

## Some Important Anniversaries in the History of Protozoology\*

*Algunas fechas importantes en la historia de la protozoología*

John O. Corliss\*\*

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### ABSTRACT

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The mid-1990s are rich in anniversary dates of major past events, publications, and people in the broad field of protozoology. This fact seems to be especially true for happenings in the area of ciliatology, thus it serves as the principal rationale for the present paper. Discussed here are the many anniversaries — typically, ones at 25-, 50-, 75-, and 100-year intervals — of events and works that have been highly influential in subsequent advances in teaching and research activities involving particularly the ciliated protozoa. Highlighted are the dates of the founding of specialized biological societies, dates of births or deaths of prominent protozoologists of past decades and centuries, and publication dates of relevant textbooks and of selected papers and monographs, particularly in subject areas of ecology and taxonomy.

**Key Word:** Anniversaries; History; Protozoology.

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### RESUMEN

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La mitad de la década de los años noventa es rica en fechas de aniversarios de grandes eventos, publicaciones y de personalidades en el campo de la protozoología. Este hecho parece ser verdaderamente especial por los acontecimientos en el área de la citología, así que estas son dos razones principales para el presente artículo. Aquí se discuten algunos aniversarios - típicamente, a intervalos de 25 -, 50 -, 75 -, y 100 años- de los acontecimientos y las obras que han sido influyentes en los avances subsiguientes en la enseñanza y las actividades de investigación, involucrando particularmente a los protozoarios ciliados. Son de destacarse fundamentalmente las fechas de las sociedades biológicas especializadas, las fechas de los nacimientos o las muertes de prominentes protozoólogos de décadas y siglos pasados, y las fechas de publicación de pertinente libros de texto, de artículos selectos y monografías, particularmente en el área de la ecología y taxonomía.

**Palabras clave:** Aniversario, Historia, Protozoología

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### Introductory remarks

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By coincidence, but of considerable interest, the present period (roughly the mid-1990s) represents a time of occurrence of quite a number of anniversaries of major significance in the overall past history of protozoology and especially of ciliatology. Many of the events, discoveries, and great works themselves have been chronicled in a lengthy paper published in this same journal some five years ago (Corliss, 1992a; see also López-Ochoterena and Fernández-Galiano, 1992).

\* Trabajo por invitación. Miembro Honorario de la S.M.H.N.

\*\* P.O. Box 2729, Bala Cynwyd, PA 19004, USA.

In view of the "jubilee" nature of this issue of the 47th volume of the *Revista de la Sociedad Mexicana de Historia Natural*, I should like to take the opportunity to remind the readership briefly of some of these anniversaries, mostly ones coming at intervals of 25, 50, 75, and 100 years, dates important because of the impact of the original happenings (years and centuries ago) on the subsequent development of protozoology as a unique field of study and on the nurturing of later generations of protozoologists. In other words, strongly affected over time have been both *principles* and *principals* in this specialized domain of the biological sciences.

Among the many persons benefiting by the growth of protozoology over the past 350 years have been leaders in Mexico, including the man being honored by this particular volume, Dr. Eucario López-Ochoterena, UNAM, Mexico City. It is a distinct pleasure to dedicate this paper to Dr. López-Ochoterena for his untiring labors and publications of the past three or four decades, accomplishments achieved principally in the areas of taxonomy, ecology, and evolution of the free-living ciliated protozoa.

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### Appearance of Scientific Societies

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Exactly 50 years ago, in 1947, the international Society of Protozoologists was founded in Chicago, Illinois. One year earlier, the Phycological Society of America had been born. These new biological organizations, plus the long established American Microscopical Society with its esteemed journal the *Transactions* (now 120 years old!), were soon publishing their own journals, providing excellent outlets for papers on protozoa and algae, especially convenient for workers living on the North American continent. Dr. López-Ochoterena was/is an active member of the protozoological and microscopical societies, serving from time to time as an officer or committee person in one or the other and participating in some of the annual meetings held in the U.S.A. or abroad.

Without doubt inspired by the model of the International Conferences/Congresses on/of Protozoology, which commenced in Prague in 1961, with the fourth convened 25 years ago in Clermont-Ferrand (the 10th is to be in Sydney in 1997), Dr. López-Ochoterena initiated an annual Mexican series of international symposia, conferences, and courses, starting in the 1970s (López-Ochoterena, 1986). One of the first of these, I. Simposio Internacional de Protozoología, was held in Mexico City in April, 1974. In view of the date, it was most appropriately dedicated to the memory of Antony van Leeuwenhoek, the "Father of Protozoology," whose first description of a free-living protozoan had been published exactly 300 years earlier (Beltrán, 1974; Dobell, 1932).

Nearly 25 years ago, a neoHaeckelian concept of a **protistan** kingdom of eukaryotic microorganisms (to embrace the protozoa, the algae, and certain lower fungi) was introduced into the literature (by Lynn Margulis and others: see a detailed historical

account in Corliss, 1986). This exciting idea led to a fresh outburst of research on protozoan/algal evolution and phylogeny and also directly brought about the founding (in 1975) of a new association of (non-bacteriologically oriented) microbiologists, the International Society for Evolutionary Protistology. Although a "Kingdom Protista" may have to be abandoned as such (Corliss, 1994, 1995), the so-called "protist perspective" has been firmly established, is of stimulatory value in research, and allows one, today and into the future, to refer to individual members of high-level taxa of protozoan and algal assemblages as "protists" (with a lower-case "p").

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### Anniversaries of Highly Influential Protozoologists

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The two greatest 20th century students of the free-living ciliates, Alfred Kahl of Hamburg and Emmanuel Fauré-Fremiet of Paris, men who passed away 50 and 25 years ago, respectively, have had profound effects on the researches of modern-day ecologists and taxonomists of the ciliated eukaryotic microorganisms. Kahl's (1930-1935) unsurpassed monographic work on the taxonomy of many hundreds of ciliates is still very useful today despite the more than doubling of the number of species since his time and the advent of more refined microscopical techniques for proper comparative morphological studies (Corliss, 1979). The cytological observations, hypotheses, and high-level classification schemes of Fauré-Fremiet's (e.g., see 1924, 1945, 1948, 1950, 1954, 1967a,b, 1970) have revolutionized our investigations into the ultrastructure, morphogenesis, evolution, and systematics of ciliates and our understanding of the resulting data. The French leader postulated innovative phylogenetic interrelationships at class and ordinal levels that represented the first major changes in ciliate classification since the early masterful observations of Stein (1854, 1859, 1867) as reflected in Bütschli (1887-1889), a great monographer who passed away some 75 years ago. One must not fail to mention here also the prodigious output, primarily on the taxonomy and ecology of marine and/or symbiotic ciliate groups, by Edouard Chatton (e.g., see Chatton, 1938; and Chatton and Lwoff, 1930, 1935, 1949-1950), a fellow countryman of Fauré-Fremiet's (born in the same year, 1883). Chatton, developer of the indispensable French silver impregnation technique, died 50 years ago.

The deaths of three other great European protozoologists occurred 30-40 years ago. Their names deserve citation here, too, because, along with Kahl and the two Frenchmen listed above, they round out the "top six" ciliatologists of the first half of the present century. E. Penard, a remarkable Swiss student of sarcodinid rhizopod amoebae as well as freshwater ciliophorans whose long and active life spanned full halves of two centuries, was an ecologist as well as a taxonomist of note. He produced a unique book on ciliates 75 years ago (Penard, 1922) that is replete with precise observations made mostly on living (unfixed) specimens under only "high dry" magnification! J. von Gelei of Budapest was also an ecologist but, at the same time, a superb cytologist whose techniques have seldom been equalled by others since his era. Gelei (1954) represents his last (in fact, a posthumous) major paper on ciliate ecology, cytology, and taxonomy. J. Lepš of Bucharest, somewhat like Penard, worked on both ciliates and rhizopods, and his compact booklet (Lepš, 1926) on the taxonomy of the former, complete with useful keys to freshwater and marine species, preceded Kahl's monographs by several years. His 999-page textbook (Lepš, 1965) was his culminating production of a lifetime of research and teaching in protozoology.

Nearly half of the distinguished contributors to the highly influential American publication known (from the color of its original covers) as the "Blue Bible" (*Protozoa in Biological Research*, edited by G. N. Calkins and F. M. Summers, 1941; see Corliss, 1992b), which appeared half a century ago, passed away within a decade of that volume's appearance (thus roughly 50 years ago): notably, Calkins himself (mentor, incidentally, of Enrique Beltrán's during the latter's doctoral studies at Columbia University in the 1930s), Jennings, Kirby, Kofoid, MacLennan, Mast, Metcalf, Taylor, and Woodruff (Calkins' first student). But the insightful chapters by the 20 specialists totally involved brought about a noticeable surge in both protozoological teaching and research, especially in the U.S.A. and Mexico.

Calkins will long be remembered for his early strong leadership in American protozoology and his research investigations, many of them carried out at the Marine Biological Laboratory, Woods Hole, on the life-history of ciliates (e.g., see Calkins, 1902a,b; and references in his textbooks which are cited later in this paper); Jennings (e.g.,

1897, 1904, 1920, 1931), for his ground-breaking studies on the behavior of "lower organisms"; Kofoid (e.g., see these exhaustive monographs: Kofoid, 1903-1908; Kofoid and Campbell, 1929, 1939; Kofoid and Skogsberg, 1928; Kofoid and Swezy, 1921), for his remarkable coverage of diverse major taxonomic groups of protists (and from highly diverse habitats); and Metcalf (1923, 1940), for his long-authoritative monographs on the opalinid infusorians (protists now no longer considered to be "proto-ciliates").

Three additional worldwide leaders of note died within the same decade, half a century ago, viz., the American worker Hegner (see 1938, his amusingly illustrated "*Who's Who Among the Protozoa*") and the celebrated British parasitologists Dobell (see 1932, his classic on the life of Leeuwenhoek) and Wenyon (see 1926, his still valuable two-volume textbook in protozoology published nearly 75 years ago).

By the way, the only work that might reasonably be considered a successor to the 1148-page classic — the "Blue Bible" — described above is the four-volume production, some 25 years ago, by editor T.-T. Chen (1967-1972). But, by today, even many of its specialist-contributors have passed away. Perhaps the chapter of most lasting value to practicing field ciliatologists in Chen is the ecological one contributed by Noland and Gojdics (1967), a nice companion piece to Fauré-Fremiet's (1967b) review paper on aspects of chemical ecology of protozoa.

Speaking of outstanding early pioneers in protozoology, the year 1995 marked the 200th birthday of C.G. Ehrenberg, producer of the first well organized overall taxonomic treatise on the protozoa (Schlegel and Hausmann, 1996), and the 350th anniversary of the birth of L. Joblot, an enterprising microscopist born just 13 years after A. van Leeuwenhoek. Interestingly, the long-lived Dutch "Father of Protozoology" and the Frenchman Joblot died within four months of each other in the same year, 275 years ago.

Photographs or portraits of such early (plus some of the relatively recent) "giants" in protozoology as those being mentioned throughout the present paper have been published by me elsewhere (e.g., see Corliss, 1978-1979, 1979). Space and other understandable restrictions preclude their reproduction here.

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### Anniversaries of some key publications on ciliates

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Thousands of significant papers have been published, over scores of years, on the free-living ciliates alone. Most of the ones that I have singled out for mention below happen to have a major anniversary date --their 100th-- during the mid-nineties, especially around the year 1996. Often monographic in scope, they are also ones that have had direct impact on the works of such North American ciliatologists as López-Ochoterena and myself.

A few older publications might be mentioned first, such as Leeuwenhoek's (1674) discovery of protozoa some 222 years ago and the pioneering booklet by Joblot (1718). Two other contemporaries of Leeuwenhoek's also might be cited here: Harris (1696) and King (1693), followed not long after by Trembley (1744), with his amazing experimental work on *Stentor* ("king of the ciliates"), and by Hill (1752), the earliest nomenclatural taxonomist of unicellular organisms. These works of 300 and 250 years ago soon led to the appearance of O. F. Müller's (1786) magnificent monograph, a taxonomic work which predated Ehrenberg's (1838) classic and Dujardin's (1841) rivaling book by more than 50 years. Eichwald's (1844-1852) unusual series of 150 years ago on Russian ciliates deserves brief citation, too, all the more so because it has generally been overlooked by taxonomic protozoologists of more recent times.

One hundred years ago marked the appearance of such highly influential publications as the following books and/or monographs, works largely dedicated to consideration of the ciliated protozoa: Balbiani (1892-1893, 1895), Bundle (1895), Delage and Hérouard (1896), Guanzati (1896), Jennings (1897), Johnson (1893), Levander (1894), Schewiakoff (1893, 1896), and Wallengren (1895). Outstanding papers of a century ago on flagellates, including algal protists, are the following: Beiyerinck (1890), Blackman (1900), Borzi (1895), Francé (1894), and Klebs (1892). Several memorable still earlier works in mostly phycological areas are those by the influential botanists C. A. Agardh (1824), J. G. Agardh (1842, 1848-1901), and Nägeli (1847), and by the zoologist Diesing (1866).

An additional group of authoritative publications appeared during the decade preceding the 1890s; these warrant citation because of their enduring value and continued impact on modern studies mostly in areas of ciliate taxonomy and general ecology: Fabre-Domergue (1888), Hertwig (1889), Kent (1880-1882), Maupas (1881, 1883, 1888, 1889), Schewiakoff (1889), and one by a lone American, Stokes (1888).

It might be pointed out, parenthetically, that several other workers in Mexico and the U.S.A. besides Stokes had observed and published on diverse protozoan species before the turn of the 20th century: see López-Ochoterena and Fernández-Galiano (1992) and Wenrich (1956). Likely, the most outstanding example of such may be seen in Leidy's (1879) magnificently illustrated 324-page monograph on the freshwater rhizopod amoebae of North America.

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### Impact of Protozoological Textbooks of Past Decades

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The current year marks the 25th, 50th, 75th, or 100th anniversary of several authoritative textbooks on protozoology, productions of great importance in the training of students in the field. Dr. López-Ochoterena himself, and numerous teachers of protozoology around the world, have benefited from the availability of many of these.

It is difficult historically to determine what might be considered the earliest "true" texts on the protozoa. Some would say that the compendia of workers such as Pritchard (1834-1861), Dujardin (1841), Perty (1852), or von Siebold (1848), appearing some 150 years ago, would qualify for the title. Others might cite the several late-19th century French or German treatises in zoology or invertebrate zoology that contained substantial sections on the protozoa. My choice for the first genuine textbook of protozoology is the remarkable production, exactly 100 years ago, by Delage and Hérouard (1896), authors who offered more than taxonomic summaries and who recognized the cellular nature of the protozoa. Their insights into the organization and diversity of these eukaryotic microorganisms were ahead of the times. Also perhaps worthy of note, among other novelties, Delage and Hérouard included some line drawings printed in inks of different colors, an aid to student understanding of key protozoan structures.

Generally, the early years of the present century are credited with the appearance of "true" textbooks on the protozoa, with Doflein (1901) and Calkins (1901) leading the way, followed in 1907 by Hartmann's (1928: 5th and last edition) *Practicum* and, a few years later, by the excellent book by Minchin (1912). In the interim, Lankester (1903-1909) and Hartog (1906) appeared, although as parts of larger (and multiauthored) treatises on the animal kingdom, reminiscent of the later series in America by Hyman (see 1940, 1959, for her sections on protozoa). However, Hyman's remarkable invertebrate volumes were entirely single-authored. Both Doflein's and Calkins' books were greatly enlarged and improved in subsequent editions (e.g., see Calkins, 1909, 1926, 1933; Doflein, 1909, a work eventually becoming the well known *Lehrbuch der Protozoenkunde*: see 5th and 6th final editions by Doflein and Reichenow, 1927-1929, 1949-1953).

As already mentioned in a preceding section of this paper, the encyclopedic two-volume textbook by Wenyon (1926) is still a much admired and useful treatise. Protozoological textbooks in Russian, Czech, Polish, and Roumanian did not appear until some decades later (see Jirovec *et al.*, 1953; Raabe, 1964; Dogiel, 1951, continued by Poljansky and Cheissin, 1962, with an English edition in 1965; and Lepši, 1965).

Exactly 75 years ago marked the appearance of the first textbook on protozoology in the Spanish language, the now classic book by E. Fernández-Galiano (1921), father of the distinguished honorary member of the S. M. H. N., Dimas Fernández-Galiano, a most active ciliatologist born, as a matter of fact, in the same year as the publication of his father's book! Some 25 years later, the late Prof. E. Beltrán (1948) produced the second textbook in the field in Spanish, although here the emphasis was mostly on species of biomedical importance to humans, recalling Hoare's (1949) work of about the same time and Hegner and Taliaferro's (1924) earlier treatise.

Nearly 50 years ago, Jahn and Jahn (1949) issued their short but still most helpful illustrated guide to common species of protozoa (2nd edition, Jahn, Bovee, and Jahn, 1979). Not much later, Hall (1953) offered a full and scholarly modern textbook, although by no means did it replace the long series of editions by Kudo: the latter's solid and popular

presentations of protozoology (see Kudo, 1931, and his fifth and last edition, 1966) continued to be the choice of many university teachers and students. Not to be completely neglected here are textbooks on the algal protists: a favorite for many years was G. M. Smith's thorough treatment of the subject; the last edition of his treatise was printed half a century ago (Smith, 1950).

There has been quite a rash of protozoological textbooks within the past 50 years and even within the past 25 years, but outstanding among them all have been two whose 25th anniversaries will be celebrated next year: Grell (1973), the excellent English edition of his beautifully illustrated book; and Sleight (1973), a very popular well written work that now exists in an updated 2nd edition (Sleight, 1989). (Several other fine recent books are now available, by French, German, and American authors, but their citation is beyond the scope of the present paper.)

In many countries, native language translations of internationally known authoritative textbooks (for a good example, the several editions of Kudo) have been used, or else it has been assumed that protozoologists everywhere read either German or English without too great a difficulty. In the 1950s and 1960s, however, there were a number of texts in "national" languages (see some citations above). And now, relatively recently, there has appeared a comprehensive 816-page protozoological book in Japanese produced by Inoki (1981), with the help of some 43 colleagues, a handsomely printed compendium celebrating its 15th birthday this year.

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### Specialized Books on Specific Taxonomic Groups of Ciliates

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The current year also represents the 25th anniversary (or very close to it) of a number of books or monographs dedicated to the general biology, the systematics and ecology, the biochemistry, or the genetics of specific taxa, often simply genera, of the ciliated protozoa. Such groups of organisms are generally of commonly found species or are ones popularly used in both teaching situations and research investigations of diverse kinds, so that periodic reviews of their subject matters meet a widespread need.

Two of the long most studied genera among ciliates are *Paramecium* and *Tetrahymena*. Celebrating 25th anniversaries on them these years are the volumes by van Wagtenonk (1974), Jurand and Selman (1969), Elliott (1973), and Hill (1972). But *Paramecium* books also date back to Kalmus (1931), Beale (1954), and Wichterman (1953, with 2nd edition by the same author 33 years later: 1986!). Giese (1973) published a fine volume devoted to *Blepharisma*; Stiller (1971, 1974), one on peritrichs and another on hypotrichs; Borror (1972), also on the intriguing hypotrichs; Jankowski (1973), on the highly unique chonotrichs; Canella and Rocchi-Canella (1976), on the ophryoglenids; Didier (1971), on the peniculine hymenostomes; Raabe (1972: last of a five-part series), on the thigmotrichs; de Puytorac (1972: last of a series), on the astomes; and Jones (1974), a slim volume on all the ciliates (and, a bit later, see Nanney, 1980, a book mostly on *Tetrahymena* and *Paramecium*).

The classic account on *Stentor*, although published some 35 years ago, deserves special mention here (Tartar, 1961), as does the tremendous monograph on sand-dwelling ciliates by Dragesco (1960), and the most heuristic book by Pitelka (1963) that launched the "Age of Ultrastructure" in research on protozoa (Corliss, 1974). The year 1961 also marked the appearance of the first edition of my book on the classification of ciliates (Corliss, 1961), a publication which, in effect, introduced the novel Faurean systematic scheme to the world.

I have mentioned the constant need for updating various of the specialized topics, often involving specific taxonomic groups, covered by the 25- and 35-year-old works cited in the preceding paragraphs (and by a few older books not directly mentioned there). For a few recent examples demonstrating that this has been (and is being) done, see Corliss (1979, 1994), Lynn and Small (1988), de Puytorac *et al.* (1993), and Small and Lynn (1985), on ciliate systematics; Fenchel (1987), Dragesco and Dragesco-Kernéis (1986), and Patterson *et al.* (1989), on ciliate ecology (plus some taxonomy); Foissner (1987), updating Sandon (1927), on soil protozoa; Foissner (1993), on the colpodids; Foissner and Dragesco (1996: first of a predicted series), on the sand ciliates; Frankel (1989), on *Tetrahymena* morphogenesis; Gall (1986), on ciliate molecular biology; Harrison and Corliss (1991), on protozoan ultrastructure; Raikov (1982), updating Bélař's (1926) classic, on the protozoan nucleus; and Hausmann and Bradbury (1996), on ciliates as cells.

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### The 25th Anniversary of Some Major Ecological Works

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Finally, primarily because ecology has long represented one of the principal areas of great interest to Dr. Eucario López-Ochoterena and his students, let me mention a number of significant books or papers in ciliate ecology that were published some 25 years ago and have not already been cited above in any preceding section. It may also be interesting to note here, in passing, that it was exactly 25 years ago, at the last International Congress of Zoology, convened in Monaco (in September of 1972), that a special Symposium was held on the theme "The Role of Protozoa in Some Ecological Problems." For an introduction to that historically important session, including a list of the speakers, see the brief note by Corliss (1973).

The roughly 25-year-old works referred to above are listed here simply in alphabetical order, without comment; the nature of each topic covered by the authors can be surmised from perusal of the titles given in the bibliography: Balech (1971a,b), Bamforth (1971, 1973), Bereczky (1975), Bick (1972, 1973), Borror (1973), Cairns (1971), Curds (1969, 1973), Dragesco (1970, 1972), Dragesco and Njiné (1971), Fenchel (1969), Fenchel and Riedl (1970), Jones (1974), Legner (1973), López-Ochoterena (1966), Pätsch (1974), Small (1973), Stout (1973), and Wilbert (1969).

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## RESUMEN