This is the effect of phase preferences on the attraction. Our former argumentations make it evident that in the case of commensurable rather than equal modes the effect of *identical* phase preferences in the pair of molecules which depends on the identity of the pair, is causing the specificity.

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*INHERITANCE OF SEXUALITY IN CHLAMYDOMONAS REINHARDI**

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Moewus[1-3] has studied the inheritance of sexuality in haploid heterothallic (dioecious) algae where the zygote nucleus divides meiotically and where a germinating zygote produces four haploid cells in which two of the cells are of one sex and two of the opposite sex. He has analyzed sexuality of cells from germinating zygotes of five heterothallic species of *Chlamydomonas* and one heterothallic species of *Polytoma*. For all species investigated he finds exceptional cases in which all cells produced by a germinating zygote are homothallic (monoecious) instead of all being heterothallic. For zygotes produced by union of male and female cells of the same species he found that the percentage of exceptions ranged between 2.8 and 7.8. In germinating zygotes formed by a cross between *Chlamydomonas paradoxa* and *C. pseudoparadoxa* the percentage of exceptions was 11.7. Moewus holds that the genes for maleness and femaleness are not alleles, but are at different loci on homologous chromosomes, and that as a result of crossing-over one chromosome contains the genes for both sexes and the other chromosome lacks genes for sex. Daughter nuclei lacking genes for sex disintegrate; those with genes for both sexes persist and cells with such nuclei are homothallic.

Plus and minus (male and female) clones of several species of *Chlamydomonas* have been isolated at Stanford University. These have been cultured in an immobile palmelloid condition on 0.1% Beijerincks solution plus 1.5% agar. When palmelloid cultures growing on agar are flooded with distilled water the cells develop flagella and become motile shortly after flooding. If motile cells from clones of opposite sex are mixed there is an immediate fusion in pairs to form zygotes. The resultant zygotes become thick-walled within a few days, and are fully ripened in about three weeks. Germination of ripe zygotes may be induced by placing them on nutrient agar.

Of the species isolated at Stanford, *C. Reinhardi* proved the most satisfactory for study of inheritance of sexuality. It has relatively large zygotes; germinates 22–26 hours after transfer to nutrient agar; and about 90% of the zygotes germinate. Single zygotes of *C. Reinhardi* were isolated on blocks of agar about 5 mm. square. Four blocks, each with a single zygote, were quadrately arranged 5 cm. from one another on nutrient agar in a Petri dish. At the end of 26 hours each of the small blocks was flooded with a large drop of water. This induced motility in daughter cells extruded from germinated zygotes and the cells swam about in the small puddle of water. Swimming continued until the motile cells became stranded on the agar surface because of absorption of the water by the agar. Each stranded cell, by division, developed into a colony that at the end of ten days contained hundreds of cells. When the colonies were large enough to be visible to the naked eye, each was fished out with a sterile needle and transferred to an agar slant. The sexuality of the four or eight clones obtained from each germinated zygote was then determined by flooding with distilled water and noting the sexual reaction of the cells made motile by flooding.

The sexual reaction was determined for each of the clones developed from individual cells liberated from 249 zygotes of *C. Reinhardi*. None of these clones proved to be homothallic. A few (17) isolates did give a homothallic reaction when tested for sexuality. However, when clones were reisolated from vegetative cells of these putative homothallics all proved to be heterothallic and not homothallic. From this it is evident that the homothallic reaction of the original isolation was due to a heterothallic colony being invaded by cells of opposite sex.

All clones proved to be heterothallic and, where four or eight clones were obtained from a zygote, with half the clones of one sex and half of the opposite sex.

In view of the percentage of crossing-over of genes for sex reported by Moewus for five species of *Chlamydomonas* it is reasonable to expect that at least one case would have been found for *C. Reinhardi*. Since this has not been found in *C. Reinhardi* it is very probable that in this species the

genes for sex are at the same locus and not at different loci as Moewus finds in the species he investigated.

For inheritance of sex, as well as for inheritance of other characters, Moewus always reports obtaining four clones from a zygote. His papers do not show whether he always obtained four clones or whether he discarded material from zygotes where he obtained fewer or more than four clones. Germinating zygotes of *C. Reinhardi* may produce eight instead of four cells, and the number of zygotes producing eight cells is greater in old than in recently ripened ones. Although there is always a liberation of four or eight cells, there is not always a development of four or of eight colonies. For example, in a random selection of 100 zygotes recorded as liberating four cells, 83 had a development of four colonies, 11 a development of three colonies, and 6 a development of two colonies. The reason why certain liberated cells fail to divide and develop into colonies is as yet undetermined, but it is not correlated with sexuality. When the three colonies developed from a single zygote are tested for sexuality two are always of one sex and the third is of the opposite sex. When there is a development of but two colonies the two may be of the same sex, and either plus or minus, or one colony may be plus and the other minus.

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THE HOMOLOGY STRUCTURE OF SPHERE BUNDLES

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1. Since a fiber bundle is a generalization of a product space, it is natural to expect some relations between the homology groups of the bundle, the base space, and the fiber. The simplest relation is between the Euler characteristics, the characteristic of the bundle being the product of the characteristics of the base space and the fiber. For sphere bundles the first comprehensive result was obtained by Gysin.[1] Recently, Steenrod[2] gave a new derivation of the Gysin results. On the other hand, results have been announced by Hirsch[3] and Leray[4] for more general types of bundles.

In the works of both Gysin and Steenrod the base space is assumed to be an orientable manifold. The main purpose of our work is to extend