

or enclose. Compare English *cup*, *cob* (corn, or nut), *coop*, *coomb*, *cap*, *cape*, *keep*; Latin *cupia*, *caput*, *cum*, *capio*; the Semitic roots *H-p-n*, *g-H-p*, and *K-m* meaning handful, take, quantity; Sumerian *kam* earthen jar, *gab* breast; Cantonese *kap* imbibe, *káp* jaws, *kam* grasp, *kóp* a measure; Bantu *-k'apo* sack; Polynesian *kapu* cup; Indonesian *kabo-k* goblet; Hoka (North American) *kupo* basket; Arawak (South America) *kabo* hand, *komiki* bowl.

Al, as we have seen, means up, on high; *copal* therefore naturally would mean cup-up, that is, the vessel fastened up the tree to collect the resin.

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Adaptation.

THE present-day attitude with respect to adaptations is peculiar and to my thinking unscientific. Adaptation implies duality, an interaction between the organism and the environment. The descriptions of outstanding examples of the relationship are made in dual terms. But there the implication ends, for biological creed steps in to forbid it.

The younger biologists have been brought up in a genetic school which will not allow of such an interaction between circumstance and life. The protoplasm is possessed by a series of gods which determine what the protoplasm is to do. Variations are due to these gods and the relative degree of power they are able to develop. Let us take two examples. A blind and colourless animal is found in conditions of darkness because a section of the gods in its ancestors were producing inferior eyesight and diminishing pigment. A white animal chooses an Arctic environment because the gods of the germ-plasm gave it a colour suitable to such circumstances.

(1) In 1903 (Northumberland Sea Fisheries Committee. Report on the Scientific Investigations, p. 51) I described the occurrence of *Gammarus duebeni* in the Mill Pit at Blyth. From that account it will be seen that the amphipod lives in drains near the pit head and is liable to be carried into the pit when flooding takes place. The pit was flooded in 1887 and in 1899. The gammarids were first observed in 1893 (and were called by the men 'pit fish') in the landward workings, but they were carried by the drainage water into the second drift. The fact of time and the circumstance of a large increase in numbers about 1898 when the drainage water was dammed back for the use of the stables, show that they breed in the new environment.

The examples I obtained in 1901-2 had a dull transparent white colour, and the three red spots were absent. They were apparently blind so far as simple tests could testify. The colour was gradually regained under laboratory conditions, the degree of restoration depending upon the intensity of the light and successive ecdyses. The first exuviated cuticle was white and the second yellow to light brown in colour. The red spots appeared also and, at first very faint, gradually increased in strength of colour.

The variation therefore is reversible. But it is in this respect of importance. If, during the life of an individual still able to undergo ecdysis the stimulus of light is capable of restoring the pigment and probably the function of the eyes, it is evident that the original change was also direct and affected all the individuals successfully introduced to the conditions. In neither case is the germ plasm involved. The life in a state of darkness and the subsequent exposure to light produce results which are due simply to stimuli and the cessation of stimuli on protoplasm. After the first event of breeding of similar variants, the first

generation would be exposed to the conditions of darkness from the egg-stage and the effects would be intensified. The next generation would arise from parents still more completely colourless and blind. The pit is liable to receive fresh contributions from the surface which would tend to delay the change; but even so it is evident that it would progress to a stage when restoration would be more difficult, when, instead of a succession of ecdyses, one or more generations would be required.

This is not the only case of the kind. More than sixty years ago Thomas Atthey sent to my predecessor examples of a copepod which were obtained from the damp roof of the pit workings of a colliery at Cramlington. Brady described it originally as a new species, but later identified it with Sars' *Canthocamptus pygmaeus*. The references will be found in Brady's Ray Society monograph under the name *Attheyella pygmaea*. Brady said nothing about the pigment, but the queried 'eyes wanting' is significant.

It may be urged, and rightly, that the effects of the one and the other environment are just what would be expected. The variations result from the nervous capacity of protoplasm and are not inherited. They depend upon the sustained condition of the cause. But this consideration gives rise to a feeling of misgiving as to what is meant by heredity. It is plainly difficult to say where non-inheritance ends and inheritance begins. If the circumstances confine the reproduction to a section of the population, the members of which are all similar variants, then a direct inheritance results without the germ plasm being called upon to do more than start a history which is affected in similar degree in every generation. This is what might be called a conditioned or passive sexual selection. But it must be remembered that an active sexual selection is generally exhibited and has been in operation since conjugation was instituted.

Whether the change is to be inherited depends upon circumstance. An annual ring is not inherited. This brings us to the other example, the Arctic animals.

(2) It is already obvious that a similar explanation can be given in the case of northern terrestrial animals. They are affected by the seasonal alterations of heat and cold, the degree of the modification depending on temperature. The whitest of them all, the polar bear, becomes more yellow in summer and progressively white in winter. No one now seriously believes that the origin of the change had anything to do with colour protection. A physiological explanation of the change is apparent, and inheritance is assured, for all the members of the species exposed to the conditions would be similarly affected.

I beg to submit, therefore, the proposition that all adaptive variations are psychogenetic and that they are directly inherited under asexual conditions of reproduction and by the action of sexual selection in the sexual state.

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Aug. 29.

Distribution of Potential Temperature in the First 25 Kilometres over the Northern Hemisphere.

IN his communication in NATURE of June 15, p. 906, Sir Napier Shaw has emphasised the fundamental importance of a knowledge of the distribution of entropy in the atmosphere for an understanding of the physics of the general circulation.

In Fig. 1 is drawn a smoothed diagram (similar to Sir Napier Shaw's diagram on p. 116 of his "Manual of Meteorology", vol. 2) showing the latitudinal distribution of potential temperature in summer and winter of the northern hemisphere. The potential temperatures plotted (in degrees absolute) are