only will a given tone produce a varied pattern of amplitudes, but different tones will have patterns that differ from one another. A particular tone will act most strongly upon a region of the basilar membrane where the mechanical conditions are most favorable. The sensitivity to this tone will be determined by the general conditions of tuning and the size of the region responding to this tone, and it will not be influenced to any considerable extent by the total number of hair cells in the cochlea. Another ear that is less differentiated may show equal sensitivity to this tone because all or a large proportion of the hair cells present enter vigorously into the action.

A difference in the performance of differentiated and relatively undifferentiated ears will appear, however, when the sound intensity is raised to high levels. The ear with few hair cells, all performing in much the same manner, will reach a limit early, when perhaps half the hair cells have passed their individual maximums and are giving decrements as the stimulus intensity is increased. Raising the sound to still higher levels carries the remaining hair cells into the decremental portions of their individual functions, so that the total response undergoes a rapid decline (*6*).

In the ear with many hair cells and frequency differentiation, the response to a given tone will continue to rise as the intensity is increased because large numbers of hair cells on the fringes of the principal region are able then to make a significant contribution to the output. At moderate levels of stimulation their contributions are small, but, as the stimulation increases and the hair cells in the favored region pass their maximums and produce negative increments of response, these fringe cells continue to increase their output, and assume a new importance in the total action. A maximum is reached when all their contributions are balanced by the large negative increments of the overstimulated cells of the primary region. At this high level of stimulation all the cells of the cochlea are making significant contributions to the output. Hence a close correlation exists between the total number of hair cells and the highest value of the maximum.

The presence of a large maximum in the ears of certain lizards points to an extended dynamic range in these animals. The more extended range has an obvious value in the greater variety and precision of representation of the intensive aspects of acoustic stimuli.

The existence of a measure of structural differentiation in some of the lizard species is perhaps unexpected. Up until now the reptilian ear has generally been regarded as primitive and lacking in many of the important qualities that make hearing one of the dominant senses in birds and mammals. Our evidence suggests the need for a new evaluation of the lizard ear and of the reptilian ear in general and a consideration of how this ear serves in adaptive behaviors. The value of an ear depends directly upon the number and nicety of the discriminations that may be made on a basis of the information that it presents. From our evidence it appears that many of the lizards have progressed far beyond an elementary stage in the process of hearing, and have reached a level of development in which there is both intensity and frequency differentiation of considerable degree.

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Heterothallism in Biflagellate Aquatic Fungi: Preliminary Genetic Analysis

Abstract. *Genetic analysis of several hundred progeny from crosses of two heterothallic species of* Achlya *and* Dictyuchus *provides preliminary information about the life cycle and pattern of sexuality in the biflagellate Phycomycetes. Extensive testing of mycelial progeny indicates a diploid life cycle. Control of sexual expression and mating competence appears to be based on a complex genetic system.*

A distinctive pattern of sexuality characterizes the heterothallic members of the biflagellate, phycomycetous orders, Saprolegniales, Leptomitales, and Peronosporales (*1, 2*). Each heterothallic species of these orders typically consists of a linear series of sexual strains, each of which, with the exception of the two terminal strains, interacts as male or as female, depending upon its position in the series relative to that of its mate. The two terminal strains typically react in a single sexual capacity. In addition, the sexual reproduction process in *Achlya*, and probably in the other genera, is initiated and coordinated throughout its entire course by a series of specific, diffusible hormones (*3*).

Genetic analysis of this system has been thwarted for many years by our inability to induce significant numbers of oospores to germinate. Sansome (*4*), however, has published cytological evidence that indicates strongly that meiosis occurs during the maturation of the antheridium and oogonium in *Pythium debaryanum*, rather than during oospore germination (*5*), with the result that the gametes are the only haploid phase in the life cycle. Sansome also reported "similar unpublished evidence for *Phytophthora cactorum* and *Achlya sp*" (*4*).

We have succeeded in germinating several hundred oospores from two typical heterothallic species belonging to the genera *Achlya* and *Dictyuchus*.

Mature oospores, held at 2°C for several weeks, thinly spread upon water agar, and incubated at 23°C, germinated at very low frequency (less than 1 percent) in 1 to 3 days (*6*). Each germling consists of a multinucleate germ tube that develops into a germ sporangium if transferred to water or into an extensive coenocytic mycelium if it is in the presence of nutrients. The established mycelium can also be induced to form zoospores by transfer to water.

It is thus possible to test either the mycelium directly derived from the germinating oospore or many mycelia mitotically derived via uninucleate zoospores. For example, with *Achlya ambi-*

sexualis, the cross E 87 ♂ (Cambridge, England) × 734 ♀ (Lake Calumet, Chicago) yielded a sample of 56 germinated oospores, which were singly isolated and grown on nutrient media. The mycelia were then mated with each of the parents with the following results: 39 ♂ (25 strong, 12 intermediate, 2 weak in regard to sexual potency); 11 predominantly ♂ (♂ with 734 ♀; induced antheridia on E 87 ♂ and bore aborted oogonial initials in three cases; self-induced antheridia); 6 mixed ♂ ♀ (♂ with 734 ♀; ♀ with E 87 ♂; self-fertile).

In another series of germinations using the same parents, the germ-hypha of one oospore was induced to form a sporangium, from which 19 single zoospore cultures were established and tested. In addition, nine mycelial plugs from various places on colonies produced by each of five different germinated oospores were tested with the parents. In both cases, all products of each single oospore always gave the same result in regard to their sexual interaction and, as far as we could determine, had the same sexual potency.

In matings of *Dictyuchus monosporus* 115 ♂ × 125 ♀ (Cambridge, Mass.), a sample of 36 oospores was germinated and singly isolated on nutrient media. They were then mated with each of the parents with the following results: 18 ♂; 12 ♀; 4 predominantly ♂, and 2 predominantly ♀. The two latter classes yielded, via zoospores, occasional mycelia that mated with neither parent. This apparent sterility, however, probably reflects only the marginal sexual differences between these intermediate isolates and either parent, since failure of interaction between the parental strains themselves is sometimes as high as 10 percent in replicated series of matings. Although we have tested, for several subcultures, large numbers of mycelia derived from single zoospores and mycelial plugs from the germination of individual oospores, we have found no case of male and female isolates derived from a single germinated oospore. We have thus not been able to confirm Couch's (*1*) report of "mixed" strains, which seemed to show some type of vegetative segregation.

Two significant indications may be drawn from these preliminary data on segregation in these forms. (i) The life cycle is probably diploid, the gametes comprising the only haploid phase, although the possibility that meiosis occurs in the germination of the oospore with survival of a single meiotic product cannot now be rigorously discounted. (ii) Control of sexual expression and mating competence resides in a more complex genetic system than paired alleles at a single locus and provide sexual expressions ranging from male through numerous intergradations to female. Of even greater importance, the demonstration of the feasibility of genetic analysis in the biflagellate water molds promises a far more adequate understanding of the biology of this important group of fungi and enhances their already considerable utility for the study of morphogenesis.

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Immunoglobulin A Production in Ataxia Telangiectasia

Abstract. *Serum from five patients with ataxia telangiectasia contained no detectable immunoglobulin A (IgA). However, there was evidence (by immunofluorescence) of IgA in the bone marrow of the three patients so examined, suggesting that the defect in IgA production was not complete. IgA was in the saliva of all five patients and in the parotid gland of the one patient studied. This is further evidence of IgA synthesis by the salivary glands.*

The immunoglobulins have been divided into the following classes: (i) immunoglobulin A (IgA, β_{2A}); (ii) immunoglobulin G (IgG, 7*S* γ-globulin); (iii) immunoglobulin M (IgM, 19*S* macroglobulin); and (iv) immunoglobulin D (IgD). These classes are distinguished on the basis of physicochemical and immunological characteristics, and they are present in a variety of body fluids (*1*). Evidence of a salivary and colostral IgA which differs from serum IgA has been presented (*2*).

Serum IgA is absent or markedly decreased in many patients with ataxia telangiectasia (AT), a progressive heredofamilial disease characterized by ataxia, involuntary movements, oculocutaneous telangiectasia, and recurrent pulmonary infections (*3*). Such patients provide an opportunity to study immunoglobulin metabolism, particularly the relation between serum IgA and salivary IgA. We now report on the amounts of immunoglobulin in the serum and saliva of five patients with ataxia telangiectasia. In addition immunofluorescence was used to detect IgA in bone marrow from three patients and in parotid tissue from one patient.

Immunoglobulin concentrations were measured by specific immune precipitation (*4*). Normal values were established from a panel of 50 control serums. The maximum sensitivity of the method was estimated from serial dilutions of standard serums; 0.01 mg of IgA per milliliter could be detected (0.3 percent of mean normal amounts).

The concentrations of IgM in serums were normal and those of IgG varied, but no IgA was detected in the five patients. When the serums were concentrated fivefold, we were still unable to detect IgA (Fig. 1).

Study of immunoglobulin metabolism in these five patients provides evidence that the reduced concentration of IgA in serum is due to decreased IgA synthesis and, in some cases, to an associated hypercatabolism (*5*). To distinguish between severely decreased and absent synthesis of IgA, we have sought additional information by immunofluorescent study of the bone marrow from three patients, two of whom had shown hypercatabolism of IgA. We used a direct immunofluorescent technique (*6*) employing goat antiserum to human IgA, labeled with fluorescein isothiocyanate (*7*). This antiserum showed only antibody reactivity to IgA and did not react with serum from patients with AT (Fig. 2). Just prior to use it was diluted 1:6 and 1:40 and absorbed with guinea-pig-liver powder and serum from patients with AT.

In normal marrow and in marrow from patients with AT, brilliant green cytoplasmic fluorescence was seen in cells of two types; both types were present in approximately equal num-