eventually a large number of hitherto unrecorded yarns may be found in print.

When the Fluted Scale was doing great damage to the citrus groves of California, it became rather generally known by its generic name Icerya. People inquired the meaning of this strange word. A scientific man with some philological knowledge wrote a letter to the Los Angeles *Times* (in 1888, I think it was) in which he explained that it was one of those unfortunate bastard names derived from two languages—the Greek *isos,* meaning straight, and the Latin *cerum,* meaning wax—the names evidently being descriptive of the straight waxy secretions of the insect. This was plausible and ingenious. But to those of us who knew that Signoret, the French authority, named it after Dr. Icery, of Mauritius, who sent him the original specimens, the *Times* letter was a rather good joke!

Many years ago a writer in Mexico established a genus which he called Freisuila for certain curious insects of the family Psyllidae. We puzzled long about the possible etymology of this name. It stumped the best zoological philologists in Washington. Years later I met the Mexican savant and asked him about it. He told me that he had a great reverence for his old master, Alfredo Dugès, of Guanajuato, and that he had named this genus after his master's wife's maiden name—Louisa Frey—putting it in anagrammatic form.

Will SCIENCE open its columns to botanists and zoologists who may think it worth while to send in other curious stories like these?

L. O. HOWARD

SCIENTIFIC APPARATUS AND LABORATORY METHODS

NEW METHODS IN THE STUDY OF FOSSIL SHARK TEETH

SINCE Mid-Paleozoic times sharks have been an important type of marine life. Unlike other forms of fish, however, they have been marked throughout their range of development by the possession of a cartilaginous skeleton which is incapable of preservation in fossil form except under unusual conditions. Studies in their evolution in bodily form and structure, therefore, are generally relegated to the field of theory and conjecture.

It is true that sharks have at different periods shown tendencies of developing partially calcified skeletons, but the process has never developed beyond the point of a slight calcareous strengthening of the cartilage in some forms, and in others the formation of rings of the same material imbedded in the vertebrae. At times, also, they have developed protective calcareous tubercles and spines capable of preservation as fossils, but of doubtful value in establishing relationships because these features are merely the result of specialization. Early in their development, however, and due to their predaceous habits, the sharks acquired a remarkably efficient dentition which they have retained ever since. Many of these teeth are found to-day in perfect condition, and form the basis of most studies of extinct sharks.

Soon after the death of an individual shark the decay of the cartilaginous jaws results in the teeth becoming separated and scattered over a wide area. Very rarely are more than several teeth from the same individual found in one place, and since a single shark may have had as many as several hundreds of teeth the reconstruction of the dentition has been almost impossible. This not only affects the determination of the number of teeth of the different species but the classification of the teeth themselves, since in the same jaw the forms of the teeth varied greatly.

As a result of this unfortunate situation the classification is in a chaotic condition, and is probably correct only as far as determination of family. In many instances teeth originally adjacent in the jaw of an individual shark have shown differences sufficiently great that they have received separate specific names; or the differences may have been so marked as to lead to their being placed in different genera. Several such cases are known, the errors becoming evident only in the rare instances when the teeth were finally discovered in their proper relationships. Naturally, the result of such unsound interpretations has been that in both laboratory and field work little geologic importance is now attached to fossil shark teeth. The writer believes, however, that examination of them on an entirely different basis from outward form will result in positive determination of species, and that such fossils will become of great value in stratigraphic geology. The basis of this new method of determination is the proven fact that in the same species, no matter to what extent the teeth may vary in form or in number, they all show the same internal structure, and in no two species is this structure identical. Besides enhancing their value in stratigraphic work, the possibility of their certain identification in the future makes them of great importance in studies of morphology.

With this fact in mind the writer has undertaken to examine the collection of fossil shark teeth in Walker Museum at the University of Chicago. This collection, though large, is far from complete. Because of this fact and the difficulty of securing specimens from other museums it will be impossible to describe all the known fossil teeth. Therefore it is hoped that others who may have supplementary material available will be sufficiently interested in the work to communicate with the writer.

The study requires that microscopic sections of the teeth be made, since their interior structure is very minute. At least three sections must be made of each tooth, and, if the tooth is large, enough more to show all its characteristics. It is also necessary that these sections be made so that they correspond in position with those of other teeth in order to establish a uniform basis of comparison. The three standard sections comprise: one of the grinding or biting surface (called the crown section), one taken parallel to the crown section through the tooth at a point about half way down the side (called the medial section) and one taken vertically from root to biting surface (called the vertical section). In order to facilitate comparison of the teeth, microphotographs are made of each section.

The description of the teeth on the basis of microscopic structure will require a new system of nomenclature. The problem resembles very much that of the description and classification of the bryozoans which was so admirably accomplished by Ulrich and Bassler. The introduction of descriptive terms new to the science necessitates adequate definition of them as an introduction to the study. Familiar terms such as enamel, root, pulp, etc., will be used whenever possible.

The work of sectioning and photographing the teeth is almost complete for the Psammodont and Petalodont families of the Walker Museum collection. When the other families are finished the work of reduction of species and the correction of classifications will be undertaken. It is possible that enough teeth of a single species may be present in the collection to warrant the reconstruction of the dentition of some forms.

It is the writer's hope that as a result of this study the geologist engaged in field work of either paleontological or stratigraphical nature, or both, will regard fossil shark teeth as valuable additions to his collection, since it will no longer be necessary to compare them with hundreds of others in books or in collections to make doubtful determinations. Under the new plan the geologist will make sections of the teeth as indicated above, and after carefully noting the characteristics by microscopic examinations he will be able to make positive determinations by either the trial and error method or by elimination. It is only when such positive identifications are possible that fossils become of stratigraphic value. In this connection the stratigraphic range of each of the species studied will be established wherever possible. Such information in table form will be an important part of the paper.

This work is being done under the supervision of Dr. Carey Croneis and Dr. Alfred S. Romer, of the department of geology (paleontology division) of the University of Chicago.

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SPECIAL ARTICLES

THE INTERNAL TEMPERATURE OF THE EARTH'S CRUST

RECENT investigations in the utilization of the earth's internal heat led the author to consider the possibility of obtaining an equation which would represent the average temperature gradient of the earth's crust. The use of the linear gradient of 1° F. in 55 ft. is not satisfactory because it leads to large errors at even shallow depths.

Kelvin's equation (Thomson and Tait, "Treatise on Natural Philosophy," vol. 2, p. 458, 1883) which yields the solution,

$$\vartheta = \frac{2\vartheta_0}{\sqrt{\pi}}\int_0^{\beta} \epsilon^{-\beta^2}\, d\beta \text{ and } \frac{d\vartheta}{dx} = \frac{\vartheta_0}{\sqrt{2\pi kt}}\,\epsilon^{\frac{-x^2}{4kt}} \qquad (1)$$

where $\beta = \frac{x}{2\sqrt{kt}}$ and in which Θ is the temperature, x is the depth, k is the coefficient of thermal diffusivity, and t is the time since the earth was at the initial temperature of Θ_0, is unsatisfactory, because it necessitates assumptions which are not in accord with the facts. Consequently, this equation is more of hypothetical than of practical value. Kelvin's equation has considerable theoretical background, being the solution of the well-known Fourier equation for assumed limiting initial conditions. The equation, however, takes no account of internal heating which may arise from causes other than the original molten condition, such for example as those of radioactivity, chemical activity, and the like, which have been amply demonstrated as effects which can not be neglected. Furthermore, even when using a value for the earth's age which gives a geothermal gradient equal to known measurements, the computed temperatures have an almost linear relation to the depth for the first few miles, which is within the measured limits and the discussion in this note.

Butavand (Butavand, *Le Génie Civil,* May 10, 1919) and Lees (Lees, *Proc. Royal Soc.,* 83 A: 339, 1909) have proposed equations for the geothermal