of the spasticity through electrical stimulation of the antagonists permitted the passive movement of the limb through a greater range and in this way helped minimize the recurrence of the spasticity, thereby cutting down the possibilities of contracture. Details of the procedure will be described elsewhere (*7*).

We may summarize our observation by stating that in normal voluntary movement in man there is at present insufficient evidence that reciproeal innervation plays the role in the coordination of the contraction of antagonist muscles which is assumed for it by most thinking on kinesiology. Cocontraction seems to be the rule rather than the exception. On the other hand, we were able to demonstrate reciprocal innervation in patients with neuromuscular disease who showed evidence of spasticity.

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Systematic Status of the Pure Culture Ciliate known as *"Tetrahymena geleii"* and *"Glaucoma piriformis"*

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Since Lwoff's (*1*) success in establishing a small holotrichous ciliate in axenic culture (i.e., free from other microorganisms), at least 50 identical or closely related members of the *Colpidium-Glaucoma-Leucophrys-Tetrahymena* group have been so grown. Some 30 of these organisms are still being maintained in various laboratories and have been used in over 250 investigations, principally of a physiological or biochemical nature, within the past 15 years (*2, 3*). The increasing importance of the experimental animals has made highly advisable a comparative morphological study in order to establish their probable taxonomical interrelationships. Twenty-six of the pure culture strains have been investigated, employing, in particular, the method of silver impregnation, an invaluable technique in study of such small and relatively undifferentiated ciliates. The present report is concerned chiefly with the 21 strains which I consider to be members of a single species but which, to date, have been carried in the literature under several different names, the most common two in recent years being *Tetrahymena geleii* Furgason, 1940, in America and *Glaucoma piriformis*[2] (Ehrenberg, 1830) Maupas, 1883, in Europe.[3] The history of these strains has been traced (*2*).

All the strains studied fall within the limits of the following brief characterization of this very widely distributed species:

Body typically pyriform in shape, 26–92 μ in length, average size about 50 μ × 30 μ; 17–22 ciliary meridians, usually 19–20, consisting of well-defined primary and secondary portions; generally 2 postoral kineties, unipolar meridians with anterior ends terminating directly at posterior margin of cytostome. Delicate apical loop at morphological apex of body; preoral suture single or double fibril from loop to cytostome; 3 intermeridional connectives, anterior end of body, roughly concentric about apical loop. Cytostome pyriform, 9–11 μ in length, about 5 μ from anterior end of body, oriented directly in body axis; characteristic tetrahymenal buccal ciliature consisting of right-hand undulating membrane and left-hand adoral zone of 3 membranelles, bases of the latter oriented at an angle of about 45° to axis of cytostome. Two to three permanent contractile vacuole pores, diameter 1 μ or less, typically located near posterior end of body in meridians 5 and 6; cytoproct slitlike in posterior end of stomatogenetic meridian 1. Macronucleus ovoid to irregularly spherical, generally not greater than 11 μ in any diameter, centrally located or slightly posterior, exhibiting typical chromatin extrusion during fission; micronucleus often absent (see below). Conjugation never observed; cysts reported by one worker (*4*).

In a study of the micronuclear problem presented by this species I have employed the Feulgen technique in critical observation of ciliates, both from axenic strains and from a number of more recently isolated bacterized strains. To date, I have examined 13 pure culture strains, using organisms from 18–20-hr cultures (rich in dividing forms) and 5–7-day cultures, and I have found all of them to be amicronucleate. The axenic strains in question were originally isolated in France, England, and in four widely separated geographical areas in the United States. Three of the American strains had been reported to be amicronucleate (*5*). Five strains, more recently isolated from various localities around Paris, and grown only in bacterized cultures, are also without micronucleus. In addition, in more than 6 cases in which the species has been found as a facultative parasite in the body cavity of living chironomid larvae (*Chironomus plumosus*), it is entirely amicronucleate.[4] A coprophilic

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[2] The trivial name was originally spelled "pyriformis" but has been written with an "i," in particular by French protozoologists, for the past 30 years.

[3] Very recently the French investigators Fauré-Fremiet and Lwoff, in several separate publications (cited by Corliss [*2*]; most recent being Lwoff's footnote, p. 325, in Kidder and Dewey [*3*]), have employed the name *Leucophrys piriformis* in reference to a number of the strains. Both these workers are now in agreement with the writer that the species should be called *Tetrahymena pyriformis* (personal communications).

[4] I have also isolated a second, very closely related, species of *Tetrahymena* from *Chironomus*, sometimes from the same larvae. It is frequently found in conjugation and is very likely the ciliate reported once before (*6*). Its micronucleus is prominent, generally 2.5–3.0 μ in diameter. Full description will be published later.

ciliate kindly supplied by C. A. Hoare, of London—the strain described as *"Glaucoma piriformis"* (*4*)—also shows no evidence of a micronucleus. One may, perhaps, justifiably conclude that the amicronucleate condition in this species is of widespread and common occurrence. On the other hand, one investigator (*7*), also employing the Feulgen technique, has recorded the presence of a micronucleus in members of an extinct strain of this species. Also, I have observed it in preparations (belonging to E. Fauré-Fremiet) of a second bacterized strain from the Paris region, likewise no longer being maintained, in which it is typically in a depression of, or embedded in, the macronucleus. Its size is small (under 2 μ), but it can be clearly differentiated from rounded-up masses of chromatin extruded from the macronucleus during fission. At the present time, therefore, one should hesitate to assume that the American strains of *"Tetrahymena geleii"* being cultured axenically are amicronucleate until all of them have been subjected to careful examination.

In agreement with Furgason (*5*), I consider the ciliate a member of the genus *Tetrahymena* Furgason, 1940, but I have suggested (*8*) that *Tetrahymena* is the same genus as that to which Ehrenberg (*9, 10*) invalidly applied the name *"Leucophrys."* I further consider the ciliate as probably specifically identical with Ehrenberg's *"Leucophrys pyriformis."* His descriptions and figures of the organism leave something to be desired in the matter of fineness of detail, but there is nothing in them which cannot be reconciled with Maupas' (*11*) redescription of this species and with the characterization offered above. That Ehrenberg's figures show 9–11 ciliary striations on one surface, and that he never observed the occurrence of conjugation, also support—or at least do not contradict—the identity of the forms. Maupas erred in transferring the ciliate to the genus *Glaucoma,* but in his detailed description of *"G. pyriformis"* there again appear to be no characteristics given which contravene those found by Furgason (*5*) for *"T. geleii"* or by the writer for a large number of strains belonging to the same species. It is true that Maupas misinterpreted the relationships among the cytostomal organelles, very difficult to resolve without modern techniques, but he recognized their similarity to those in the closely related ciliate *"Leucophrys patula"* (*12*).

By application of the Law of Priority (Art. 25, *International Rules of Zoological Nomenclature*) all more recent names applied to the organism under consideration may be regarded as subjective synonyms of the first proposed name, keeping in mind the alleged nonavailability of the generic name *"Leucophrys"* for these particular ciliates and the suggested conclusion that *"Tetrahymena"* is chronologically the next available published name (*8*). Lwoff (*13*), without description, figures, or discussion, and spelling the trivial name with an "i," used the combination considered correct by the writer and therefore the full name would become *Tetrahymena pyriformis* (Ehrbg., 1830) Lwoff, 1947. It is the type species of the genus. Lwoff's ciliate, strain GL, cultured axenically without interruption for 30 years, may be considered as the type strain of the species.

In a longer publication a more detailed description of this species will be offered, with attention to minor variations among the various strains. Also, the relationship of *T. pyriformis* to some 5 or 6 congeneric species[5] which have been, or are now being, investigated by the writer, including in particular *T. vorax* (Kidder, Lilly, and Claff, 1940) Kidder, 1941 and *T. patula* (Müller, 1786) Corliss, 1951, will be discussed. That the 3 extant axenic strains of *T. vorax,* PP, V_1, and V_2 (only the last of which appears still capable of undergoing profound transformations in its life cycle), have all been found to be amicronucleate presents a problem of some interest regarding the phylogenetic relationship between this species and *T. pyriformis.*

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[5] Since this paper was submitted for publication, I have received from A. M. Elliott, University of Michigan, pure culture strains of the very interesting ciliate, species not yet determined, whose cytogenetics has been investigated by Elliott and Nanney (*Science,* **116**, 33 [1952]). Preliminary morphological study indicates that although the organism is similar in many respects to members of the axenic strains of *T. pyriformis,* it possesses certain characteristics which appear to differentiate it slightly from that species as the latter has been described in the present paper.

Differential Stability of Various Analogs of Cobalamin to Vitamin C

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The conversion of vitamin B_{12} (cyanocobalamin) to vitamin B_{12b} (hydroxycobalamin) through the sulfite was reported in 1949 from this laboratory (*1*). The discovery was made independently in two laboratories that vitamin B_{12b} (B_{12a}) is destroyed quickly by ascorbate, whereas vitamin B_{12} is destroyed relatively slowly (*2, 3*). Coordination of the cobalamin ion with various anions has been described (*4–6*), and these findings illuminate our early observation on the stabilizing effect of sulfite (*2*). The ascorbate reaction

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