were recorded consistently at the contact between uncrusted and crusted snow, whereas they dropped to as low as 14° F. at the surface of the snow crust. Air temperatures at 4.5 feet above the snow mantle rarely dropped below freezing and usually were about 5 to 10 degrees higher than those of the snow surface during the crusting period.

Daily snow-melt was reduced artificially at some of the sampling stations by shading and by minimizing air movement. On May 8, for example, snow-melt in bright sunshine with free air movement totaled 1.3 inches. Total melt in the same day was 0.89 inch on a shaded site with free air movement and 0.47 inch on a shaded site with restricted air movement.

Discoloration of the snow surface increased snow melting on other sites. The daily melt of clean white snow giving a Weston photometer reading of 220 averaged 1.2 inches as compared to 1.3 inches for normal snow giving a Weston reading of 200. Snow surfaces which were darkened by applications of dust and soot so as to give Weston readings of 180 and 150, respectively, melted at rates of 2.0 and 2.4 inches per day.

Rates of snow melting during the day varied from 0.014 to 0.205 inch per hour. Inasmuch as no surface run-off occurred on the site throughout the study period, it is evident that melting was sufficiently slow for all the water to enter the soil at or near the spot where it was released from the snow mantle.

Evaporation from snow during 6 days of measurement between April 28 and May 21 at 8,700 feet elevation varied from 0.005 to 0.07 inch of water per day. The average evaporation for these 6 days was 0.04 inch or the equivalent of about 1.20 inch per month. Greatest evaporation occurred on days when the vapor pressure of the atmosphere at the snow surface was materially greater than at 2.5 and 12.0 feet above the surface. Least evaporation occurred when vapor pressure of the atmosphere approached that at the snow surface. Vapor pressure of the atmosphere exceeded that at the snow surface for a short time on one of the days of record and probably caused some condensation of moisture, although the amount was not measured.

Evaporation during two days in early May averaged 0.54 inch per day on a site having full insolation and free air movement. During the same period, average daily evaporation was 0.52 inch on a shaded site with free air movement and 0.23 inch in the shade with no air movement. Thus, whereas shading alone had little effect on evaporation, a 50 per cent. reduction in evaporation loss was achieved by minimizing the movement of air over the snow surface. Stands of trees and other vegetation are known to have a pronounced stilling effect on the atmosphere near the ground surface. Further studies are needed to determine the amount of water lost by evaporation of snow during the entire season of snow accumulation and melting and the extent to which manipulation of the plant cover on the western watershed lands will decrease this loss and thereby increase ground water and streamflow.

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# SCIENTIFIC BOOKS

## VERTEBRATE PHOTORECEPTORS

*Vertebrate Photoreceptors.* By SAMUEL R. DETWILER. 10 + 184 pp. New York: The Macmillan Co. 1943. $4.00.

FROM time to time a book appears that contains precise technical information, presented so simply, clearly and interestingly that it makes good reading for scientist and layman alike. Such is this latest publication in the series of Experimental Biological Monographs. As the title suggests, the author has largely limited his presentation to the structure and activities of the visual and pigment cells of the retina. By so doing he does not invade the field covered by the intensive treatise of Polyak ("The Retina," 1941); there is, likewise, only partial duplication of some of the topics more exhaustively treated by Walls ("The Vertebrate Eye," 1942). Professor Detwiler, though presenting no small amount of detailed information, aims rather at the biologist who is not professionally concerned with the photoreceptive apparatus but who wishes to know its present status as an adaptive visual-mechanism. Other beneficiaries are the non-biological scientist with catholic intellectual interests and the clinical ophthalmologist.

The first 59 pages are devoted to pure morphological description. In them the author presents the background-material necessary to an understanding of the rest of the monograph. After a preliminary chapter on the plan of the vertebrate eye as a whole, the organization of the retina is described. Here the reader may obtain a digest of the far-reaching and revolutionary concept of Polyak concerning the types of neurones encountered in the primate retina, their synaptic relations and the paths taken by retinal impulses. The next chapter deals with the structure

of visual cells, including a discussion of the difficulties encountered in assigning certain aberrant types to the rod or cone category, and the criteria (advanced by Kolmer through the use of differential staining) to be employed in the proper identification of these elements. A final morphological chapter covers the development of the retinal elements, in which the differentiation of the visual cells receives major attention. The rod and cone are considered to be the products of divergent specialization from a common prototype; consequently, arguments are marshalled against the claim that cones are specialized rods or that cones are rods arrested in development.

From this point on, the treatment shifts from straight morphology to functional correlations and interpretations. Three chapters discuss some of the more general adaptations that are seemingly useful. One of these chapters cites the correlations that exist between the kinds and ratios of visual cells found in any retina and the habits (diurnal, nocturnal or both) of that animal. Somewhat disappointing is the failure to come to grips unequivocally with the issue raised by Walls's provocative claim that cones have transmuted into rods in many nocturnal animals. A second chapter gives a résumé of the capacities of rods, cones and retinal pigment to undergo positional changes in light and darkness. Some other influences, such as temperature, are included as well. The final chapter in this group reviews the possible usefulness of positional shifts in the visual receptors and retinal pigment in the furthering of efficient vision. No one theory is deemed sufficiently inclusive to explain all the responses to light, temperature, etc., on an adaptive basis. The author fails to present what, in the opinion of the reviewer, is the most conclusive evidence showing how the several photomechanical responses to bright and dim light in fishes correlate with the duplicity theory of vision.

The remaining four chapters are devoted to more specialized topics. Two consider the arrangements by which visual acuity is attained, particular attention being paid to the significance of the fovea. The correlation between foveal development and the ability to perform extensive ocular movements is accepted, but the author concludes that conjugate movements, binocular vision and partial decussation of the optic tracts are not necessarily implied. He also demurs against Elliott-Smith's view that the presence of a macula has led to marked evolutionary advances in the portions of the brain concerned with vision. Walls's recent interpretation of the fovea as a mechanism for enhancing the resolving power of the retina, not for mere optical thinness and homogeneity, is given the sympathetic consideration that this important concept deserves.

The two final chapters center about the retinal photopigments. The fundamentals emerge through an exposition of the properties of rhodopsin and the less familiar porphyropsin of the rod and of iodopsin of the cone. The relations of these carotenoid derivatives to the vitamins A (as both precursor substances and decomposition products) are reviewed on the basis of Wald's recent, important disclosures. The author attempts to make tangible the spectrophotometric analyses concerning these substances by identifying the Kolmer droplets, seen abundantly alongside dark-adapted rods, as retinene —the decomposition product intermediate between vitamin A and visual purple. In conclusion there is a timely digest of the dependence of vision on vitamin A, of the effect of its deficiency on physiological thresholds (night blindness), of the breakdown of rods following prolonged avitaminosis A and of the capacity of rod repair after a return to an adequate diet.

This monograph carries 110 excellent illustrations, several extensive tables, a recapitulation, a valuable bibliography against which textual statements may be checked, and both an adequate author and subject index. It contains some original data, of use as source material to the specialist. The scientific world is placed in debt to Professor Detwiler for having produced so readable, stimulating and authoritative a book in a field that has been both enlarged and quickened through his own investigative activities.

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## RADIOLOGY

*Physical Foundations of Radiology.* By OTTO GLASSER, EDITH H. QUIMBY, LAURISTON S. TAYLOR and J. L. WEATHERWAX. x + 426 pp. 95 figures. 55 tables. New York and London: Paul B. Hoeber, Inc., Medical Book Department of Harper and Brothers. 1944. $5.00.

THE applications of physics to the field of radiology have grown rapidly within the last decade. The subject is assuming a place of increasing importance in the field of radiology.

The student in radiology, as well as the established radiologist who wishes to study this phase of the subject, will find this book relatively easy and profitable reading. The four eminent research workers and well-known teachers have pooled their experiences to produce this fundamental and non-mathematical work. The text is not a source book of theoretical radiologic physics, for it contains very little mathematics. A