themselves. Instead of the usual number there were up to nine florets with, in some cases, as many as the first six having well-filled grain, and all bearing a geniculate awn on the outer pale except the uppermost one or two which bore only a small straight awn. Each floret was articulated with its neighbour by means of a well-developed and readily separated sucker and callus pad (Fig. 1) exactly similar to that found at the base of the first floret in the wild stock. Hairiness, also, was markedly different in these mutants, a tuft of hairs being present on the base of every floret and on each rachilla segment.

The lines producing these fatuoids could be divided into two groups, namely, those in which the mutants were completely sterile and those in which the fertility was as high as in normal *A. sterilis maxima*. No fatuoids of intermediate fertility were found, neither were sterile and fertile forms present in the same line. Differences between the two groups were slight except for a further reduction in vigour and slightly earlier panicle exsertion in the sterile fatuoids.

Apart from the rather high number of florets formed on each spikelet, these fertile fatuoids closely resemble the true *Avena fatua*, and it is suggested that this latter species could well have arisen through a mutation of this type from *Avena sterilis* as indicated by Coffman. This theory is not in conflict with the evidence from phytogeography, since most authors agree that Asia Minor is the centre of origin of oats, and both Vavilov⁶ and Malzew⁷ state that *A. fatua* and *A. sterilis* are found growing together in that region.

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¹ Nishiyama, I., *Jap. J. Genet.*, 5, 1 (1929).

² Joshi, A. B., and Howard, H. W., *J. Agric. Sci.*, 46, Pt. 2, 183 (1955).

³ Haussknecht, C., *Mitt. Geog. Gesell. Jena*, 3, 231 (1885).

⁴ Thellung, Von A., *Vjschr Natur. Gesell.*, 56, 293 (1912).

⁵ Coffman, F. A., *J. Amer. Soc. Agron.*, 38, 983 (1946).

⁶ Vavilov, N. I., *Bull. App. Bot. and Plant Breed.*, 17 (2), 139 (1926).

⁷ Malzew, A. I., *Bull. App. Bot., Leningrad*, 33, Supp. (English translation, 473) (1930).

Spores of the Large Free-living Amoebae

IN the course of some experiments on *Amoebae* suggested to me by Dr. P. Couillard of Brussels, I have discovered an easy method of procuring clean spores, newly hatching and developing specimens of the large free-living *Amoebae* (*proteus*, *lescheriae*, *discoidea*, *kerrii*). These stages are difficult to separate from ordinary stock cultures of the *Amoebae*. Hence, I am frequently asked for spores by teachers whose pupils are interested in the life-history of the large *Amoebae*.

The method is as follows:

Use a rather old culture of mixed ages in which fission division is going on in the full-grown adults. Having removed as much as possible of the 'debris', pipette the *Amoebae* into a vessel containing a dilute solution of inorganic salts (potassium chloride, 0.006 gm., magnesium sulphate, 0.002 gm., double super phosphate, 0.007 gm., 1,000 ml. distilled water). (I use Glasgow tap water, which is very soft, instead of distilled water.)

The change in pH very quickly kills off the ciliates flagellates and the adult *Amoebae* (often in a beautifully expanded condition).

Allow the whole to stand in a warm place for about a week, then examine the bottom of the Petri dish with a No. 7 water immersion lens. Unhatched and hatching spores, as well as young creeping *Amoebae*, will be seen, the latter feeding on the bacteria produced by the decomposition thus set up.

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Isotopic Exchange of Oxygen between Free Hydroxyl Radicals and Water

WE have investigated the exchange reaction¹⁻⁴

using potassium ozonide KO_3 ⁵ as a new source of free hydroxyl radicals⁶. Potassium ozonide reacts instantaneously with water enriched in H_2^{18}O , evolving oxygen according to the reactions:

The ozonide preparation was of the following composition: KO_3 , 89.3 per cent; KOH , 8.4 per cent; H_2O (as $\text{KOH} \cdot \text{H}_2\text{O}$), 2.3 per cent. The experiments, in which water containing 1.38 per cent H_2^{18}O was used, were carried out in an apparatus equipped with a magnetic stirrer and the means for introducing the potassium ozonide powder in small portions in an atmosphere of nitrogen. The process of adding the ozonide in all lasted 3–5 min. The degree of enrichment of the evolved oxygen was determined mass-spectrometrically, the error in the oxygen-18 content being less than ± 2 per cent of the measured quantity.

The degree of exchange was referred to the total amount of hydroxyl radicals less the amount utilized in the formation of the hydrogen peroxide, the latter being determined by titration with 0.1 N potassium permanganate (molecular oxygen and hydrogen peroxide are incapable of rapid exchange with water⁴). Not more than 15 per cent of the hydroxyl radicals were consumed in the formation of the hydrogen peroxide. Table 1 shows the isotopic composition of the oxygen evolved and the degree of exchange.

It can be seen from the table that at 20° and 0° C. the hydroxyl radicals exchange with water to the amount of about 10 per cent. The degree of exchange does not depend upon the pH of the solution; this confirms that the exchange actually occurs between the hydroxyl radicals and the water, and not between the former and hydroxyl ions.

Considering the relatively low degree of exchange, it must be borne in mind that this reaction competes with the extremely rapid reactions of disproportionation and dimerization of the hydroxyl radicals.