On the other hand, the photochemical formation of ozone will start first at λ2200, since the existence of oxygen atoms is required for this reaction. Decomposition of ozone was found at λ6000 (Kistiakowski) and λ4360 (Bonhoeffer) and formation at λ2070 (Warburg) in agreement with the above statement.

In the same way the energies of different C-H bonds in hydrocarbon compounds might be determined, for example (formaldehyde):

Photochemical: $H_2CO = HCO + H - 107$ kcal. (Predissociation at λ2670)

Thermal: $H_2CO = CO + H_2 - 2$ (calc. from heat of combustion)

$H_2 = 2H - 101$

$HCO = CO + H + 4$ kcal. (!)

The energy of the C-H bond in formaldehyde is 107 kcal. (acetaldehyde 93 kcal., benzaldehyde 110 kcal.—predissociation at λ3050 and λ2550 according to V. Henri and S. A. Schou). Therefore it requires 111 kcal. to excite normal (bivalent) carbon monoxide to the tetravalent $=C=O$ molecule, which is responsible for the reaction. The same value is obtained from the dissociation of carbon dioxide. The energy of the CO bond, derived from spectroscopical data, is about 240 kcal. (not very accurately known), whilst the decomposition of carbon dioxide into normal carbon monoxide and oxygen requires only 130 kcal., so that the excitation energy is about 110 kcal.

Assuming this value, derived independently from two reactions, to be correct, one is able to calculate the energy of the CH bond in methane to be 115 kcal. and that of the C-C bond in different hydrocarbon compounds to be 110-115 kcal., compared with the old values of 90 kcal. (CH) and 65 kcal. (C-C). The energies of the $C=C$ and $C\equiv C$ bonds come out to be about 200 and 300 kcal.

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Feb. 28.

Sex in Fungi.

IN their letter in NATURE of Mar. 1, Prof. R. Ruggles Gates and D. V. Daran appear to welcome the new views on heterothallism in the fungi, such as Dame Helen Gwynne-Vaughan's conception of nutritive heterothallism, which have come in, as they say, "to relieve the tension on the earlier rigid hypothesis of fixed + and − strains corresponding respectively to the female and the male sex".

It is only fair to point out that Dame Helen Gwynne-Vaughan and her colleague, Mrs. H. S. Williamson, only put forward this suggestion of nutritive heterothallism tentatively and frankly admit that "we have not yet been able to justify this term".

To interpret the various forms of heterothallism found in the fungi, the facts discovered in recent years must be fully realised. Sex heterothallism is only one of several forms of heterothallism, and it is perhaps due to the confusion between these various forms that the theory of multiple sexes has gained such a hold. A much simpler and more workable hypothesis, as pointed out by Brunswik, is the conception of two sexes, the inter-reactions between them being controlled by one or more factors other than sex factors. These controlling factors are held by Kniep to be positive sex factors, by Brunswik to be negative sterility factors; and, as the latter also points out, the conception of one or more sterility factors eliminates the necessity (on the positive sex factor hypothesis) for the assumption of multiple allelomorphism (to the *n*th) to account for the complete fertility between geographical races, as found in some of the Coprini. But a corollary must be added to Brunswik's hypothesis. Since, in a number of cases of Coprini, all the mycelia of one fruiting body will show complete fertility towards all the mycelia of another fruiting body, the mycelia must be potentially bi-sexual, although haploid, and the lack of fusion between certain given mycelia from the *same* fruiting body is due to the effect produced by one self sterility factor, or by certain given combinations of two self sterility factors.

The work on *Humaria granulata* has thrown a flood of light on this problem. Here we have a fungus in which the mono-ascospore mycelia are to all appearances female, the first case of the kind to be recorded. When grown singly the mycelia remain sterile; when combined with each other, half the combinations prove fertile. The authors rightly point out that this is not sex heterothallism (haplo-syncœcism). If it is a case of nutritive heterothallism, then a further assumption has to be made, to explain the fact that only half the combinations are fertile.

Thus two entirely new assumptions have to be made which only add to the complexity of heterothallism in the fungi of which Prof. Gates and Mr. Daran complain.

The results, however, can be explained adequately in another way, without either of these assumptions, as follows:

The mycelia must be self sterile, and although haploid must be potentially bi-sexual. They fall into two definite groups, in the ratio of 1 : 1, and the members of each group are sterile *inter se*. This sterility can be explained on the basis of one self sterility factor *Aa*. This factor and its allelomorph would segregate at meiosis in the ascus, so that half the spores would receive *A*, and the other half *a*. As like will not fuse with like, mycelia carrying *A* will only fuse with *a*, and the only possible zygote is *Aa*. On this assumption the mono-ascospore mycelia from such a zygote would be of two kinds and would give 50 per cent of fertile combinations.

This is not sex heterothallism but a form of physiological heterothallism based on one self sterility factor in a haplo-syncœcious fungus.

The same interpretation might be applied to the heterothallic Hymenomycetes; haplo-syncœcism with one self sterility factor in the species showing bi-polar segregation, and two self sterility factors in the quadripolar species.

The results of the experiments on *Humaria granulata* tend to strengthen the evidence in favour of the conception of only two sexes in the fungi, and the occurrence of other factors which disturb their interreactions.

With regard to the results of the experiments on the heterothallic *Mucor hiemalis* (a species showing true haplo-heterœcism), it is not quite clear whether it is to be inferred that they bear upon the subject of nutritive heterothallism or not. The striking morphological and physiological changes induced by subjecting the mycelia to adverse conditions are interesting, but although zygospore formation may be completely inhibited, there is no evidence of nutritive heterothallism, and the repulsion shown by the mycelia of both strains suggests some form of staling. Neither does the production of imperfect zygospores support this view, as the formation of abortive fruiting bodies is not uncommon in the heterothallic fungi. In the Hymenomycetes, some strains are even capable of producing haploid fruiting bodies with viable spores, but these spores are all of the same sex (so called).

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Merton Park, S.W.19, Mar. 6.