This restraining influence of the bluffs is brought out in the table. Below Vicksburg the right-handed cutting is notably in excess. Here the number of cut-offs is likewise in excess on the right side of the stream. A typical case of restraint may be seen at Natchez (Fig. 3), where the development of the left-handed curve is hindered while that on the right is free. As a result of these conditions and the down-valley migration of the meanders the river has twice cut through the neck of the lobe and is now increasing the radius of its present curve preparatory to a third cut-off. In stretches which have nothing but free flood-plain on both sides, a right-handed curve could not develop without an accompanying left-handed curve—a fact which can be more readily appreciated when it is remembered that, except for the down-valley movement of the meander as a whole, the center of the growing curve on the open flood-plain is relatively fixed, and the extension and development of sympathetic curves in adjacent parts of the channel are necessary attendants of the growth of the meander.

The foregoing serves to show that on the Mississippi, cut-offs as well as relative bank cutting should be counted as right or left not over the course as a whole but in sections which depend for their individuality, in part at least, upon conditions external to the river and not directly related to deflective tendency.

In conjunction with Professor M. S. W. Jefferson, of the Michigan State Normal College, the writer has undertaken measurements of this kind in Michigan along the River Rouge between its headwaters and Detroit. The river flows to the east through a plain of glacial and lacustrine origin which, on account of its level nature, offers advantages not possessed by the Mississippi. The latter stream, by cutting into a bluff, on one side, and into flood-plain deposits, on the other, does not enable one to use the maps previously mentioned in determining the absolute amount of work accomplished on the two sides of the stream. The areal expression of such cutting is no basis for the determination of the actual amount performed. The river may be doing even more work on the bluffs along its eastern bank than it accomplishes on the western bank. The River Rouge has incised itself in a level plain and in the process of deepening and widening its valley swings against bluffs of the *same* height on opposite sides of the valley.

During the summer of 1903 and in connection with hydrographic work for the U. S. Geological Survey I had the opportunity to examine most of the streams on Long Island with respect to the visible effects of deflection, and although many of the valleys on the south side of the island have a noticeably unsymmetrical development, one bank being steeper than the other, an actual count of the valleys from Montauk Point to Far Rockaway shows such a small majority of valleys asymmetrically developed and with the right bank steeper than the left, that in this case the argument based on deflective tendency does not appear well-grounded. The cuesta-like arrangement of the slopes on the island and the consequent great disparity of stream lengths, velocity and persistence throughout the year, precludes fruitful comparison of valleys on the northern and southern sides of the island as showing in how far the difference in composition of wind force and deflective tendency affects the fashioning of the valley slopes.

ISAIAH BOWMAN.

YPSILANTI, MICH.

## SCIENTIFIC BOOKS.

*Lehrbuch der Physik;* Zweiter Band. Von O. D. CHWOLSON, St. Petersburg; übersetzt von H. Pflaum. Braunschweig, Friedrich Vieweg und Sohn. 1904. Pp. 1056.

The first volume of the German edition of

Chwolson's 'Physics,' covering the general subject of mechanics so far as this is required as an introduction to general physics, was reviewed by the present writer not quite a year ago in SCIENCE. The second volume, covering the subjects of sound and radiant energy, abundantly justifies the very favorable opinion at that time expressed. The author keeps before him a well-defined object, the preparation of a text-book for students, but not a handbook for specialists. The aim is that the student may find what he needs, and also that he may need what he finds. The student's standpoint is continually occupied, though it is assumed that no student would feel prepared to undertake the mastery of such a book in four large volumes without having previously mastered at least the elements of the subject as set forth in ordinary preparatory school work. Nevertheless, in such work it is not uncommon for the elementary student to reach a standpoint that interferes with his subsequent attainment of a comprehensive view. For example, light rays, heat rays and chemical rays are even yet supposed often by beginners to be different in kind, and the gap between these and electric rays is hard to bridge.

Chwolson undertakes the task of setting the student initially on the right standpoint, and of guarding specially against what his experience has shown him to be the most frequent misconceptions. Mathematics is not avoided, but no unnecessary complexities are ever introduced. Indeed, it would be hard to find a book in which good arrangement and accurate statement are attained with so little in the way of mathematical difficulties, though no one need expect to attack any of the problems of physical optics without having to grapple with equations that require thought.

Rather less than the first seventh of the present volume is devoted to the subject of sound. It begins with a chapter on the velocity of propagation of a disturbance in an elastic medium, in which the well-known formula for both longitudinal and transverse vibrations is deduced with unusual simplicity. The last few pages are given to the physical basis of music, which is treated only in outline. In the development of the natural scale the exclusive standard recognized is the French normal $A = 435$, at present adopted as an international musical standard. Now that König is dead, the Chladni standard, $C = 256$, so extensively employed by him for standard forks, may quite probably pass away, as Stuttgardt pitch, $C = 264$, has already disappeared, despite its use by Helmholtz in the 'Tonempfindungen.'

In the introduction to the general subject of radiant energy Chwolson goes at once into an exposition of electric radiation, closing the chapter with an enumeration of five divisions based on wave-length, and with a brief reference to 'neue Strahlen,' the rays connected with the names of Röntgen, Becquerel and Curie. These are still so little known that he does not feel warranted in linking the treatment of them with that of radiations of measurable wave-length.

The phenomena of luminescence are treated as a special transformation of energy quite apart from those of calorific radiation. Specially good and up to date is the discussion of the rate of emission of a black body as a function of temperature and wave-length. The laws of Stefan and Wien are considered, and the conclusion expressed that Stefan's law is thoroughly reliable, but is applicable only to the total radiation of an absolutely black body. The expressions for radiation of special wavelength obtained by Weber, Paschen, Wien, Thiessen, Rayleigh, Planck and Lummner and Jahnke are all considered, and as the result of comparison a preference is expressed for that of Planck (1900). The effect of radiation as pressure upon the surface of an absolutely black body, suspected as long ago as 1754 by DuFay, was first proved experimentally in 1900 by P. Lebedew, whose apparatus is shown and explained. Due credit is given to Nichols and Hull (1901), who have measured this pressure and obtained results that accord well with the requirements of theory. The application to the phenomena of comets is expressed by the statement that the theory is capable of affording a full explanation of the observed forms of comets' tails. E. F. Nichols's great improvements upon the sensitiveness of the radiomicrometer, and his measurement of the energy radiated from certain stars and planets, are properly acknowledged.

The chapter on optical instruments is excellent. It is followed by one on the eye, which furnishes a satisfactory summary of what is of chief interest in physiological optics to the physicist. This includes a brief discussion of the telestereoscope of Helmholtz, and the more recent double telescope by Zeiss for the perception of a distant object in relief. Interesting developments are the stereo-telemeter, stereo-micrometer and stereo-comparator of Pulfrich. This last instrument finds a new and unexpected field of application to the heavenly bodies. Assume that on two successive evenings photographs of Saturn are taken, using the comparator with camera attachment. During the interval of a day the position of the planet with regard to the stars has changed, as well as the position of the satellites with regard to their primary. Let these two photographs be arranged to form a stereograph and viewed binocularly either with a stereoscope or with the unaided eyes if suitably trained. Against the black background are seen the distant stars. Suspended independently in mid space between foreground and background is the planet. Behind it on one side is a satellite, and on the other side is another satellite just emerging from eclipse. Spatial relations are as distinct as if all were within arm's length. A stereograph of this kind from proofs secured by Wolf at the Heidelberg observatory is one of several that are presented for the reader's scrutiny. The instrument has been applied to the discovery of planetoids, of variable fixed stars, and to the study of such as have considerable proper motion.

The last part of the volume, relating to optical phenomena in the atmosphere, interference of light, diffraction, polarization, double refraction, interference of polarized beams and the turning of the plane of polarization by quartz and other bodies optically active, is well up to the standard of the earlier part. The value of the book is greatly enhanced by the clear cut summaries of important conclusions, and the bibliographic list of references to the literature of the subject with which each chapter is closed.

W. Le Conte Stevens.

## DISCUSSION AND CORRESPONDENCE.

### PALEOZOIC SEED PLANTS.

In my short note in Science of July 1 proposing the name *Pteridospermaphyta* for this group of plants, I assumed that all interested in the subject were acquainted with the facts and the literature, and I expressly refrained from entering into details. It seems that I was mistaken in this assumption, otherwise I could hardly have been misunderstood.

When in 1897 Potonié founded the group Cycadofilices,* he based it on the internal structure and classed it under the Pteridophyta with the same rank as the Filices. It included *Nœggerathia,* the Medullosæ, *Cladoxylon, Lyginopteris, Heterangium* and *Protopitys.* Later he worked the same subject over for Engler and Prantl's 'Natürliche Pflanzenfamilien.'† He here says that the groups Sphenopterides, Percopterides and Neuropterides might perhaps be better included in the Cycadofilices, although he continues to class them with the ferns. He now includes *Calamopitys* in this group. M. R. Zeiller in 1900‡ discussed these forms, and although he admitted that the characters then known approached more closely those of cycads than of ferns, he says it would be rash to exclude them from the latter on these characters alone, that they may represent a special type of Filicineæ, provided with secondary wood, and that indications of fructification observed on certain fronds of *Alethopteris, Odontopteris* and *Neuropteris* may be adduced in favor of this hypothesis.

In the first preliminary paper of Drs. Oliver and Scott§ they show that *Lyginodendron,* which Potonié classes in the Lepidodendraceæ,

* 'Lehrbuch der Pflanzenpalaeontologie,' p. 160 (Lief, 2, dated 1897).

† Teil I., Abt. 4, pp. 780–795 (Lief. 213 dated 1902).

‡ 'Eléments de Paléobotanique,' pp. 124 ff., 370.

§ 'On *Lagenostoma Lomaxi,* the seed of *Lyginodendron,' Proc. Roy. Soc.,* Vol. LXXI., pp. 477–481.