Editorial

The scientist Fernando Fraga: a life devoted to oceanography

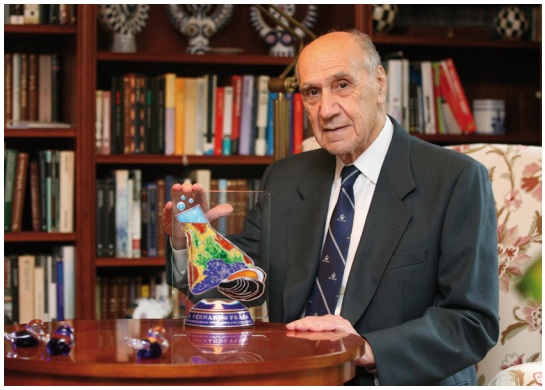
Dr. Fraga joined the Coastal Laboratory of Vigo, of the *Instituto de Investigaciones Pesqueras* (IIP), on the first of May 1953. This new scientific centre had been created in 1951 by the Spanish National Research Council (CSIC) under the directorship of Dr. Francisco García del Cid to promote fishing research in Spain. The Atlantic Laboratory of the IIP was inaugurated in September of the following year in Vigo, in a former German school building, and the biologist Buenaventura Andreu was its head. The laboratory had three scientist posts, one of which was taken by Dr. Fraga through public competition. His was the only doctorate (1949, University of Madrid) in the Vigo Laboratory and, as a disciple of Professor Ignacio Ribas, he contributed his solid research experience acquired in the Department of Organic Chemistry of the Faculty of Science, University of Santiago de Compostela (Spain), from where he resigned his post as Associate Professor of Organic Chemistry to settle in the CSIC.

After his arrival at the IIP, Dr. Fraga gave up his research on alkaloid structures in broom in order to study the chemical composition of fish and molluscs. He started his specialisation in oceanography by making "The Oceans, their Physics, Chemistry and General Biology" by Sverdrup, Johnson and Fleming (1946) his bedside reading. This book defined the extant knowledge on the characterisation of water masses and the interdependence between the composition of sea water and marine organisms; subjects that would form the basis of Dr. Fraga's research.

One year after his incorporation into the IIP, he presented in the first Spanish meeting on Productivity and Fisheries (Barcelona, 1945) the work *Crítica de los métodos para la determinación cuantitativa de materia orgánica disuelta y suspendida en el agua de mar* (Critique of the methods for quantitative determination of dissolved and suspended organic material in sea water). This subject would be pursued in the following meetings: in the third meeting (Barcelona, 1957) with *Nitrógeno orgánico suspendido y disuelto en la Ría de Vigo* (Suspended and dissolved organic nitrogen in the Ría de Vigo), and in the fourth meeting (Barcelona, 1960) with *La materia orgánica nitrogenada inerte disuelta en el agua de mar* (Inert dissolved nitrogenated organic material in sea water). His published articles alternated this new scientific subject, organic nitrogen in sea water, with the chemical composition of mussels and the alkaloids in papilionacea.

At the beginning of the sixties, with the enthusiasm of the IIP pioneers and the small boat *Lampadena*, he started to study the hydrography and photosynthesis in the Ria of Vigo. He counted on the collaboration of, amongst others, the biologist Francisco Vives and especially Carmiña Mouriño, a research assistant greatly dedicated to the work. During one of professor Ramon Margaref's stays in Vigo, they observed a red tide event, a question that would also feature in his publications.

The original and impeccable scientific labour of Dr. Fraga on dissolved and particulate nitrogen in sea water made it possible for him to participate in the international expeditions to the Indian Ocean (R/V *Anton Bruun*, 1964; R/V *Magga Dan*, 1967), where he met Professor David W. Menzel of Woods Hole Oceanographic Institution. Around that time, he also started to collaborate with the chemist Fernando Saiz, who was paying special attention to amino acids. Dr Fraga's studies on the contribution of dissolved organic matter to the nitrogen cycle (we would now say the biogeochemical nitrogen cycle) in the Galician rias, which he subsequently extended to the Atlantic and Indian Oceans, proved the existence of an organic nitrogen fraction which doesn't take part directly in biological cycles.

Left: Dr. Fraga on a research cruise on board R/V *Mechelen* (September, 1965); right: the XV Iberian Seminar on Marine Chemistry paid homage to Dr. Fraga in recognition of his outstanding contribution to oceanography.

Soon after, Dr. Fraga formed part of the group of Spanish scientists who, on board the R/V *Cornide de Saavedra* (1971-1975), studied the oceanographic conditions of the upwelling area off northwest Africa where part of the Spanish fishing fleet worked. His discoveries provided a notable innovation in relation to the general scheme of water mass circulation described up until then, and his publication on primary production had repercussions on the work carried out by other scientists in the same region.

Next, Dr. Fraga tackled northeastern Atlantic oceanography and Galician upwelling by means of a series of cruises (1977-1986) on board the R/V *Cornide de Saavedra* and R/V *García del Cid* looking for the ecological connexion between oceanography and the productivity of the coastal seas, in line with Professor Margalef's concepts. As Dr. Fraga gathered more collaborators, and in the specific research cruise series "Galicia", he increased the number of oceanographic variables that could be measured. His new research in that Atlantic area culminated in the first conceptual model of the transport and mixing between the different water masses that surround the northwest Iberian Peninsula and in the description of the remineralisation process of organic matter on the Galician shelf as an additional process of coastal fertilisation.

Leader of the Oceanology Group since 1979, Dr. Fraga created a school in the field of chemical oceanography in which he educated young scientists, amongst them the authors of this prologue. With Dr. Fraga you acquired a conceptual way of seeing the research and perseverance in pursuing scientific objectives. Under his supervision in the lab we learnt to be patient in order to optimise the analysis, to be meticulous with calibrations, and to investigate unexpected results in great depth. Taking part in his cruises provided the chance to observe impeccable, general planning and the exhaustive preparation and inspection of the materials and equipment needed on board the research vessel.

Within his commitment to the scientific community, Dr. Fraga, who became a Research Professor of CSIC in 1973, participated in numerous national and international courses and seminaries giving lectures about water masses, often combining regional aspects with other large scale aspects, and defending the usefulness of descriptive oceanography. In addition, he collaborated in the germination and maturation of scientific meetings like the "International Symposium of the Bay of Biscay" and the "Iberian Seminar on Marine Chemistry (SIQM)". For the IV edition of the latter (January 1988) he travelled to Cadiz where he gave the conference: Stoichiometry of organic matter in seawater.

On 26 May 1988, Dr. Fraga became Emeritus Professor of CSIC but, as he said in an interview during the XV SIQM, "a researcher never retires". Free from the typical administrative and bureaucratic tasks, he threw himself into completing studies started earlier, bringing to fruition about twenty scientific articles between 1988 and 2005. Currently he continues his collaboration with CSIC researchers and dedicates part of his time to generating and sharing new chemical oceanographic knowledge. His command of computer tools, including online systems, is impressive; nevertheless, we, who know him, know that this is the result of the method that Dr. Fraga has always practised: first read the instruction book in depth.

A significant part of the results of his prolific research has been published by the main path open to scientists of the IIP: the CSIC's journal *Investigacion Pesquera* (1955-1987), later converted into *Scientia Marina* (1988-). An example of his wide and varied interests can be appreciated in his articles published in both journals, which are referenced below and which we recommend reading because of the clear and fresh science they still contain.

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