British Association. It is said that there is some anxiety as to how they shall return home. If press despatches are to be believed, several German astronomers, including Professors Kempff and Ludendorf, who had gone to the Crimea to observe the eclipse of the sun, have been taken prisoners and their scientific instruments confiscated.

THE Paris Academy of Sciences has placed itself at the disposal of the national defense. This resolution having been communicated to the government, members have been placed on commissions on the subjects of wireless telegraphy, aviation, explosives, hygiene and medicine. The academy is said to be continuing its meetings. A paper was presented at the last meeting of which reports are at hand on the recent eclipse of the sun by Messrs. Bailaud and Bigourdan, of the Paris Observatory.