If the composition of the porphyrin of chlorocruorin is ascertained, valuable light may be thrown on the peculiar metabolic process by which a few annelids synthesise chlorocruorin while so many animals build up hæmoglobin.

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December 17.

Blindness of Cave-Animals.

I DOUBT whether Sir Ray Lankester would maintain his theory of the origin of blindness in cave-animals, at least in the fishes living in the North American limestone caves, if he had carefully considered the observations on these fishes published by Eigenmann and other American zoologists. There are two points of special significance in relation to the question of selection by the escape from the caves of individuals with better developed eyes, versus direct influence of darkness on the eyes. The first is to what degree the actual ontogeny of the eye shows recapitulation, the second whether the individuals with power of vision would actually swim away from the darkness towards the light.

Amblyopsis spelæus, the most abundant of the blind fishes of the caves of central North America, reaches a maximum length of 13·5 cm. It is placed in a small family closely allied to the Cyprinodontidæ. This family includes five other species occurring in the same or contiguous regions. Three of these, *Chologaster agassizii*, *Typhlichthys subterraneus*, and *Troglichthys rosæ*, also live in subterranean streams in total darkness. Two of them, *Chologaster cornutus* and *C. papilliferus*, live exclusively in streams and swamps on the surface of the earth.

If we consider the eye of Amblyopsis as the example of the subterranean species which has been most thoroughly examined, the organ is visible as a minute black spot on each side in specimens 35 mm. long. Microscopically examined, it is very degenerate. The lens is very small and displaced, or entirely absent. The vitreous humour has disappeared, the remnants of the retina form an irregular mass in the cavity of the eye, the optic nerve can be recognised where it leaves the eye but cannot be traced to the brain. After the mature stage of the fish the eye undergoes further progressive degeneration.

With regard to recapitulation, the lens and optic vesicle develop in the embryo at the normal stage and in the normal manner, but soon begin to degenerate. The optic nerve also develops normally in the embryo. Defects due to mutation do not usually follow a normal initial development.

In *Chologaster agassizii*, which is also completely subterranean, the eye is normal in structure, and functional, but reduced in size. The fact that there are two other species of the same genus which live in daylight shows that this one cannot have been confined to darkness so long as the subterranean genera in which the eyes are degenerate and vestigial. If Sir Ray Lankester's theory were true, *C. agassizii* would not be in darkness at all but would have found its way out to the light. But it is probable that the instinct of all the species of Chologaster is not to seek the light but to avoid it. Eigenmann actually observed this in *C. papilliferus*, which is found under stones in the "springs" or small streams of south-western Illinois: the fish are negatively heliotropic, or photophobic. He found that this was equally true of Amblyopsis and Typhlichthys, which, notwithstanding their blindness, have retained the habit of hiding under stones and the ledges of rocks. In Chologaster there is evidence that the reduction of the eye has commenced in association with its photophobic habits without confinement to total darkness. In a specimen of Zygonectes, one of the Cyprinodontidæ, 38 mm. in total length, the eye was 2 mm. in diameter. In *Chologaster papilliferus*, 32 mm. in total length, the diameter of the eye was 0·83 mm. In *C. cornutus*, 32 mm. in total length, diameter of eye 0·96 mm. In *C. agassizii*, the subterranean species, 39 mm. in total length, diameter of eye 0·72 mm.

Lastly, it may be mentioned that in *Typhlogobius californiensis*, the eyes in the adult are minute and degenerate and almost if not quite insensitive to light. This fish lives in holes under stones, which it never quits. It can scarcely be maintained that it remains in dark holes because defects in vision make it unable to find its way out, especially as in the young state its eyes are visible and apparently functional.

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December 12.

Heterochromosomes and Polyploidy.

DURING recent cytological investigations in the Salicaceæ, undertaken to demonstrate the presence or absence of sex- or heterochromosomes in certain species of Salix, I have discovered such chromosomes in the males of *Salix lucida* Muhl., *S. aurita* L., *S. cinerea* L., and *S. Andersoniana* Sm. Of these species, *S. lucida*, an American form, belongs to the section Pentandræ of the supersection Pleiandræ, *S. aurita* and *S. cinerea* to the Capreæ group of the Diandræ, and *S. Andersoniana* to the Phylicifoliæ of the same supersection; all are, of course, diœcious. Of the polyploid series developed in Salix, *S. lucida*, *S. aurita* and *S. cinerea* are tetraploids, and *S. Andersoniana* hexaploid.

In the case of *S. lucida*, the heterochromosomes are easily discernible both in profile views of the heterotypical spindle in pollen mother cells and also in diakinetic figures. On the contrary, owing to the intimate relations between the paired chromosomes during diakinesis in *S. aurita*, *S. cinerea* and *S. Andersoniana*, they are not so readily recognisable at that stage in those species but stand out very clearly in heterotype metaphase side views.

In all four species, the larger member of the pair is more or less broadly (and occasionally obliquely) pear-shaped whilst the smaller is spherical; they lie on the periphery of the equatorial plate.

Although the mere demonstration of heterochromosomes in these species is in itself important, of even greater value is the light thrown on the development of polyploid series in plant genera. No matter what explanations are given of the origin of tetraploid species they all amount to the same in the end: whether we invoke chromosome division in the fertilised egg followed by a suspended mitosis, or any of the other theoretical explanations now current, in all there is implied a duplication of chromosome complement. Therefore, in diœcious plants possessing heterochromosomes, amongst the chromosomes so duplicated should be those chromosomes themselves, so that in the heterotype division of tetraploid species we ought to be able to detect two pairs of heterochromosomes and in hexaploids three pairs. However, careful examination has shown that in diploid, tetraploid and hexaploid alike only one pair is present. Hence, the problem of polyploid series in the Salices, and presumably in other genera, cannot have the simple solutions previously propounded, and the whole matter is thrown open for further consideration.

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December 21.