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Appraisal of the scientific work of Harald SIOLI

by

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Harald Sioli's life is strongly related to the Amazon region. In 1934, before the beginning of the Second World War he went to Brazil to initiate and conduct ecophysiological studies on toads in the dry northeast part of the country. His studies were interrupted by the war. In 1945, after the release from war-related internment, he started the first limnological investigations in Amazonia. But he looked at the Amazon region not as a limnologist but in the sense of Bluntschli as a unit of land, water, and forest, as a landscape-ecologist, a term first used by Troll.

Based on the local terminology of white-water, black-water, and clear-water, used by the local population and first mentioned by Wallace in scientific literature in the middle of the last century, Sioli applied hydrochemical and physical parameters to elaborate a scientific classification system of Amazonian rivers. He studied the relationship between water quality and soil conditions and was a pioneer in describing the large scale hydrogeochemical structure of the Amazon basin (SIOLI 1950, 1951, 1955).

He explained the existence of the large fringing floodplains of the Amazon River and its major tributaries with oscillations of the sea level during glacial and interglacial periods. He related the various types of floodplains and their specific structures to differences in the sediment load of the rivers, which he explained by geological and geomorphological differences in the respective catchment areas and variations of vegetation cover (SIOLI 1951). Some decades later, his considerations became confirmed by his collaborator, the mineralogist Georg Irion.

The extreme poverty in nutrients of many Amazonian streams and rivers led to Sioli's statements about the poverty of soils in the catchment areas (SIOLI 1950; SIOLI & KLINGE 1961). He contradicted the public opinion about the high fertility of Amazonian soils and pointed to the low agricultural potential of Central Amazonia (SIOLI 1954, 1956, 1957, 1969) during a period, when the Brazilian government began to initiate plans for large scale agro-industrial development of the region. Therefore, in the middle of the 1970s, he was often heavily criticized by Brazilian development planners. Today we know, that these critics were wrong.

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In the 1970s, Sioli got unintentional publicity by a misinterpretation of his observations on the impact of deforestation of the Amazon rain forest regarding carbon dioxide and oxygen concentrations in the atmosphere. In an interview with United Press in 1971, he had explained, that the deforestation of the rain forest would lead to an increase in the carbon dioxide concentration in the air. Thereupon, the Brazilian press formulated the term of the Amazon forest as the "green lung of the planet" suggesting, that the forest would release oxygen into the atmosphere. The press ignored Sioli's statement, that a forest in equilibrium between production and decomposition of organic material consumes as much oxygen as it produces. However, this misinterpretation strongly stimulated public discussion on the importance of forests in general and the Amazon forest in specific for global climatic processes.

The realization of Sioli's work was strongly supported by his appointment in 1957 by the Max-Planck-Society as director of the "Plöner Hydrobiologische Anstalt". In 1966 the name was changed to "Max-Planck-Institute for Limnology (MPIL)". From Plön, he continued his work in the Amazon region in collaboration with Djalma Batista, at that time director of the National Institute for Amazonian Research (INPA) at Manaus. In 1965, they cofounded the scientific journal AMAZONIANA, that publishes limnological and landscape-ecological articles about the Neotropis. The journal is distributed worldwide.

In 1966, the Max-Planck-Institute for Limnology in Plön was divided into two departments. Sioli became director of the Department for Tropical Ecology and focussed his activities on studies of the Amazon. In 1969 a contract for scientific collaboration was signed between the Brazilian Research Council (CNPq) and the Max-Planck-Society (MPG). The contract was renewed and amplified in 1984.

After his retirement in 1978, the collaboration between INPA and MPIL Plön continued as did Sioli's engagement with tropical ecology. His landscape-ecological research approach, that he presented at many international congresses, was of interest to many ecologists, not only those in the tropics. With more than 150 publications in scientific journals and his book which was edited in 1984 and titled: "The Amazon: Limnology and Landscape Ecology of a Mighty Tropical River and its Basin" he has made a fundamental and everlasting contribution to tropical ecology. Other distinguished scientists are connected with Sioli's name, e.g., Hans Klinge and Ernst-Josef Fittkau, who as members of his team, have made important contributions to our knowledge of the ecology of Amazonia.

The impact of Sioli's activities reaches far beyond the impact of his scientific publications. His very early warnings about the destruction of the Amazon rain forest and his appeals to protect the area for the benefit of nature, and the local population including the Amerindian tribes, were heavily criticized by some politicians and development planners, but received endorsement from Brazilian scientists and were enthusiastically accepted by Brazilian students. This development fortified the ideas for the need of environmental protection in Brazil. Some of the students, influenced by his ideas during the sixties and seventies, are today leading scientists and administrators in Brazilian state and governmental organizations and introduce ecological aspects into politics, planning and administration. Today, Harald Sioli is Nestor of German tropical ecology and one of the great tropical ecologists in the world.

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SIOLI, H. & H. KLINGE (1961): Über Gewässer und Böden des brasilianischen Amazonasgebietes. - Die Erde **92**(3): 205-219.

Curriculum vitae of Harald Sioli

Harald Felix Ludwig SIOLI, born August 25, 1910 at Köthen, Germany. Son of Siegfried SIOLI (Intendant (Director) of Theaters, 1924 - 1930 of National Theater Mannheim) and Emilie SIOLI, born EHRHARDT. Married 1951 to Hilke SIOLI, born KREMER, divorced 1968. Two children: Ute Olga Emilie KAISER, born SIOLI and Ehrhard Wilhelm Otto SIOLI.

Schools: Spring 1916 - Spring 1919 Primary School, Realgymnasium at Halberstadt; Spring 1919 - Spring 1921 Secondary School, Oberrealschule at Halberstadt; Spring 1921 - Spring 1924 Reformrealgymnasium at Aachen; Spring 1924 - Spring 1928 Reformrealgymnasium at Mannheim. Graduated after taking final examination (Abitur), Spring 1928.

University studies: Spring 1928 - Fall 1930 University of Heidelberg, first semester Astronomy, then Zoology. Winter semester 1930/31 University of Göttingen; Zoology. Spring 1931, entered Ph.D. programat, University of Kiel. Completed Doctoral Thesis in Zoology, July 28, 1934 with Botany and Limnology as secondary subjects. (Doctoral thesis see publication list nr. 1).

September 1934 - June 1935 Voluntary Assistant for Prof. Dr. Friedrich LENZ, Hydrobiological Institute of Kaiser-Wilhelm-Gesellschaft, Plön, Germany, on his limnological research travel to Northeastern Brazil.

Summer 1935 Scientific Auxiliary Assistant at Biological Institute Helgoland for three months.

January 1936 - June 1937 Research fellowship from German Research Community (Deutsche Forschungs Gemeinschaft) for comparative-physiological research on the temperature-sense of animal, performed at Zoological Institutes at the Universities of Kiel and Halle and at Biological Institute at Helgoland. (See publication list nrs. 3 and 4).

July 1937 - March 1938 Scientific Assistant in the Biological Department of General

Institute against Tumor-diseases at Rudolf-Virchow-Krankenhaus, Berlin.

April 1, 1938, Exchange Assistant for German Research Council, Agronomy and General Biology Department, later: Colonial Sciences Department, and sent to Instituto Biológico of São Paulo, Brazil, in September 1938. Thematic of the study: Physiology of summer sleep (rigidity of drying) of toads.

The outbreak of the war hindered my return to Germany, and after the end of the exchange-contract with the Instituto Biológico of São Paulo in March 1940, I was supported by a fellowship from the German Research Council to instigate limnological investigations of the Amazonian waters which at that time had been completely unknown in that regard. In October 1940, after the necessary technical preparation in São Paulo for organizing the Amazonian study program, I departed to the Amazon region and stayed in the Brazilian Amazon region until the end of 1953.

October 1940 - September 1942, studied the waters of the regions of Santarém, Maués, upper Rio Tapajós and Rio Cururú, lower Rio Solimões, Rio Madeira and upper Rio Branco.

In September 1942 the limnological work was interrupted when Brazil declared war against Germany. During the following three years I was interned in the interment camp of Tomé-Açú on Rio Acará-pequeno south of Belém-Pará. For 18 months I worked as a physician and "Head of the Pharmacy and Hospital "Evando Chagas" of Tomé-Açú". By treating about 1000 different patients (Brazilians, Japanese, Germans) and being the only physician in a vast region I acqurired experience with treating practically all tropical and cosmopolitan diseases that occur in Amazonia.

After being released from the internment camp in September 1945 I was contracted by the Instituto Agronômico do Norte or the Ministry of Agriculture for the Brazilian Federal Government, (by the director: Dr. Felisberto C. de CAMARGO) to continue limnological research in the Amazon region. For the next eight years I studied the lakes and their hydrobiological and hydrochemical connection with geology, lithology, vegetation and, later, the pedology of their terrestrial surrounding (catchment basin). The following regions were included in the study: Lower Rio Tapajós, Rio Cuparí, Rio Acará-pequeno, Rio Branco de Òbidos, Lago Salgado near Oriximiná with Rio Cuminá, and Rio Cuminá-mirim, Campos do Arimba, Alenquer, Paraná do Tapará, Cacaual Grande on lower Amazon, Fordlândia and Retiro Daniel de Carvalho on lower Rio Tapajós, Zona Bragantina east of Belém-Pará, Rio Arapiuns, Upper Rio Negro and Monte Alegre. From April 1949 until the end of 1949 the limnological activities were interrupted as I headed a rubber latex processing plant at Fordlândia, one of the formerly Ford owned rubber plantations on lower Rio Tapajós, with beginning of 1946 taken over by the Brazilian Government and administerd by Instituto Agronômico do Norte. I planned and performed a modernization of the latex plant. January 1950 returned to limnological research activities.

The primary aim of the limnological research in the Amazon Region was, to understand the mutual relationships (interactions) between chemistry and biology of the natural waters on one hand and the geological-mineralogical (lithological) and pedological conditions of their catchment areas on the other hand. That included collection of hydrobiological material found in the studied waters and examining the ecology and geographical distribution of the aquatic animals and plants as well as conducting a hydrochemical examination in loco and collecting water samples for chemical analyses in the laboratory. Studies on sedimentation in Amazonia were also conducted.

Special studies of the biological-limnological problems in connection with the discovery, in October 1949 by the physicians of the hospital of Fordlândia, of the first and only focus of endemic Schistosomiasis (Bilharziosis, infection with Schistosoma mansoni) in the entire Amazonia, in Fordlândia. Based on the studies of these connections, a proposal for combatting the snail-vectors of the disease using biological-ecological measures could be elaborated.

From April 1951 to end of February 1952 promoted to Professor of Zoology at the newly founded "Escola de Agronomia da Amazônia" annexed to the Instituto Agronômico do Norte. That professorship ended by decree of the Ministry of Agriculture, the chairs of Zoology as well as Botany and Geology in Schools of Agronomy should be reserved for "Agrônomos" (agronomists) and a "Zoologist" was no longer allowed to hold that position.

September 1953 became Head of the newly created Department of Limnology at the Instituto Agronômico do Norte at Belém-Pará.

January 1954, took one year leave of absence to install a new hydrochemical and hydrobiological laboratory for Serviço Especial de Saúde Pública (SESP = Special Service of Public Health) in cooperation with Conselho Nacional de Pesquisas (National Research Council of the Brazilian Federal Government) at Belo Horizonte (Minas Gerais) and head it. The working program of the new laboratory included conducting studies of the limnological problems in connection with the snail-vectors of Bilharziosis which was very widespread in the state of Minas Gerais, for SESP, and to continue the previous limnological studies program in Amazônia, for the Research Council.

September 1954 I was invited to head Limnology Department in the newly founded Instituto Nacional de Pesquisas da Amazônia (INPA = National Institute of Amazonia Research) of the Brazilian National Research Council, at Manaus (Amazonas). February 1, 1955, beginning of that position and since until April 30, 1957, again in the Amazon region.

December 1956 appointmed, by the President of the Max-Planck-Society, Prof. Dr. Otto HAHN, to Hydrobiologische Anstalt der MPG (Hydrobiological Institute of Max-Planck-Society) at Plön, Germany, as Head of an Independent Department (Selbständiger Abteilungsleiter), Executive Director and Scientific Member of that institute effective May 1957.

With departure from Instituto Nacional de Pesquisas da Amazônia at Manaus, nominated as Scientific Counsellor (Consultor Científico) of that institute.

October 1958 nominated as Honorary Professor (Honorarprofessor) of Limnology at Christian-Albrechts-University in Kiel, Germany.

1959/60 and 1962/63 new research travels into the interior of the Brazilian Amazon region: Upper Rio Solimões, the lake-like mouthbays of southern affluents of the lower Amazon between Rio Madeira and Rio Maués-mirim, Rio Cururú and Rio Marauiá (northern affluent of upper Rio Negro).

1962 - 1969 Member of Sectional Committee for Productivity of Freshwater (PF) in cooperation with the International Biological Program (IBP) and to elaborate on Amazonian PF-research projects.

1963-1974 Member of Commission on Ecology of International Union for Conservation of Nature and Natural Resources (IUCN).

Co-founder and co-editor of publication-series AMAZONIANA, Limnologia et Oecologia Regionalis Systemae Fluminis Amazonas (since 1965).

1966 renamed, according to my proposal, the Hydrobiologische Anstalt der Max-Planck-Gesellschaft to Max-Planck-Institut für Limnologie (Max-Planck-Institute for Limnology) and created a second independent department at the institute. Appointed as director of my department, now called Department of Tropical Ecology, as well as Director at the Institute.

1967 awarded the Brazilian "Order of the Southern Cross", Officers Rank ("Ordem do Cruzeiro do Sul").

1969 in Rio de Janeiro, as representative of the Max-Planck-Society, to sign a convention between the Max-Planck-Society for the Promotion of Science and the Brazilian National Research Council for scientific cooperation of the Max-Planck-Institute for Limnology, Tropical Ecology Department, Plön, Germany and the National Institute for Amazonia Research (INPA), Manaus, Brazil.

1971 - 1973 president of Association for Tropical Biology, USA. 1979 nominated as fellow of that Association.

Traveled annually to the Amazon until 1986 regarding the cooperative research between the Tropical Ecology Department (after 1978: Working Group Tropical Ecology) of Max-Planck-Institute for Limnology, Plön, Germany and INPA, Manaus, Brazil.

1973,1974, 1975 and 1976 Adviser of UNDP (United Nations Development Program) and OAS (Organization of American States). Conducted research in northeast Argentina (Región del Iberá), Paraguay (Rio Pilcomayo in the Paraguayan Chaco), the Argentine Chaco and the north west Argentine Andes (Región del Rio Bermejo), and the Pantanal of Mato Grosso, Brazil, with the purpose of providing expert opinions on specific development projects.

Numerous travels to congresses and to give lectures in East Africa, Pakistan, India, Venezuela, Ghana, Bolivia, USA, Argentina, Panama, Canada, Malaysia, South Africa, Zaire, Japan as well as inside Europe.

1976 and 1980 invitated by National Institute of Amazonia Research, Manaus, Brazil, to give postgraduate courses on General and Amazonian Limnology.

1977 awarded the medal "Ciência para a Amazônia" ("Science for Amazonia") from Instituto Nacional de Pesquisas da Amazônia, Manaus, Brazil.

April - June 1977 (spring quarter) Guest-professor at University of California, Berkeley, USA, in cooperation with a postgraduate course "Environment and Man in the Amazon Basin" at the Institute of Geography.

End of August 1978 retired as Director at Max-Planck-Institute for Limnology and as Honorary Professor at University of Kiel.

1990 award of the "Medalla Fundación La Salle de Ciencias Naturales en Primera Clase" ("Medal Foundation La Salle of Natural Sciences in First Class"), Caracas; Venezuela, at occasion of the 1st International Symposium on the Great Rivers of Latin America which was dedicated to H.S. as the "Father of South American River-Limnology".

155 publications (see list).

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