fossils have been referred by geologists to such severally remote times as the Ordovician and Tertiary, for example, it would have been appropriate to add that such a view of fossil records would be paralleled, and not in the least exaggerated, by the thesis that George Washington, Queen Elizabeth of England, Charlemagne, Cleopatra and the Pharaoh Tut-Ankh-Amen were contemporaries in the sense in which that word is used in human affairs.

Perhaps I may be permitted space to comment on Dr. Keyser's strictures on the scientific method as opposed to authority by asking, in all seriousness, how we are to arrive at a satisfactory conclusion as to the claims for credibility of different systems of religion except by the employment of the scientific method.

EDWIN LINTON

ZOOLOGICAL LABORATORY,
UNIVERSITY OF PENNSYLVANIA

SCIENTIFIC BOOKS

Pathologische Pflanzenanatomie in ihren Grundzügen, Dargestellt von DR. ERNST KÜSTER, Professor der Botanik an der Universität Giessen. Dritte, neu bearbeitete Auflage. Mit 285 Abbildungen im Text, darunter 2 farbigen. Verlag von Gustav Fisher in Jena, 1925. Pages, XII, 558. Price: paper cover, 24 gold marks; bound, 26 marks.

PUBLISHER and author have both done their best to make the third edition of Dr. Küster's "Pathological Plant Anatomy" an attractive and useful book. It is one that should be in the hands of every professional plant pathologist and of every student who can read German. In 570 well-illustrated compact pages the author deals with all the more important phases of the morbid anatomy of plants, summarizing what is best known. The book is divided into two parts of about equal size. The special part deals with: (1) Panaschierung; (2) etiolation; (3) hyperhydric tissue, and under this, with overgrowth of lenticels and bark, and with intumescences; (4) wound tissue and regeneration, callus, thyloses, wound wood, wound bark, wound cork, gum and resin formation and regeneration; (5) galls. The second general part deals with: (1) Histogenesis of pathological tissues with eleven subdivisions; (2) developmental mechanics of pathological tissue with five subdivisions; (3) ecology of pathological tissue. The book also has a brief supplement and a good index. It is the best book there is on this subject and is likely to remain so for a considerable time. Most of the references are to German literature. Judging by the number of original figures (82 out of 175) the subjects most familiar to Dr. Küster are variegation, wound reactions and the anatomy of insect galls. Most of the illustrations in the other chapters (91 out of 109) are borrowed. There is a commendable abundance of literature references and the figures are good.

ERWIN F. SMITH

Bones of the Ethmoid Region of the Fish Skull. By EDWIN CHAPIN STARKS, (Stanford University, California, Biological Sciences, Vol. IV, No. 1).

THE osteology of the bony fishes, an immense and highly varied group of animals, has been relatively neglected of late years. For while these creatures date back to the separation of the land-breathing animals from primitive fishes, they are out of the line of descent which leads towards mammals and men. This memoir of Professor Starks's comprises a very thorough study of the bones of the roof of the mouth in fishes, and their evolution from the one end of the long series to the other. No study of vertebrate morphology can safely lose sight of the osteology of fishes, to which the present paper is one of the most notable contributions. An earlier paper by the same author (Vol. III, No. 3) deals with the Osteology and Relationships of the Uranoscopoid Fishes (Star-gazers), a large group in which the systematic position of many of the families is still in doubt. The true place in Taxonomy and in Evolution (which should be the same thing) can rarely be determined until the bony structure, which underlies superficial traits, is well understood.

DAVID STARR JORDAN

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A CONVENIENT METHOD FOR FEEDING PLANARIANS

THERE are many biological problems for which planarians and rhabdocoeles may serve as very suitable material and in many laboratories these animals are kept for some length of time for this purpose. With a proper care as in Professor Child's laboratory, University of Chicago, they live well on beef liver. In Manila we found that beef liver can not be used to our entire satisfaction. On account of a warm climate the liver soon putrefies and after a few hours the water becomes very polluted and injurious to the animals. Besides this, the fresh beef liver is not always obtainable when it is needed. This led me to search for other food materials which could be used in place of beef liver.

After some investigation, it was found out that the yolk of egg is a very convenient food material. The duck's egg on account of its denser yolk is better than the hen's egg, but the latter is quite satisfactory. The method of feeding which I adopted is very simple. A wide-mouthed pipette (with 3 to 4 mm opening) is inserted in a freshly opened egg so as to get directly

into the yolk without taking in any albumen. If some albumen gets into the pipette it does not do much harm except that it increases the bulk of material which is apparently not eaten and later has to be removed. The pipetteful of yolk is taken and then by a pressure it is placed at the bottom of a dish where the planarians are kept. The yolk usually gets out from a pipette in the form of a ribbon which pressed out sinks down to the bottom or may be attached to the sides of the dish if desired. Planarians if hungry respond to the food at once. They gather from all directions, eagerly eat the yolk, and in fifteen or twenty minutes most of them become yellow on account of the ingested food. If just a sufficient amount of yolk is given, practically all of it is eaten up and there are no remains left after the feeding. If more than necessary has been placed in the dish, the excess should be removed before any putrefaction sets in. It may remain for a day or so without any harm, but this depends upon the sensitivity of the animals toward the decaying food materials. With the Philippine planarians the yolk may be kept for a couple of days without any bad effect.

Using this method of feeding and changing water once a week (or even once in two weeks in more neglected cultures) I kept my stock of planarians for over a year in a very good condition. In these cultures, especially in the ones which had a few stones at the bottom of a dish, the animals not only lived well but some of them became sexually mature and even laid the eggs.

Entomostracans, such as Ostrocoda, Annelids, especially Aeolosoma, and rhabdocoeles also thrive well when fed on egg yolk.

The yolk is not only good as a regular food, but it is also very suitable for feeding these animals for use in the study of problems of digestion. The yolk can be easily beaten with non-irritant coloring matter such as carmine and then fed to the animals. With carmine beaten with the yolk I was able to obtain preparations of planarians showing the digestive system well.

In the sea water the yolk can not be used for this purpose. Here it goes in solution, and it soon makes the water foul without doing any good to the animals.

P. B. SIVICKIS

DEPARTMENT OF ZOOLOGY,
UNIVERSITY OF THE PHILIPPINES

SPECIAL ARTICLES

SERIES RELATIONS IN THE FIRST LONG PERIOD

IN *Nature*, July 24, 1926, I reported the discovery that certain pairs of lines appearing in the high-potential spark spectra of these elements seem to be the first P doublets. These are shown in Table I, which is quoted here for reference.

Further series relations for these elements are now given in Tables II and III. The wavelengths of already known lines are quoted from Fowler's Report, with the exception of the single line of Sc II, Table II, which is taken from Ireton's paper[1] and the Ca sextet, which comes from Russell and Saunders' paper.[2]

TABLE I

FIRST P DOUBLETS

Element	Wave length I. A. vac	I	Wave number	Separation
K I	7664.94	10 R	13042.82	57.71
	7699.01	10 R	12985.11	
Ca II	3933.66	10 R	25414.41	222.85
	3968.47	10 R	25191.56	
Sc III	2699.9	10	37038.4	474
	2734.9	9	36564.4	
Ti IV	2067.6	9	48363	821
	2103.4	8	47542	
V V	1680.4	5	59510	1462
	1722.7	3	58048	
Cr VI	1446.7	4	69123	2367
	1498.0	2	66756	

It will be noted that the intensity of the pairs of doublets decreases continually with increase in atomic number and that the shorter member of each pair has the greater intensity. Of course the intensity given for the first two pairs is quoted from the report and no direct comparison is intended between this and the intensity of the following pairs. It was found, however, that the Ca lines were very much more intense than those of Sc on the same plate.

The existence of these doublets from Sc onward, if this arrangement has a real physical significance, forces us to a conclusion which has already been reached on account of magnetic and chemical behavior, that when the electrons of the N levels are removed one or more of the extra electrons in the M levels moves out to the N levels more or less frequently. As we proceed toward heavier elements the likelihood of this happening seems clearly to decrease, as shown by the failing intensity of the doublets. Catalan[3] also found it necessary to assume some such transition to explain his multiplets.

There is very considerable doubt about the single

[1] Proc. Roy. Soc. of Can., Vol. XVIII, p. 103, 1924.
[2] *Astro. Phy. J.*, Vol. LXI, No. 1, Jan., 1925.
[3] Phil. Trans. A., Vol. 223, p. 166.