

We might leave the subject here, but considering the vogue that the mutation theory of evolution has had, it is proper to consider whether any definite cause for these mutations can be found, and if so, what relation this cause bears to the reactions which set up habits.

Nothing has been more remarkable than the consensus of opinion of the upholders of the mutation theory that mutations are due to "chance," and yet, as Huxley remarked, one had hoped that a belief in chance had been finally exploded. Quite recently, however, a physiological cause for mutations has been suggested by Tornier, and much evidence in favour of it has been collected by him. The special subject of his investigations was the goldfish. The most bizarre races of this creature have appeared, and these races when crossed produce offspring which obey the Mendelian rules. Now Tornier showed that the races of goldfish had been derived from a small species of carp which inhabits the rivers of China. He found that the Chinese breeders kept their stock in small dark jars under insanitary conditions in which they were scantily supplied with oxygen. Much of the spawn died, and among the survivors all sorts of abnormalities turned up; from these the most striking specimens were selected and used to found the new breeds. These facts suggested to Tornier the view that the cause of the mutations was the weakening of the developmental energy of the germ by the abstraction of oxygen during an early and critical period of development.

Tornier showed that this weakening had two consequences: (1) it made the embryo sluggish in its movements; and (2) it diminished its power of regulation of the various processes on the harmonious co-operation

of which the upbuilding of the body depends. Thus enormous fins were produced by the swelling of the yolk in consequence of undue absorption of water underneath the skin-area from which the fin developed, telescopic protruding eyes by the engorgement of the growing eyeball with water, and so on. By treating the eggs of newts and toads in such a way as partly to suffocate them for a short period after fertilisation, similar embryos were produced. Independently of Tornier, Jansen had arrived at a similar explanation of the cause of human deformities, the part played by the pressure of the swollen yolk in the goldfish's egg being assumed in the human embryo by the pressure of a too closely adherent amnion. What is inherited is, according to Tornier, not a factor or gene for an enlarged fin or protruding eye, etc., *but a certain grade of germ-weakness which in each succeeding generation produces the same morphological effects.*

If this view is correct—and all the evidence available conspires to show that it is—then mutations can have played no part whatever in evolution. Since they are the outward and visible signs of a weakened constitution, they are in a state of Nature ruthlessly weeded out by natural selection. Nevertheless they, like functional adaptations, are the result of the action of the environment—only in their case the animal has *failed to respond* to the changed conditions, whereas evolution depends on cases where the animal *has successfully responded*. In the last resort, therefore, like Darwin we come back to natural selection, only what is "selected" is not a chance variation or peculiarity but the constitutionally vigorous individual with ability of self-adaptation; what is rejected is the individual of weakened constitution.

### Obituary.

SIR WILLIAM E. GARSTIN, G.C.M.G., G.B.E.

SIR WILLIAM GARSTIN, whose death at the age of seventy-five occurred on January 8, commenced his career in India in 1872 as an officer of the Public Works Department, after studying engineering at King's College, London. Thirteen years later he was invited by Sir Colin Scott Moncrieff, who had just taken charge of the Public Works Ministry in Egypt, to make one of the small group of Indian engineers who were undertaking the reorganisation of the irrigation system of Egypt, which was at that time in complete disorder.

In charge of the Circle of Irrigation which included the eastern half of the Nile Delta, Garstin spent seven arduous years in effecting his share of the restoration of the irrigation system, and then, on the retirement of Col. Justin Ross in 1892, he was appointed Inspector-General of Irrigation for the whole country. A few months later, on the retirement of Sir Colin Scott Moncrieff, he became Under-Secretary of State in the Ministry of Public Works.

At that time the irrigation system was being rapidly improved; the basin irrigation of Upper Egypt had been largely remodelled by Col. Ross, improvements in the Delta had led to large increases of crops, and larger supplies of water in the early summer were urgently required. Plans for a reservoir in or near the Nile

Valley were being studied, and it fell to Sir William Garstin to advise on the scheme to be adopted. As a result, the Aswan Dam with subsidiary barrages at Assiut and Zifta were built, and by these means, and later developments of them, Egypt's low-stage water supply was assured.

As soon as Omdurman had fallen and the Sudan had been retaken, Garstin took prompt measures for the clearing of the Bahr el Jebel and the Bahr el Ghazel from the "sudd"—those blocks of drift and growing vegetation which had closed many of the channels. Sir William visited the Sudan on numerous occasions, and especially in 1901, and again in 1903, when he traversed Uganda also to see the headwaters of the Nile system. The investigations and surveys which were then initiated have since furnished a mass of hydrographical information of the highest value both to Egypt and to the Sudan.

Although his work in relation to irrigation is the most known in Great Britain, Garstin's position as the senior officer of the Ministry of Public Works in Egypt brought him in contact with many other forms of the public service. On his recommendation a geological reconnaissance of Egyptian territory was started in 1896, which soon developed into the present Geological Survey. The Survey of Egypt commenced in the Ministry of Public Works while he was in charge, and

he warmly supported the various scientific activities which grew up in connexion with it.

The Department of Antiquities has always formed a part of the same Ministry, and in its work and its responsibilities Garstin always took a keen interest. As soon as the Aswan Dam was decided upon, entailing the partial submergence of the island and temples of Philæ, he took measures for the complete underpinning of all parts of the buildings which were not founded on rock; and later, when the raising of the Dam became necessary, he obtained the allocation of a considerable sum for the execution of an archæological survey of that portion of the Nile Valley which would be submerged. The present Museum at Cairo is also due to his efforts to house safely the ever-increasing collections of Egypt's ancient civilisation.

A keen sportsman, the wild fauna of the Sudan strongly attracted Sir William Garstin; from its inception he strongly supported and took an active interest in the Zoological Gardens at Giza.

H. G. L.

WE are indebted to *Science* of November 28 for the following details of the life and work of Prof. W. A. Locy, professor of zoology in Northwestern University, Illinois, who died on October 9 at the age of sixty-seven. William Albert Locy was born at Troy, Michigan, of Dutch ancestry, and received his early training in the University of Michigan. During the year 1884-85 he held a fellowship at Harvard, where he completed an embryological investigation on "The Development of *Agelena nævia*." In 1887 he went as professor of biology to Lake Forest University, where he remained nine years. During this period he published important papers on the embryonic development of the elasmobranchs, the derivation of the pineal eye, and the structure and development of the vertebrate head. In 1896 Locy succeeded Prof. E. G. Conklin at Northwestern University, where he remained until his death. His work there had two aspects; one, the developmental history of the sense organs, to some extent a continuation of his earlier researches; the other, the history of biological science. In 1908 he published a collection of historical portraits entitled "Biology and its Makers," which has since been translated into German, while in 1918 he produced "Main Currents in Zoology," and at the time of his death he was completing another work, "The Rise of Biology." The significance of his work on the history of science was recognised by his election as the first president of the History of Science Section of the American Association. He was also president in 1915 of the American Society of Zoologists.

WE regret to record the death, at the age of sixty-seven, of Prof. J. Bergonié, professor at the clinic for medical electricity and biological physics in the University of Bordeaux. Prof. Bergonié was chiefly known for his work on electro-therapy. He was the author of numerous papers, and was for many years editor of the *Archives d'Électricité médicale*, in which journal most of his original publications appeared. Among the most important of his original contributions to medicine we may mention "Contributions à l'étude du phénomène physique du muscle" and "Physique du physio-

logiste et de l'étudiant en médecine" (1892). Prof. Bergonié invented an ingenious device for localising metallic foreign bodies in the human subject, which was used to some extent in the War. He also invented an apparatus designed to treat the condition of obesity. He died as a result of injuries associated with X-rays and radium. During the last few years he had been actively at work upon the anti-cancer centre at the Hôpital St. André, Bordeaux. He twice received the gold medal of the Carnegie Foundation.

IN the issue of the *Physikalische Zeitschrift* for November 15, Prof. E. Warburg gives a sympathetic account of the life and scientific work of his former assistant and colleague, Karl Richard von Koch, who died a short time ago after having resigned the professorship of physics at the Stuttgart Technical School in 1919 owing to heart trouble. Prof. Koch was born at Stettin in 1852, and after studying at Bonn, Freiburg and Göttingen, graduated Ph.D. at Freiburg in 1875. While librarian there he commenced research in physics under Warburg, and was appointed lecturer in physics in 1881 and extra professor in 1886. In 1888 he became professor at the Aachen, and in 1891 at the Stuttgart Technical School. Here he designed the new Physical Institute, opened in 1910, which has since served as a model of what such an institute should be. His scientific work lay mainly in the direction of improving methods of measurement, especially in elasticity, but he took great interest in the application of physical principles to practical problems and to natural phenomena. His best-known researches are probably those on the elasticity of metals at high temperatures, on the determination of gravity, and on the auroræ.

WE regret to announce the following deaths:

Prof. S. A. Beach, professor of agriculture at Iowa State College, who was known for his work on apple growing and whose name is included in the list of honorary and corresponding members of the Royal Horticultural Society, on November 2, aged sixty-four.

Mr. Alfred H. Brooks, for twenty years chief of the Alaskan Division of the United States Geological Survey, on November 21, aged fifty-three.

Dr. E. Hedinger, professor of pathological anatomy and histology in the University of Zurich, and formerly of the University of Basle, who, in 1914, undertook a special mission to South Africa to investigate trypanosomiasis in cattle, on December 24, aged forty-eight.

Dr. Theodore Hough, dean of the medical department and for seventeen years professor of physiology in the University of Virginia, who worked on the factors regulating breathing and on related subjects, aged fifty-nine.

Mr. A. H. Savage Landor, well known as a traveller and explorer in Tibet and China and also in South America, on December 26.

Mr. F. G. Newton, director of the Egypt Exploration Society's excavations in Egypt, on December 25, aged forty-six.

Dr. B. R. G. Russell, of the Imperial Cancer Research Fund, who made noteworthy contributions to our knowledge of tumour transplantation and of the respiration and carbohydrate metabolism of normal and cancerous tissue, on December 22, aged forty-four.