eight pages in all, will be disappointing to old-time ecologists, to whom, however, its brevity should be a suggestion that they have hitherto given overmuch emphasis to this phase of the subject.

A thoughtful chapter on "adaptation," in which the author gives his personal views on the subject, closes the book in such a manner as to leave the student in a properly humble state of mind, since it makes it clear that many of the "cock sure" conclusions of yesterday are improbable, or quite impossible.

A most useful, ten-page appendix contains a classified bibliography which will prove very useful to the student who wishes to go farther than the study suggested in the text.

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SPECIAL ARTICLES

THE PHOTOELECTRIC EFFECT

READERS of SCIENCE may be interested in the following brief summary of some of the principal results of an investigation of the magnitude and distribution of the total kinetic energy of the electrons emitted when light falls on metals, considered as a function of the frequency of the light and of the nature of the metal. A fuller account of the investigation was communicated to the meeting of the American Physical Society at Boston on April 27.

Monochromatic ultraviolet light of various wave-lengths from a quartz-mercury arc lamp was allowed to fall on a small strip of the metal to be tested placed at the center of an exhausted conducting sphere. Measurements of the currents against various opposing potentials enable the distribution of the energy among the emitted electrons to be obtained directly. The experimental results may be analyzed and exhibited graphically by plotting the number of electrons having a given energy against the energy. These curves are nearly symmetrical about the axis of mean energy. The mean energy is very close to the most probable value of the energy. The probability of an electron having energy within a given range changes very rapidly in the neighborhood, both of the maximum energy and of zero energy. The maximum energy, and also the range of energy, of the electrons emitted by light of a given frequency is approximately a linear function of the frequency.

For different substances the relation between the mean energy Tv and the frequency v of the exciting light is found to be $Tv = k_1(v - v_0)$. For sodium, magnesium, zinc, aluminium, tin and platinum $k_1 = 2.9 \times 10^{-27}$ erg. sec. v_0 is a constant characteristic of the substance. The above formula is a particular case of a more general relation $Tv = v\phi(v_0/v)$, where ϕ is a universal function of the argument, which was deduced theoretically by one of the writers. According to the theory the values of v_0 should be calculable from Planck's radiation constant h and the intrinsic potentials of the substances. The calculated values of $\lambda_0 = c/v_0$ are compared with those given by the photoelectric measurements in the following table:

	Na	Al	Mg	Zn	Sn	Bi	Cu	Pt
λ_0 (calculated)....	52.6	36.0	34.6	33.3	31.0	29.4	28.0	27.3
λ_0 (photoelectric)	57.0	39.5	36.5	36.1	33.8	33.1	29.7	29.0

Our measurements of the maximum energy Tm are probably less accurate and certainly more irregular than those of the mean energy; but they are all fairly near the linear relation $Tm = k_2(v - v_0)$. The values of v_0 are the same as before and k_2 is very near to 6×10^{-27} erg. sec. k_2 is thus about 10 per cent. less than Planck's constant h. We do not, however, wish to emphasize this difference, pending further investigation, as we realize that the accurate measurement of the maximum energy is a rather difficult problem. Bismuth and copper appear to have smaller values of both k_1 and k_2 than the other metals, but here again it is possible that further research will remove the difference.

If the laws which we have found to connect the frequency of the light with the maximum and mean energy of the liberated electrons hold up to the highest frequencies, it follows that the frequency v of Röntgen rays may be obtained from either of the equations

$$v - v_0 = \frac{T_v}{2.9} \times 10^{27} = \frac{T_m}{6} \times 10^{27},$$

where T_v is the mean energy and T_m the maximum energy of the electrons emitted when Röntgen rays fall on a metal. For these high frequencies v_0 may be neglected compared with v.

Our results are favorable to a theory of the photoelectric effect of the type of Einstein's[1] combined with the hypothesis that the difference in the work P for different substances is determined by the contact difference of potential.

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PRELIMINARY NOTE ON THE OCCURRENCE OF A SEX-LIMITED CHARACTER IN CATS[1]

THE problems offered by so-called "sex-limited characters" have lately been attacked by several investigators who have found in many of the cases a possible explanation of the observed phenomena by considering one of the sexes a Mendelian homozygote for the "sex-producing" factor, while the other sex is considered a heterozygote.

The sex-producing factor is commonly designated by X, its absence by —. Thus one sex would be homozygous, XX, and the other would be heterozygous, X—. Certain cases have been found in which experimental results indicate that the female is homozygous, XX, while the male is heterozygous, X—, while in other cases the facts are best explained on the hypothesis that the female is heterozygous, the male homozygous. Interest increases as sex-limited characters are found in the higher animals, the inheritance of which follows one or the other of these formulæ.

It has long been known that "tortoise shell" (a blotching of black and yellow, or blue and cream) occurs in cats, in a vast majority of cases in the female sex. Doncaster[2] (1904) attempted to ascertain whether tortoise shell could be considered as a sex-limited character whose appearance conformed to the then existing hypotheses of sex-inheritance. He came to the conclusion that "tortoise" was merely the female form of heterozygote obtained in a cross between orange (yellow) and black animals. The male form of "heterozygote" was orange in certain crosses. Thus he found that (1) orange female × black male gives tortoise females and *orange* males, but the reciprocal cross (2) black female × orange male gives tortoise, *black* (and probably orange) sexes not stated. This last-named cross is crucial, for in it is contained the evidence that the male "heterozygotes" between orange and black are *not always orange, but may be black.* The writer has, in a very small way, carried on this cross. Thus four black females crossed with the same orange male have given a total of 15 young; of these 7 were males, *all being black,* and 8 were females, *all being tortoise; no "orange" animals appeared.* Here there is evidence that the cross of orange male × black female produces male offspring, *all of which are black,* while Doncaster's evidence shows the reciprocal cross to produce male offspring, *all of which are orange.*

We must, therefore, suppose a reversal of dominance to occur in the reciprocal crosses unless we can use the hypothesis of sex-limited inheritance.

If we adopt, tentatively, the hypothesis that the female is a homozygote, XX, and the male is a heterozygote, X—, and if we suppose that black, B, is always coupled with the sex-producing factor, X, we should conclude that the black female is of the gametic constitution, BB, and that the black male is of the composition B—.

The yellow male lacks the factor for the production of black pigment in the coat and is of the gametic composition Y—, while the

[1] *Ann. der Physik.*, Vol. 17, p. 146, 1905.

[1] From the Laboratory of Genetics, Bussey Institution.

[2] *Proc. Camb. Phil. Soc.*, XIII., Pt. I., p. 35, 1904.