must be regarded as the necessary background through which the foveal image acquires a significance it would not otherwise possess.

Furthermore, in connection with the distortion which rays of light from a point source, not on the axis, undergo, he points out that their foci must vary according to the position in space, shape and colour, of the object viewed. This he thinks affords a basis for the notion of uniocular tridimensional space perception.

He next briefly discusses astigmatism and accommodation, and finally, passing from the consideration of these physical, to physiological and psychical relationships, proceeds to discuss colour vision at some length.

The three "classic" theories, e.g., Young-Helmholtz, Hering, and Ladd Franklin, postulate the existence in the retina of specific chemical substances, acted upon by light. The more modern theories, however, are largely built upon the basis of resonance phenomena. Resonance, in this connection, may be spoken of as a correlation between radiant energy, and what may be either chemically dissociated atoms or electrons. The author himself believes that the visual reception process is of a character included within the broad term "photo-electric."

In conclusion he realizes that the "explanation of the phenomena of vision in their entirety, must involve a knowledge of the laws of the brain and its operation, the functions and structure of nerve-tissues, and the physical chemistry of the retinal processes," and pleads that for the solution of such problems physicist, physiologist, and psychologist should all work together.

E. MAXWELL.

BOOK NOTICES

War Blindness at St. Dunstan's. By Sir ARNOLD LAWSON.

This book is the outcome of a promise to the late Sir Arthur Pearson, by the author, "to present the work at St. Dunstan's from a purely medical standpoint," and contains the "history of over five years' medical work amongst the war-blind" by Sir A. Lawson and his colleague Major Ormond. During the war the cases under Sir A. Lawson's care numbered 825, while Major Ormond had charge of 1,008 blinded men, most of whom were transferred from his wards at the 2nd London General Hospital.

The book is in three parts. Part I deals with 407 men the subjects of traumatic blindness, arranged in groups, with brief
clinical notes of many cases. Though not adding greatly to our surgical knowledge of gunshot and other wounds of the eyes and adjoining structures, this part contains records of many cases of interest and of some with unusual features.

Part II is devoted to non-traumatic or disease blindness and comprises 417 cases. The causes of blindness in this category are very varied. While all the cases occurred in men on active service, many of them are not attributable directly to the conditions of war. The author holds advanced views concerning the effect of war service in precipitating blindness from causes already threatening it.

Part III contains two chapters, one on "Disability Pensions for the blinded Soldier"; the other on the "Re-education of the blinded Soldier." In the latter, Sir A. Lawson gives an interesting and sympathetic account of the efforts made and the success attained in teaching the blinded soldier, not merely, or chiefly, a trade or occupation, but the even more important lesson of adapting himself to an altered mode of life, in which he may still find contentment and modified happiness.

The printing, etc., is of the high standard we have learned to expect from the Oxford Medical Publications.

**Colour Vision: A Discussion of the Leading Phenomena and their Physical Laws.** By W. Peddie, D.Sc., V.P.R.S.E., Harris Professor of Physics, University College, Dundee, University of St. Andrews. London: Edward Arnold & Co. 1922. Price 12s. 6d.

There are two ways in which the phenomena and theories of colour vision can be taught. The phenomena, divorced as much as possible from theoretical considerations, can be described, and the theories then discussed in their relation to these phenomena. Or a theory can be stated and the phenomena discussed in the light of the theory. The latter method has generally been adopted, partly because it is the easier, but much more because most of the literature of colour vision has been written by the exponents of some given theory.

Professor Peddie is a whole-hearted adherent of the Young-Helmholtz theory. Like most physicists, he starts with the Newtonian law of colour mixture, which we agree with him in regarding as the basic fact of all colour sensation. The unassailable fact that practically every conceivable light or light mixture gives rise to a sensation, which can be accurately matched by the sensation produced by a suitable mixture of only three suitably chosen lights, led Thomas Young to the conclusion that the physiological receptive mechanism was a relatively simple mechanism involving only three variables. Helmholtz, who
adopted Young's hypothesis, submitted it to exhaustive mathematical treatment on the basis of Fechner's law of the quantitative relationship between stimulus and sensational response. "In view of the wider experimental basis now available, it is possible to bring in a mathematical representation through employment of the integrated form of Fechner's expressions of which Helmholtz used the unintegrated form in his work on differential sensitivity and the absolute fundamentals. In this way the whole subject of contrast, mutual interactions, decaying images, oscillating images, and inhibition, comes within the range of mathematical representation." This is the programme which Professor Peddie set out to fulfil.

The rescue from oblivion of Young's theory by Clerk Maxwell and Helmholtz, the experimental confirmation by the former and the mathematical elaboration by the latter, led to the almost universal adoption of this theory by physicists. Dealing, as it does, particularly with the phenomena of colour vision as viewed from the standpoint of physical stimuli it dealt with familiar subject matter in a familiar way, and the relatively simple mathematical exposition offered no obstacles. It was otherwise with physiologists. This was doubtless largely due to the fact that the full development of the theory was buried in Helmholtz's "Physiological Optics," and underwent modifications in the second edition. This epoch-making work has never been translated, and Professor Peddie's book is the first in English to deal really adequately with the Young-Helmholtz theory. It is true that the theory was too important to be ignored, so that it found its way into the physiological text-books. But many prejudices militated against it. Of these probably the most important was the mathematical form in which it was presented, for the biologist seems generally to be averse from all mathematical abstractions. Helmholtz himself contributed to the suspicion which fell upon the theory by resorting to psychological explanations of phenomena difficult to bring within its purview. Some of these explanations are demonstrably wrong, and one of the outstanding features of Professor Peddie's book is the valiant attempt to bring the facts of simultaneous and successive contrast, etc., into submission to the theory and to appropriate mathematical expression. While disclaiming any capacity to criticize the mathematics the physicist cannot fail to view with some suspicion the important part played in the formulae by such elusive entities as the self-light of the retina and threshold sensations.

We have no hesitation in recommending this work as the best, most exhaustive, and most lucid exposition of the Young-Helmholtz theory in the English language. For a complete understanding of its contents, what to the physicist is an elementary, to
the physiologist a relatively considerable knowledge of mathematics is necessary. But physiologists who are lacking in mathematics may rest assured that the deductions are justified on the bases of the given premises, and consequently they will find a wealth of information which will repay perusal. Although suspicion may still persist that some of the assumptions necessary to bring certain phenomena of vision within the purview of the trichromatic theory are unwarranted, the immediate deduction from it of such facts as the observed differential sensitivity of the normal eye to different wave-lengths, the approximation of all colour sensations to white at high intensities, etc., places it in the same category of utility as the Undulatory Theory of Light. As Thomas Young wrote:—"Although the invention of plausible hypotheses, independent of any connection with experimental observations, can be of very little use in the promotion of natural knowledge; yet the discovery of simple and uniform principles by which a great number of apparently heterogeneous phenomena are reduced to coherent and universal laws, must ever be allowed to be of considerable importance towards the improvement of the human intellect and in proportion as more and more phenomena are found to agree with any principles that are laid down, those principles must be allowed to acquire a stronger right to exchange the appellation of hypothesis for that of fundamental laws of nature."

As Professor Peddie says:—"The grounds upon which fitness is admitted in matters of scientific theory are: Simplicity, accuracy and sufficiency. . . . But sufficiency implies productivity also; theory must serve as an instrument of research, predicting unknown but actually existent phenomena."


This is a surprising work. The author took conical cornea as a subject for special study in leisure hours. To discover its origin he sought for similar change in other structures and convinced himself "that disseminate sclerosis, myopia, glaucoma, diabetes, and chronic rheumatism rest on the same fundamental cause." His argument, put forward piecemeal in previous papers, is here developed in elaborate detail. We can only outline it.

Conical cornea, being usually bilateral, is due to a general rather than a local cause; therefore analogous changes probably occur from the same cause in other parts. It is seated in fibrous tissue and is therefore probably of rheumatic, i.e., arthritic nature. It has no distinctive histological mark, but is a persistent, painless, non-inflammatory lesion, non-irritative to adjacent tissue; therefore analogous lesions will not be easily discovered unless they
obviously disturb function, as in the cornea; they should be most obvious when occurring in the nervous system. Disseminate sclerosis has certain of the characters named and is probably "nothing else than the cerebral localization of chronic rheumatism." Let us look, therefore, for ectasia, resulting from multiple arthritic lesions or foci in other parts, especially in parts of the eye other than the cornea.

Myopia and glaucoma simplex depend essentially on foci of this nature in the sclera and papilla. The foci are not directly discoverable but are manifest in the ectasia they induce; according to their situation they cause the one or the other of these closely allied disorders, or both together. Myopia is commonly ascribed to congenital weakness of the sclera, but this idea fits badly with the fact that its appearance is often delayed until after puberty, and sometimes till old age; that it may appear in one eye only; that the ectasia is confined to the posterior hemisphere; and that it leads to choroiditis and detachment of the retina. It is better explained by ascribing it to an intermittent arthritic process.

Glaucoma has been studied for 60 years as though it were essentially due to excess of pressure, with the result that our knowledge of its real nature has not advanced; the tonometer can no more reveal its origin than the thermometer can reveal that of fever. Certain of the earlier writers understood it better: excess of pressure is a frequent symptom, but not an essential or constant part of the disorder. In the present work glaucoma simplex stands for atrophy of the papilla with excavation, glaucoma hypertensum for so-called primary rise of pressure. The two forms are often combined but may occur separately. Excess of intraocular pressure is always secondary; when it is secondary to obvious disease the terms glaucoma and glaucomatous do not apply to it.

Glaucoma simplex is essentially due to arthritic foci, and is of three kinds according to the position of the lesion: neural, when the focus is in the papilla or close behind it; scleral, when it is in the sclera and invades the papilla therefrom—the commonest form; uveal, when it is in the choroid and thence reaches the papilla. The arthritic focus leads to softening of the lamina cribrosa and excavation of the papilla; also to Schnabel’s caverns. The neural form may begin with symptoms of retro-ocular neuritis. Excess of pressure may be present or absent in each of these forms; it may increase the excavation but does not cause it.

Glaucoma hypertensum, all are agreed, depends on changes in the ciliary body and anterior part of the choroid, but whether through blocking of filtration channels by pigment masses, altered secretion, or hyper-secretion, opinions differ. The changes are insidious, hidden from inspection, and may long
precede the rise of pressure; the old idea was a latent choroiditis; the actual origin is the same as that which leads to ectasia in the cornea and in the papilla—a chronic painless arthritic process. This leads not only to excess of pressure but also to detachment of the retina; hence the association of these complications. The question how it does so "lies outside the scope of this work."

We will not follow the author's speculations as to the effects of the hypothetic arthritic foci on other parts—joints, skin, muscles, liver, kidney, endocrine glands, etc. His work covers 160 pages, and teams with ideas and with citations that give them more or less support; it represents much ingenuity and book-work. With regard to his glaucoma theory we feel confident that if, after building it so assiduously, the author had spent equal pains in testing its strength, he would himself have demolished it. Its weakness, or what appears to us to be its weakness, he has himself explained. He tells us candidly on his first page that during his 25 years of work now completed, as head of a large eye clinic, he had little time for scientific study and was obliged to "grossly neglect the laboratory."

In the laboratory one finds excavation of the optic disc in nearly all the eyes, no matter what their original disease or injury, that had been too tense, and in no others; the few exceptions are easily accounted for. The inference is that the excavation has been caused by excess of pressure. To ascribe it to another and purely hypothetic cause in some of these eyes, while offering no explanation of it in the others, seems unreasonable. Again, those who have followed their morbid material to the laboratory, and have studied the escape of fluid from the eye under varying conditions, will hardly accept a glaucoma theory which makes no mention of a displaced iris-base. To discuss Dr. Wernicke's argument step by step would be, we fear, to attack it all along the line.


In pre-war days one of the most valuable publications in ophthalmic literature was Nagel's Jahresbericht. It contained accurate reports of all the most important papers of the year, not only on ophthalmology proper, but also on the physiology of vision, comparative ophthalmology, and physiological optics. It was admirably arranged and indexed, and, considering the enormous amount of work involved, appeared with commendable regularity a year or eighteen months after the year in which the papers were published.
In 1913 a new German publication, the Zentralblatt for general ophthalmology and its borderline subjects, was started. It was issued monthly, and thus avoided the delay in making the abstracts of papers available for readers. Six volumes of this work have appeared, and show little signs of the influence of the War. Nagel's Jahresbericht, however, apparently succumbed, and it is only now resuscitated in a somewhat different form. The subjects are classified much in the same manner as in former volumes. Instead, however, of specific abstracts of all the papers, each section is preceded by a general introduction (Uebersichtsreferat). A complete bibliography is appended to each section and each item in the bibliography has the reference to the abstract in the Zentralblatt appended. In order, therefore, to obtain both bibliography and abstracts it is necessary to have both Jahresbericht and Zentralblatt. So far as the abstracts in the Zentralblatt are concerned, we have found them excellent and quite on the same lines as in the former volumes of the Jahresbericht. The introductory survey of each section in the Jahresbericht is in every case well done, and has the advantage of throwing the different contributions into a proper perspective. There are good indexes of authors and subjects.

NOTES

* ALL medical practitioners will regret to learn of the death of Wilhelm von Roentgen at Munich, at the age of 78. His discovery of X-rays in 1895 revolutionized the whole aspect of medical and surgical diagnosis and treatment.

We regret to record the death of Dr. Alfred Henry Fison, Lecturer in Physics at Guy’s Hospital and the London Hospital. Death followed injuries caused by a fall while fixing an aerial for a wireless entertainment at the former institution. An optical article from his pen was published in this Journal of June, 1919.

Another loss to be deplored is that of Walter William Sinclair, M.B., aged 54, ophthalmic surgeon to the East Suffolk and Ipswich Hospital, which took place at Ipswich on January 29. Some details of his life will be published in the next number of this Journal.

Dr. A. H. Gaitskell died at Westcliff-on-Sea on January 1, 1923. He was Ophthalmic Surgeon to the Victoria Hospital, Southend, and to the Corporation Children’s Eye Clinic.