water by sperm also floating free in the water was no longer possible in land vertebrates. From the knowledge gained by study of the development of the respiratory mechanism,[2] one may look forward to finding a similar extensive and profound change in the neuro-muscular as well as glandular mechanisms in the development of the reproductive system of land vertebrates. The internal fertilization of the ovum and its subsequent encasement in a calcareous shell is, indeed, an advance shown by reptiles and birds over fish and amphibians. The process seemed adequate for the needs of the poikilothermal reptiles which left the eggs in the sand and fared forth in search of food. With the development of homoiothermal conditions in birds the sand no longer possessed sufficient constancy of temperature. Nest-building, incubation and the consequent restriction of range during the period of incubation were necessary developments. The restriction of range would be a serious handicap to any form in which search over a considerable region is necessary for obtaining food and water. The viviparous habit, appearing sporadically in fish and reptiles, has become constant in mammals. It is difficult to imagine animals with the other characteristics of mammals but without the viviparous habit or without the development of the reproductive system of mammals.

From the point of view of the student of comparative physiology we have, in the development of the reproductive system, a shifting of old afferent, efferent and central nervous endings as well as the development of new nervous and muscular structures which is at present an unknown and unworked field. The fundamental biological need for sex arose much lower in the animal phylum than the vertebrates and seems to me to be related more to the problem of regulation of body form[3] than to some of the other phenomena which have been associated with it in biological thought. The failure of parthenogenesis in all but the simpler forms becomes intelligible or understandable when considered in relation to regulation of body form. The thing to be explained about parthenogenesis seems not so much its occurrence in some forms as its absence in the higher forms. Regulation of body form implies a regulation of some sort of growth and development of all the constituent cells of the organism. Such control would obviously be impossible if ova were parthenogenetic and likely to start development at any time. Control of development, which is a necessary postulate for regulation of body form, means also control of fertilization. Such control of fertilization could hardly exist without sex.

[2] F. H. Pike and H. C. Coombs, SCIENCE, 56: 691, 1922. M. G. Springer, "Archives of Neurology and Psychiatry," 19: 834, 1928.

[3] F. H. Pike, *Ecology*, 4: 420, 1923.

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THE INVENTION OF THE DYNAMO

THE mistake that was noted in SCIENCE concerning the celebration last spring by the Franklin Institute has been corrected by Dr. Thomson's letter. It will be interesting, I think, to give some data as to the first dynamo of which there is positive information. This was constructed by Joseph Saxton, an American, resident at the time (1833) in England. He presented a description of it to the British Association for the Advancement of Science at its meeting that year. The original instrument is now in the collection of the Franklin Institute and is figured, with many other interesting early inventions, in the article I wrote for the booklet published on the occasion (1924) of the Centennial celebration of the founding of the institute.

The *Journal* of the Franklin Institute for 1834 (vol. 17, p. 155) contains an extract of a letter from Saxton to Isaiah Lukens, of Philadelphia, in which he says among other things: "Since writing to you last I have fitted up a magnet, which I believe produces much more powerful electrical effects than any other which has yet been made. It weighs five pounds and a quarter, and has a permanent power capable of supporting ten pounds. By the aid of this magnet, I can decompose water rapidly, and the shocks given to the tongue and mouth are so violent that few will take them a second time."

The investigation as to the efficiency of the dynamos for sale in 1878 was in charge of a sub-committee composed of Messrs. E. J. Houston, Elihu Thomson and Theodore D. Rand. Mr. Rand was in the banking business and was a mineralogist of ability, who industriously searched the vicinity of Philadelphia and enriched the local collections with many valuable specimens. It is stated in the final report that "Mr. Rand's business engagements prevented his taking active part in the work of this sub-committee."

Regarding the dynamos exhibited at the Centennial Exhibition the reports and awards of Group XXV in the official volume published by the exhibition authorities (item 24, page 136) state: "Several specimens of the well known Gramme machine without steel magnet constitute this collection and some of them were shown in action producing the electric light." Another volume of the reports states that one of Farmer's machines was also exhibited.

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IN the issue of SCIENCE for September 14, Professor Elihu Thomson makes it quite clear that the celebration in Philadelphia last April (referred to in SCIENCE for April 13, May 25 and August 3) was neither in fact nor intent a celebration of the fiftieth anniversary of the *invention* of the dynamo, as had been reported. It was unfortunate that reports misled some of us into believing that this was its intent.

Professor Thomson also calls attention to various magneto-electric machines with permanent magnets, preceding the dynamo-electric machines (commonly referred to as dynamos) with electrically excited fields which were shown at the Centennial Exposition in 1876. Electrically excited fields made possible large machines capable of regulation, and their use was an important step in the development of the electrical art of to-day, an art in which Professor Thomson himself has always taken a leading part. The exhibit at the Centennial of the first dynamo-electric machines, two made in France and one in America, was, therefore, of historical importance. So also was the report published by the Franklin Institute two years later on the first scientific tests made on this type of machine. This report is noteworthy and deserving of commemoration.

FREDERICK BEDELL

QUOTATIONS

A MONUMENT TO MEDICINE

DR. SAMUEL W. LAMBERT, in his address at the dedication of the Medical Center, described this monumental group of tall buildings as "a veritable Tower of Babel"—in view of the variety of scientific languages to be spoken there. But with this the analogy ends. The ancient tower failed of completion because of the sudden confounding of tongues. But in this modern community of towers all that the art and the science of medicine have to offer, each in its own speech, is brought together into a unity. This promises to be perpetual, under one roof—a roof so high that, just as the ancients hoped the gods might visit mortals, the builders have made it possible for the heavens to touch mankind with healing.

No such monument has ever before risen to medicine as was dedicated on the western rim of Manhattan Island. Another will soon arise on the eastern rim. Together they will be a vast fortress of defense against disease, and on their towers scientific watchmen will stand not only to give warning but also to fight day and night against the swarming bacterial infections and toxins and heal the wounded. The people of this city and the surrounding region should long be grateful to Mr. Edward S. Harkness and his mother because they kept this site through many years in prospect of such beneficent use, when the plans could be perfected and the funds found for this great enterprise, in which realization he had also a large part. It may be hard for those who have great riches to enter the Kingdom of Heaven, but this achievement demonstrates that it is not an impossibility. The vision of Mr. Harkness has literally brought into the midst of this greatest city a smaller city of refuge which is as one "let down from Heaven."

Its significance, as was again emphasized at the dedication, is that it is devoted to "the trinity of medicine": the care of the sick, research and teaching. This is not by any means unique, but never before have the three services been coordinated in one institution on such a scale and with such endowment and equipment. Even so, it is not as yet complete, and will not be till every specialty of medicine and surgery has not only its dispensary but also its wards for the care of patients, and until provision is also made for dormitories and a common dining-hall for the students of medicine. But what has been already secured is so vast and varied that those who have planned and labored through years must feel that their noble project has been brought to full fruition. The academic degrees bestowed upon them are but a handsel of the praise and gratitude that will be paid in for years to come, and should, in the phrase of Sir Thomas Browne, author of "Religio Medici," make them "happy enough to pity Caesar."—*The New York Times.*

SCIENTIFIC APPARATUS AND LABORATORY METHODS

FURTHER STUDIES IN QUANTITATIVE VIROLOGICAL METHODS

PRELIMINARY studies[1] on the virus of light-green mosaic of tobacco indicated that discrepancies in quantitative tests and variations in the initial concentration of virus in fresh extracts are caused by several factors. The relative importance of some of these factors is being determined.

Quantitative inoculation tests have been made in full and in reduced daylight and in artificial light. Such tests have also been carried out in full daylight at fairly high (77 to 85° F.) and low (55 to 60° F.) temperatures, representing extremes which might be encountered in greenhouses during the year.

The results indicate that the number of mosaic-infected plants which develop is influenced to a less

[1] H. H. McKinney, "Quantitative and Purification Methods in Virus Studies," *Jour. of Agr. Research*, 35: 13–38, 1927.