refinements in procedure must be developed before these slight differences can be demonstrated.

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IN RE "SINGING EARTHWORMS"

SINCE the publication in 1926 of a popular article entitled "When Earthworms sing Together,"[1] quoting Dr. Mangold, of Freiburg, Germany, and which has been previously referred to in these columns,[2] considerable publicity has been given the subject by the American press.

For "lo these many days," it has been the writer's custom to keep captive, in numbers as large as one hundred or more, adult specimens of the large cosmopolitan earthworm, *Lumbricus terrestris* Linn. They are kept in a five-gallon earthenware crock in a cool corner of the cellar for use in a pursuit which in some states of the Union is considered immoral or at least illegal when indulged in on Sunday. In the course of my dealings with these worms I have many times heard the sounds recently referred to as "singing" and, although personally fond of music, have failed to notice anything in the least musical about these faint clicking sounds or stridulations, recently termed "song." The singing of insects, for instance, could be considered as symphonic poems when compared with these insignificant rustlings. Previous to the publication of the recent somewhat sensational statements, little attention was paid to them as it had seemed to me that these sounds were probably produced by the movements of the worms in their burrows, possibly by the escape of air between the viscid lining of the burrow and the mucous surface of the worm's body. It is quite evident, however, that this is not the case, because these stridulations have continued after the worms were transferred from the soil to damp sphagnum moss, which is an ideal medium in preparing the worms for the rites to which I have previously alluded. The determination of the manner in which earthworms produce these mysterious sounds is fraught with difficulty because the species with which I have dealt at least is very sensitive to the presence of light intense enough to permit one clearly to observe its actions and movements, when on the surface of the soil. That this sense of light resides in the extreme anterior end of the body is abundantly evident from the fact that the worms instantly withdraw to their burrows when the light from an electric torch is flashed upon them even when but a half inch or less of the "head" end of the body protrudes from the soil. In point of fact, the worms seem most sensitive to the light when this is the case. When the entire body is exposed it often requires as much as fifteen or twenty seconds for the worm to become alarmed at the light. The production of the stridulating sounds, however, is not by any means confined to those individuals at the surface, but may be heard plainly, at least under captive conditions, when no worms are visible.

The anonymous author of the original article, previously cited, refers to the earthworm as "dumb both in a legitimate and colloquial sense," but the story of the earthworm as recorded long ago by Charles Darwin[3] abundantly indicates that these lowly creatures are indeed far from stupid, but apparently possess a seemingly disproportionate degree of intelligence.

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[1] *Literary Digest*, October 9, 1926.

[2] Ruedemann, Rudolph, SCIENCE, February 11, 1927, p. 163.

[3] "Formation of Vegetable Mould through the Action of Earthworms," London, 1881; D. Appleton and Co., New York, 1882.

SCIENTIFIC BOOKS

Vorlesungen über die Entwicklung der Mathematik im 19. Jahrhundert, Teil 1. By FELIX KLEIN. Verlag von Julius Springer, Berlin, 1926, pp. XIII + 385.

NEVER before was the mathematical literature enriched by a general historical work written by such an eminent mathematician, and those who are especially interested in the history of science will be glad to find that the extremely difficult task of writing a history of the mathematical developments during the nineteenth century has been so well begun. Even during the eighteenth century the leading mathematicians were familiar with the main known facts of all the sciences, and they seldom aimed in their writings to introduce the reader into new fields of mathematical research. On the contrary, this became more and more a characteristic feature of the mathematical writings during the nineteenth century and gave rise to extensive cooperation and to an enormous technical literature, leading to the establishment of numerous special mathematical periodicals and being, in turn, fostered by these periodicals.

Felix Klein, who died in 1925, was not only one of the leading mathematical investigators during the last half century but also one of the most influential mathematical organizers. He worked with extraordinary success in various fields of mathematics, including mathematical physics as well as the teaching and history of our subject. A number of leading American mathematicians were among his students and later helped to develop in our country a deep and abiding interest in mathematical research. The lectures which constitute the present volume were given at his home to a small number of students during a period of about five years, and he had expected to revise them and then publish them as his last mathematical contribution. On account of illness he could not do this and therefore the present volume was prepared for the press by those who were entrusted with his unpublished papers. Fortunately the editors decided to make no important changes so that we have here the words of a mathematical statesman which should interest not only mathematicians but also others who are interested in the great cultural forces of our age.

The headings of the eight chapters into which the present volume is divided are as follows: Gauss; France and the École Polytechnique in the first decades of the nineteenth century; the establishment of Crelle's Journal and the blooming of pure mathematics in Germany; the development of algebraic geometry beyond Moebius, Plücker and Steiner; mechanics and mathematical physics in Germany and England until about 1880; the general theory of functions of complex variables by Riemann and Weierstrass; deeper insight into the essence of algebraic forms; group theory and function theory, especially automorphic functions.

These headings represent fundamental centers in the remarkable development of mathematics during the nineteenth century. They also point to the fact that Klein naturally emphasized the history of those developments in which he either took part or which are closely related to the subjects which he helped to advance. In particular, the theory of numbers, algebra and the theory of aggregates received relatively too little attention. This lack of completeness is, however, compensated by the confidence inspired by one who speaks about the history of a subject on which he himself is an authority. While some attention is paid to biographical sketches and other matters which are not strictly mathematical we find here also some of the most profound and far-reaching mathematical observations. The commanding but attractive personality of the author is exhibited in many places, and his unusually wide personal acquaintance with leading mathematicians and with their most important contributions adds greatly to the value of the work. As an instance of the type of some personal remarks we may note that in speaking about H. Poincaré it is noted on page 375 that he did not enter the field of applied mathematics in the proper sense of this term and hence his contributions may be regarded as somewhat below those of Archimedes, Newton and Gauss, who also experimented and measured.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

SYNTHETIC RESIN AS A MOUNTING MEDIUM

IN the issue of SCIENCE for January 14, 1927, announcement was made of a new synthetic resin possessing physical and optical properties which made it particularly useful in microscopy. Having had experience with other compounds which at first seemed promising, yet later spoiled for one reason or another, the only doubt I had or expressed at the time the above-mentioned article was prepared concerned the stability of the product. It was first made on October 6, 1926, and a part of the original sample, as well as slides mounted therefrom, is in perfect condition on April 1, 1927. Evidently, the resin can be depended upon to keep unchanged for a period of many months; we have no reason to suspect that it will ever change.

In fluid form, this material has a refractive index of close to 1.70 for yellow light, and when hardened on the slide, it approaches 1.80, the exact figure not yet having been determined because it is far above the scale of any available refractometer.

A great deal of interest in this material has been shown by microscopists in many parts of the world as a result of the preliminary announcement in SCIENCE, and if the inquiries I have received can be used as a basis for forming an opinion, it certainly appears that there is a real desire in many branches for a better material than Canada balsam for a mounting medium.

For the benefit of all interested workers, I want to explain that I have developed the technique of handling the resin, only in the mounting of diatoms. It is so superior to other known resins for this purpose that one is tempted to call it ideal.

Whether methods of using it in other branches of microscopy can be developed or not remains to be determined by experiment. Thus far the best solvent we have found is aniline, but this does not necessarily mean that the last stage before mounting a preparation should consist of clearing in the solvent. Aniline is not very volatile; consequently a more protracted or higher temperature is needed to bring the resin to brittle hardness under the cover than would be the case could xylol or benzol be used as solvent. The hardened slides do not show a tendency to lose their