

exuberance in the earlier stages of European education, the choice is frequently painful. It is to be hoped that means may be found to establish a happy mean between the two; but it is quite certain that among the subjects of education conducive to that end, the history of the intellectual evolution of mankind must find a more conspicuous place than is assigned to it in the latest scheme of higher education. The titles bachelor and master of arts should, in my view, together with the doctor of philosophy, remain the badge of such broader education; and those who are content with narrow lines should also be content to receive only a corresponding degree. E. W. HILGARD.

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PHOSPHORESCENCE IN DEEP-SEA ANIMALS.

IT is stated, among others, by Beddard in his animal coloration that the brilliant and varied colorations of deep-sea animals are totally devoid of meaning, either by way of protection or warning, for the simple reason that not enough light penetrates to the depths of the sea to permit them to be visible. But in a paper on the 'Utility of Phosphorescence in Deep-Sea Animals,' in a late number of the *American Naturalist*, it is maintained by C. C. Nutting that the quantity of phosphorescent light emitted by the animals of the deep sea is very considerable—so great, in fact, as to supply over definite areas of the sea bottom a sufficient illumination to render visible the colors of the animals themselves. This lighting up of the depths of the sea would be of manifest benefit to the various animals which combine to bring it about—it would serve much the same purposes as protective, aggressive, alluring and directive colorations. For the free-swimming animals—fishes, crustaceæ, molluscs, part of the cœlenterates, most of the protozoa—the utility of phosphorescence is the more readily obvious; but since practically all deep-sea forms live exclusively on animal food, and since it is well known that light exerts a strangely attractive power on widely different forms of animal life, the fixed species would also enjoy at least the benefit of attracting their prey. A very large number of crustaceans are phosphorescent, often brilliantly so; many of them have large eyes

and are particularly active in movement and voracious in appetite; they feed on minute organisms for the most part, and it can hardly be doubted that they often use their phosphorescent powers for the purpose of illuminating their surroundings and revealing their prey. Certain cephalopods secured by the *Challenger* have been made out to have a highly specialized apparatus designed to reflect light from their phosphorescent bodies downward to the bottom over which it passes; in this case there is not only light but also a reflector, an efficient bull's eye lantern for use in hunting through the abyssal darkness.

Among the ctenophores and medusæ we encounter amazing displays of the 'living light'; as these animals have eye-spots, and seem to be able to distinguish light, their phosphorescence may serve to keep them together in groups and thus effect the same end as directive coloration among vertebrates and insects. It is important to note that blind species of groups normally possessed of eyes are seldom if ever phosphorescent. Noctiluca and other allied Protozoa are often found at considerable depths, and hence come under the head of deep-sea forms, but they differ from the organisms already mentioned in having no recognized organs of sight, and also in an extreme simplicity of organization. They, however, occur in enormous swarms and hence must have some means of keeping together, and moreover, they have been proved to be, although eyeless, extremely sensitive to light. In fact, it is practically certain that sensitiveness to light is a fundamental property of simple protoplasm. It is easy to conceive, therefore, that in these little creatures their phosphorescence is directive in function; the same thing is doubtless the case with a medusa of the subtropical Atlantic, which thickly covers hundreds of square miles of surface, and which glows like a living coal at night. C. L. FRANKLIN.

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CURRENT NOTES ON METEOROLOGY.

BALLOON METEOROLOGY.

THE rapid development of what may well be called balloon meteorology has resulted in the