RICHARD ROKSABRO KUDO

Richard Rokusaburo (orig.) Kudo, born in Tokushima Prefecture, Japan, on July 25, 1886, was the last son of Torakichi and Moto Kudo. After graduation from the elementary schools of the district and advanced schooling in Kyoto and Tokyo he enrolled in the University of Tokyo which awarded him the Doctor of Agricultural Science degree in 1910 and the Doctor of Science in 1924.

From boyhood he showed an inclination toward biology, and contemplated it as his life's work. Two men were influential in his decision to specialize in the study of the protozoa—Dr. C. Ishikawa, who worked for several years in the German laboratory of Dr. August Weismann, and Dr. K. Toyama, an early pioneer in research on the diseases and genetics of the silkworm. Thus, in 1909, Dr. Kudo began his studies of the protozoa, which were to continue for nearly 60 years.

During the next four years at the University of Tokyo he studied the life cycle of *Nosema bombycis*, a microsporidian parasite of the silkworm. His first publication came from this work but, more importantly for the future of protozoology, he was also invited to join the staff of the newly established Institute of Experimental Sericulture in Tokyo, as the protozoologist.

In the fall of 1915 came an opportunity to journey first to the United States and then to Europe. In the Columbia University laboratories of Dr. G. N. Calkins and Dr. E. B. Wilson he gained experience in biological techniques applicable to the protozoa. Dr. Hideyo Noguchi made his young countryman a Visiting Investigator at the Rockefeller Institute for Medical Research.

The next few years broadened the scope of his activities as he continued studies of *Nosema* (but now in tissue culture) with Dr. Noguchi, and with whom he also investigated possible relationships between flies, mosquitoes and poliomyelitis. Apparently it was during the summers of 1916 and 1917 at the Marine Bi-

ological Laboratory at Woods Hole that Dr. Kudo's lifelong interest in the myxosporidian parasites of fishes became firmly defined and established.

The trip to the United States may have been in the nature of an exploration of academic opportunities; he planned to proceed to Europe and then home to Japan.

At first he favored Europe but a war was being waged there and, as he once noted, "there seemed to be very little academic activities in European institutions." However, the real reason for giving up the projected European trip may well have been his friendship with a Swedish girl who later became his wife. Then too, President James of the University of Illinois extended an invitation to join the staff as an Instructor in Zoology. In September, 1918, Richard Kudo made Illinois his home, a residence that continued for nearly 50 years with but one break of five years. He never returned to Japan.

At Urbana, he progressed through the academic ranks — Associate (1921-25), Assistant Professor (1925-36), Associate Professor (1936-44), Professor (1944-54), and became an Emeritus Professor of Zoology in September, 1954. In later years when he sat on boards and committees reviewing the records of young men being considered for tenure or promotion, he commented on his own slow rise through a series of ranks now partly archaic. It required 15 years and more than a dozen top-quality publications to gain for him an Assistant Professorship, a rank now usually offered for the first position after the doctorate is received. But his words were not complaints; he was simply emphasizing that youth must be encouraged and rewarded, and much more rapidly than under the old system.

Dr. Kudo was invited to join the staff of Dr. S. A. Waksman, Director of the newly established Institute of Microbiology at Rutgers University, in 1954. He served as Visiting Investigator (1954-55) and Visiting Professor of Protozoology (1955-58). In June, 1958, he resigned this position to become Distinguished Visiting Professor of Zoology at Southern Illinois University where he continued until his death in the evening of June 3, 1967.

He was starred in the 7th edition (1944) of American Men of Science and held Honorary Memberships in Les Amis de l'Institute de Biologie Applique, Phi Sigma, and the Society of Protozoologists which he served as President in 1953. He was a Fellow of the American Association for the Advancement of Science, the American Academy of Microbiology, and the New York Academy of Sciences. He was a Charter Member of the American Society of Parasitologists, and a Member of the American Society of Zoologists, the American Microscopical Society, the Society of Systematic Zoology, and the Sigma Xi.

Protozoology in the mid 1920's was usually taught to a few graduate students, if offered at all, but in 1927, Dr. Kudo began an exclusively undergraduate course. Because there was no suitable textbook or guide for the study of protozoa he prepared, and published in 1931, his famous and widely used "Hand-

book of Protozoology," now in its fifth edition. A few years later he began courses in advanced and experimental protozoology. During the Second World War he taught courses in the parasitic protozoa of man to officer candidates of the Sanitary Corps of the United States Army and, characteristically, prepared a "Manual of human protozoa, with special reference to their detection and identification" (1944) to increase the effectiveness of his teaching.

Some measure of the influence of Dr. Kudo on biology, and protozoology especially, may be obtained from the extent of his instructional work. More than 600 juniors and seniors in college and 300 graduate students received instruction in his beginning course in protozoology, and some 250 graduate students took his advanced, experimental, and research courses.

The following persons obtained Master's Degrees under his guidance: Ann Marie Brosnahan, Bernard Berne, Susan L. Cartwright, Leatrice Chung, Neva N. Gleason, Roma A. Gould, Ben Greenwood, Dorothy N. Jones, William C. Marquardt, Jr., Cliff Melton, Joann E. Miller, Sarosh Mistry, Lottie Jane Owen, Francis Rebuffati, Alice Richards, Richard N. Rossan, Laurence E. Rueff, Irving B. Sachs, Bernard Seskind, David Shomay, Reuben Torch, Murray Wittner, and Virginia Yeatter.

His doctoral students included Paul A. Meglitsch, C. Leplie Kanatzer, Victor Sprague, Edward W. Daniels, Robert W. Hull, James W. Barrett, Reuben Torch, J. Forbes McClellan, Nelson Cooley, William C. Marquardt, Jr., David Shomay, Irving B. Sachs, Donald MacLoughlin, Sidney Kantor, and Ayere Yusa.

From 1910 to 1945 his primary research interest was in the parasitic protozoa of insects and fishes, although the host animals with which he worked ranged from protozoa to man. His papers and monographs of this period (Myxosporidia, 1920, 1934; Microsporidia, 1924; microsporidian parasites of mosquitoes, 1921-1930, and of termites, 1938-1942) are indispensable to those studying these groups, and they laid a firm base for future research on these parasites and pests.

Despite his tendency to work in his own laboratory, rather than attempt investigations far from home base, he was not averse to off-campus research or teaching. The summers of 1923 and 1924 were spent at the Field Station for Malaria Research in Leesburg, Georgia, where he conducted intensive field studies of microsporidian parasites of mosquitoes. The Illinois Natural History Survey sponsored his survey of the protozoan diseases of Illinois fishes in the summer of 1930, and he traveled the state from Lake Michigan to the Ohio River. In the summer of 1936 he spent three months investigating sporozoan parasites of the oyster at the U. S. Bureau of Fisheries Station at Beaufort, North Carolina. The summers of 1938, 1939, and 1941 found him teaching protozoology to graduate students at the University of Maryland's Chesapeake Biological Laboratory at Solomons Island and, of course, researching parasitic and free-living protozoa of that area.

After 1945 he devoted a great deal of effort to the giant amoebae of the

genus *Pelomyxa* for he believed that these multinucleate forms might provide an answer to a fundamental biological question: What brings about the nuclear and cytoplasmic divisions in a cell?

In the later phase of his research life, although the interest in *Pelomyxa* remained, he became concerned with the "dated nature" of some of his earlier publications and undertook new studies to begin the process of bringing them up to date. At the same time he was collecting and culturing free-living protozoa from southern Illinois, sending off for recent reprints and making arrangements for translations of Russian papers. He was greatly disturbed about his inability to read the work of Russians; they were "doing so much with my animals." And he wanted to include more of their information in the sixth edition of "Protozoology," which he was already preparing by annotating a work copy of the fifth edition, and in his current monograph on the Myxosporidia. This latter revision was well along at the time of his death—more than 400 typed pages of manuscript, many plates of figures, and a host of packets of hand-written rough drafts of additional chapters. His colleagues will complete it.

He was at work on this monograph the morning of the day he entered the hospital. That night during visiting hours he gave me explicit instructions to be delivered to his typist and to the students in his weekly protozoology seminar, but instructions that provided only for the next week. "I'll be back before then." Unfortunately, it was not to be true, and he lingered on a month before passing away in Barnes Hospital in St. Louis, Missouri.

He lived beyond the allotted four score years, and they were years full not only of research and teaching but of living, of enjoyment of family and friends and his favorite hobbies of photography, baseball, and fishing. He was never an old man!

His favorites in professional baseball were the New York Giants (later San Francisco), and he was a loyal member of the ball-playing assembly of staff and students of the University of Illinois which met regularly on Saturday afternoons. At a Zoology Department picnic just before his 80th birthday he played softball, although he did permit a substitute base runner. He walked with a spring in his step and a vital interest in world affairs and especially in his colleagues and students. He maintained a lively correspondence with these students and kept in his office a file of "progress" and comments on every student he had ever taught, in class or otherwise.

Professional contacts were maintained by correspondence and by auto trips with his devoted wife to meetings as far away as Texas, Oregon, and New York. Parts of the later summers of his life were spent with camera (taking Kudochromes, as he put it) and with fly-rod or spinning rod on the waters of the northeastern states and Minnesota. Other periods, frequent but short, involved happy reunions with his daughters and grandchildren. Even so, he spent significant portions of each summer with his protozoa.

He was a sensitive man, a man

finely tuned to the spoken and unspoken feelings of his companions, and susceptible to them. Always a gentleman and ever courteous even in disagreement, he expected others to react similarly. He was disappointed when they did not; his disapproval lay deep inside and silent. Only occasionally, and much later, was it indicated by a shake of the head and a soft *my my*.

Also covered by the affable, somewhat inscrutable exterior was a rigorously disciplined mind and body. This was of course evident in his academic productivity, but it also showed up in his personal life. He gave up smoking when he was more than 75 years old, and never did he permit extra weight to accumulate.

His presence commanded respect. More than once undergraduate and graduate students remarked that Dr. Kudo, with his devotion to people, to teaching and to research, his clean, shy humor, soft speech, quiet dress, and dignity, was their idea of a Full Professor. Yet, these very traits sometimes formed a silken barricade which his students and colleagues did not always penetrate. Many of his long-time associates never used his first name. This was not because of any lack of friendliness on either side. It resulted, I think, because we did not wish to demean by too much familiarity his quiet status of reserve and dignity. But I believe he often wished it were otherwise.

Not many persons, especially his professional colleagues, were aware of Dr. Kudo's proficiency in art work. They may have known that he always did his own line-drawings for scientific illustration, but he was accomplished in water color as well. In his own studies he often used brush and paint to record observations of stained materials and free-living protozoa in his cultures. And many of his publications, particularly those of his early years, contain exquisite colored plates.

For the enjoyment of a few intimates, and himself, he painted cartoons. He made one of these for me in 1961 and, in a rare moment, signed it "Richy."

Add to all these traits the universal ones of youth and set the whole in a strange land. Then one can begin to imagine the emotions and doubts of the young Japanese scientist upon his arrival in New York. However, he soon found his niche and made friends. One of these, whom he first met in 1916 through her sister who lived at the student rooming house where he boarded, was Miss Esther Swanson. She became his wife on May 20, 1918, in New York. To this long and faithful union two daughters were born: Elin (now Mrs. Karl Emch) in 1919 and Jean (now Mrs. Richard Pearce) in 1932. His grandchildren were five: Martha, Laurence, and Frederick — from Elin's marriage, and from Jean's—Karin and Emily.

Although Dr. Kudo was never one to intrude his personal joys or tribulations upon even his intimates, a question about the grandchildren brought a quick warm smile, a chuckle, and a story or two. The feeling was mutual, and not only with grandchildren. There was, it seemed, some intangible bond between children and the quiet gentleman, some realization of the dignity of persons of all ages.

Dr. Richard Roksabro Kudo by his presence and achievements set an example for all people. We miss his presence in our laboratories and homes.

Published Contributions of Richard R. Kudo

1910 Investigations on *Gluge bombycis* Thélohan. I. On its development in eggs of the silk-worm. Dissertation, Coll. Agric., Tokyo Imperial Univ. (not seen)

1913 Eine neue Methode die Sporen von Nosema bombycis Nägeli mit ihren ausgeschnellten Polfäden dauerhaft zu präparieren und deren Länge genauer zu bestimmen. Zool. Anz., 41(8):368-371, 4 figs.
(The present state of our knowledge concerning the developmental cycle of *Nosema bombycis*.) In Japanese. (Journal of Sericulture, (Sangyo-Synpo) No. 237. Dated only as "November 3".)
(A new myxosporidian from the carp.) In Japanese. (Zool. Mag., 27(324):517-523.

1915 Contributions to the study of parasitic protozoa. I. On the structure and life history of *Nosema bombycis* Nageli. Bull. Imperial Exper. Sericulture Stat., No. 1:31-51, 2 col. pls.
(Studies on the morphology and developmental cycle of *Nosema bombycis*, the causative organism of Pébrine disease.) In Japanese. (Bull. Imperial Exper. Sericulture Stat., No. 2:1-26, 2 col. pls.)

1916 Contributions to the study of parasitic protozoa. III. Notes on Myxosporidia found in some fresh-water fishes of Japan with the descriptions of three new species. Jour. Parasit., 3:3-9, 4 figs.

1917 Contributions to the study of parasitic protozoa. II. Myxobolus toyamai nov. spec., a new myxosporidian parasite in Cyprinus carpio L. Jour. Parasit., 3:163-170, 2 pls.
With Hideyo Noguchi. The relation of mosquitoes and flies to the epidemiology of acute poliomyelitis. Jour. Exper. Med., 26(1):49-57.

1918 Contributions to the study of parasitic protozoa. IV. Notes on some Myxosporidia from certain fish in the vicinity of Woods Hole. Jour. Parasit., 4(1):11-16, 2 pls.
Experiments on the extrusion of polar filaments of cnidosporidian spores. Jour. Parasit., 4(4):141-147, 1 pl.

1920 On the structure of some microsporidian spores. Jour. Parasit., 6:178-182, 11 figs.
Studies on Myxosporidia: A synopsis of genera and species of Myxosporidia. Illinois Biol. Monogr. 5(3-4):239-503, 25 pls., 2 figs.
Cnidosporidia in the vicinity of Urbana. Trans. Ill. State Acad. Sci., 13:298-303.

1921 Notes on *Nosema apis* Zander. Jour. Parasit., 7:85-90, 14 figs.
Microsporidia parasitic in copepods. Jour. Parasit., 7:137-143, 17 figs.
On some protozoa parasitic in fresh-water fishes of New York. Jour. Parasit., 7:166-174, 25 figs.
Studies on Microsporidia, with special reference to those parasitic in mosquitoes. Jour. Morph., 35 (1):153-193, 5 pls., 1 fig.
On the nature of structures characteristic of cnidosporidian spores. Trans. Amer. Micro. Soc., 40:59-74.
On the effect of some fixatives upon myxosporidian spores. Trans. Amer. Micro. Soc., 40(4):161-167.

1922 Studies on Microsporidia parasitic in mosquitoes. II. On the effect of the parasite upon the host body. Jour. Parasit., 8:70-77, 1 fig.
With D. C. Hetherington. Notes on a microsporidian parasite of a nematode. Jour. Parasit., 8:129-132, 29 figs.
On the protozoa parasitic in frogs. Trans. Amer. Micro. Soc., 41(2): 59-76, 36 figs.
On the morphology and life history of a myxosporidian, *Leptotheca ohlmacheri*, parasitic in *Rana clamitans* and *R. pipiens*. Parasit., 14 (3-4):221-244, 8 pls.

1923 Skate trypanosome from Woods Hole. Jour. Parasit., 9:179-180, 1 fig.
Microsporidian parasites of ephemerid nymphs. Jour. Parasit., 10: 22-24, 43 figs.

1924 A biologic and taxonomic study of the Microsporidia. Illinois Biol. Monogr., 9(2-3):77-344, 27 pls., 9 figs.
Studies on Microsporidia parasitic in mosquitoes. III. On *Thelohania*

legeri Hesse (*Th. illinoisensis* Kudo). Arch. Protist., 49:147-162, 1 pl., 1 fig.
Studies on Microsporidia parasitic in mosquitoes. VI. On the development of Thelohania oparcita, a culicine parasite. Jour. Parasit., 11: 84-89, 1 pl., 1 fig.

1925 Studies on Microsporidia parasitic in mosquitoes. IV. Observations upon the Microsporidia found in the mosquitoes of Georgia, U.S.A. Centralbl. Bakt. I. Orig., 96(7-8): 428-440, 2 pls.
Studies on Microsporidia parasitic in mosquitoes. V. Further observations upon *Stempellia* (*Thelohania*) *magna* Kudo parasitic in *Culex pipiens* and *C. territans*. Biol. Bull., 48(2):112-127, 5 figs.
Observations on *Endamoeba blattae*. Amer. Jour. Hyg., 6(1):139-152, 4 pls.
Microsporidia. Science, 61(1579): 366.
The present status of our knowledge of Microsporidia. Jour. Silk Indust., 67:37-55. (not seen)

1926 Observation on *Lophomonas blattarum*, a flagellate inhabiting the colon of the cockroach, *Blatta orientalis*. Arch. Protist., 53:191-214, 2 pls.
A cytological study of *Lophomonas striata* Bütschli. Arch. Protist., 55:504-515, 2 pls.
Observations on Dientamoeba fragilis. Amer. Jour. Trop. Med., 6(4): 299-305, 1 pl.
On *Myxosoma catostomi* Kudo, 1923, a myxosporidian parasite of the sucker, *Catostomus commersonii*. Arch. Protist., 56:90-115, 3 pls.

1927 Medical Parasitology. Nanzando, Tokyo, pp. vi + 100. (not seen)
Pathogenic protozoa of domestic animals. Jour. Amer. Vet. Med. Assoc., New ser. 24(4):466-470.
On the effect of microsporidian infectious. Jour. Silk Indust., 35 (404):171-174. (not seen)

1929 Histozoic Myxosporidia found in fresh-water fishes of Illinois, U.S.A. Arch. Protist., 65(3):364-378, 6 pls.
Studies on Microsporidia parasitic in mosquitoes. VII. Notes on Microsporidia of some Indian mosquitoes. Arch. Protist., 67(1):1-10, 1 pl.
Laboratory directions for the study of protozoa. U. Illinois Information Office, Urbana, 60 pp. (not seen)
(Unfathomed Japan.) In Japanese. Maruyama-Sha, Tokyo. June. (not seen)
(How to publish papers.) In Japanese. Maruyama-Sha, Tokyo. November. (not seen)

1930 Studies on Microsporidia parasitic in mosquitoes. VIII. On a microsporidian, *Nosema aedis* nov. spec., parasitic in a larva of *Aëdes aegypti* of Porto Rico. Arch. Protist., 69(1):23-38, 5 pls.
Myxosporidia. *In* Hegner and Andrews: Problems and methods of research in protozoology. MacMillan Co., New York, chap. 32, pp. 303-324.
Microsporidia. *In* Hegner and Andrews: Problems and methods of research in protozoology. MacMillan Co., New York, chap. 33, pp. 325-347.

1931 Handbook of Protozoology. Charles C. Thomas, Springfield, Ill., pp. x+451, 175 figs.

1933 A taxonomic consideration of Myxosporidia. Trans. Amer. Micro. Soc., 52(3):195-216.

1934 Studies on some protozoan parasites of fishes of Illinois. Illinois Biol. Monogr., 13(1):1-44, 129 figs.

1936 Studies on *Nyctotherus ovalis* Leidy with special reference to its nuclear structure. Arch. Protist., 87(1):10-42, 3 pls.

1938 A microsporidian parasitic in *Reticulitermes flavipes*. Jour. Parasit., 24(4):377, 1 fig.
With Paul A. Meglitsch. On *Balantidium pravenucleatum* n. sp., inhabiting the colon of *Blatta orientalis*. Arch. Protist., 91(1):111-124, 2 pls., 4 figs.

1939 Protozoology. Sec. ed. (Revised Handbook of Protozoology). Charles C. Thomas, Springfield, Ill., pp. viii + 676.
Observations on *Nosema notabilis* n. sp., parasitic in a myxosporidian. Anat. Rec., 75(4, Suppl.):153.

1940 With J. D. DeCoursey. Experimental infection of *Hyphantria cunea* with *Nosema bombycis*. Jour. Parasit., 26(2):123-125.
With Victor Sprague. On Myxidium immersum (Lutz) and M. serotinum n.sp., two myxosporidian parasites of Salientia of South and North America. Rev. Med. Trop. Parasit., Havana, 6:65-73, 14 figs.

1941 Notes on a microsporidian parasite, Duboscqia sp., of Reticuli-

termes of Maryland. Jour. Parasit., 27(6):32.
1942 On the microsporidian, Duboscqia legeri Pérez, 1908, parasitic in Reticulitermes flavipes. Jour. Morph., 71(2):307-333, 4 pls.
1943 Further observations on the protozoan, Myxidium serotinum, inhabiting the gall bladder of North American Salientia. Jour. Morph., 72(2):263-277, 3 pls.
Nosema termitis n. sp., parasitic in Reticulitermes flavipes. Jour. Morph., 73(2):265-279, 2 pls.
1944 Manual of human protozoa. With special reference to their detection and identification. Charles C. Thomas, Springfield, Ill., pp. xiv + 125, 29 figs.
Morphology and development of *Nosema notabilis* Kudo, parasitic in *Sphaerospora polymorpha* Davis, a parasite of *Opsanus tau* and *O. beta*. Illinois Biol. Monogr., 20(1): 1-83, 12 pls., 7 figs.
1946 Protozoology. Third ed. Charles C. Thomas, Springfield, Ill., pp. xiv+ 778.
Pelomyxa carolinensis Wilson. I. General observation on the Illinois stock. Jour. Morph., 78(3):317-351, 4 pls.
1947 Pelomyxa carolinensis Wilson. II. Nuclear division and plasmotomy. Jour. Morph., 80(1):93-144, 9 pls., 1 fig.
1949 Pelomyxa carolinensis Wilson. III. Further observations on plasmotomy. Jour. Morph., 85(1):163-176.
1950 A species of *Pelomyxa* from Illinois. Trans. Amer. Micro. Soc., 69(4): 368-370, 1 fig.
Zoology 318. Laboratory Manual. Ninth ed. 35 pp. (See first edition, 1929; no information on intervening editions.)
1951 Observations on Pelomyxa illinoisensis. Jour. Morph., 88(1):145-184, 5 pls., 3 figs.
1952 The genus *Pelomyxa*. Trans. Amer. Micro. Soc., 71(2):108-113.
1954 Protozoology. Fourth ed. Charles C. Thomas, Springfield, Ill., pp. xi+966, 376 figs.
On the cytoplasmic fibrils of *Lophomonas striata*. Jour. Protozool., 1(1):80-82, 8 figs.
1957 *Pelomyxa palustris* Greeff. I. Cultivation and general observations. Jour. Protozool., 4(3):154-164, 31 figs.
1959 *Pelomyxa* and related organisms. Ann. New York Acad. Sci., 78(Art. 2):474-486, 3 figs.
1960 Protozoan parasites in certain insects of medical importance. *In* Biological Control of Insects of Medical Importance. Amer. Inst. Biol. Sci., Tech. Rept., November, pp. 49-66.
1962 Microsporidia in Southern Illinois mosquitoes. Jour. Insect Path., 4 (3):353-356.
1963 With Edward W. Daniels. An electron microscope study of the spore of a microsporidian *Thelohania californica*. Jour. Protozool., 10 (1):112-120, 14 figs.
1966 Protozoology. Fifth ed. Charles C. Thomas, Springfield, Ill., pp. xi+1174, 388 figs.
With Edward W. Daniels and E. P. Breyer. *Pelomyxa palustris* Greeff. II. Its ultrastructure. Zeitschr. Zellforsch., 73:367-383, 14 figs.

Every effort has been made to make this list complete, except for some 12 abstracts and approximately 750 reviews. However, Dr. Kudo did not always include all his papers and there may be omissions from this list. I would appreciate hearing of any inadvertent exclusions. Dr. Matsunae Tsunae of Nara Women's University, Nara, Japan, aided greatly with the Japanese papers.

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