Education for the Transition from Student to Scientist

BY MATTHIAS TOMCZAK

In my previous contributions to this column, I addressed developments in undergraduate and graduate teaching of oceanography. Today I want to continue the sequence and focus on the transition from university studies to a career as a research scientist.

Learning is a lifelong process, but it's form changes as we move from being educated to becoming educators and researchers ourselves. There comes a point in the process when we have gained reasonable insight into the state of our branch of science. We have read the key papers and know the names of their authors. Hopefully we attended a conference or two and had an opportunity to listen to presentations from experienced researchers on their latest work.

It is at that stage of our education that some of us, who envisage research in an academic environment closely linked with a future teaching career, would like to learn directly from those considered experts in their fields. Graduate summer schools are set up for this purpose. As an intensive form for learning in a collegial and informal atmosphere, summer school programs often have a formative impact on the careers of participating students. Brix et al. (2003) list summer schools as an integral element of their suggested oceanography curriculum and one of the "factors to best serve students in their future career."

When I participated in the Geophysical Fluid Dynamics (GFD) Summer School at the Woods Hole Oceanographic Institution in 1965, it was in its seventh year. It was a highly charged theoretical workshop on rotating fluids. My own view of oceanography was much less theoretical; I envisaged days and nights at sea collecting new data and trying to unravel their meaning. But the ten weeks of intensive theoretical study and discussion with experts in the circulation dynamics of the atmosphere, the ocean and even the stars formed my approach to oceanographic research and provided me with the framework for the many observational programs that I designed during the next four decades.

The GFD Summer School program is still running in Woods Hole and is an outstanding example of a successful educational institution. Other summer schools developed over time, some serving a similar purpose, others applying a similar principle to a different field. Many programs are held only once, while others have established a short series that promise to develop into an educational institution. Examples are the Fluid Dynamics Summer School of the Pacific Institute for the Mathematical Sciences (PIMS) in Canada, which was held four times until 2002; the Surface Ocean-Lower Atmosphere Study (SOLAS) Summer School on air-sea exchange processes, which will be in its second year in 2005; and the two marine ecology summer schools of the Danish Network for Fisheries and Aquaculture Research (Fishnet.dk) held in 2001 and 2002.

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The shared trait among these and other summer schools is that they are designed for advanced training in a particular branch of science. Whether it is geophysical fluid dynamics, air-sea interaction, or fish ecology, the student participants will all have similar interest and background.

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Branch-specific advanced education will always be necessary, and summer schools with a focus on well-defined branches of science will remain valuable educational tools. But the observation can be made that oceanography has become more multidisciplinary than ever, requiring a new type of graduate summer school. Knowing this does not make it easier to get together a marine microbiologist, a mathematician specializing in fluid dynamics, and an upper-atmosphere chemist in meaningful scientific exchange. But over the last decades, some areas of oceanographic research evolved, making multidisciplinary collaboration essential for success. Climate research and marine ecosystem research are just two examples where biologists, chemists, physical and theoretical oceanographers, and meteorologists have to work together as a team. The existence of a common research goal can provide a strong bond among the most disparate science disciplines and can overcome the natural tendency of scientists to ignore what happens outside their narrowly defined branch of science.

Multidisciplinary research collaboration does not normally take the form of daily contact, nor must it lead to joint publications. What it requires is awareness of each other's work and an understanding of some underlying principles, both elements of modern research practice that require training. Summer schools can be ideal vehicles for this kind of training. When I organized a series of climate research summer schools in Australia, I experienced this first hand. Australia's population is not large by world standards (less than 20 million), and its pool of gifted science students is correspondingly small. As a result, the Australian climate summer school was comprised of students from all major disciplines studying climate. Students of physical oceanography, meteorology, geography, chemistry, and marine biology participated in the same set of advanced lectures and seminars while simultaneously working on their own projects. These projects and ideas had to be presented in terms that were understandable by all. The discussion of problems encountered sometimes required a separate *ad hoc* exposé of some basics of a scientific field. The insight developed by students into the working methods of other disciplines and their increased awareness of how other disciplines can contribute to the common goal should

THE NIPPON FOUNDATION-POGO VISITING PROFESSORSHIP PROGRAMME

The Visiting Professorship Programme began in February 2004 and supports two experienced scientists, annually, to visit a developing country for a period of three to six months, and provide training and mentoring to students and scientists from a host institute.

The general theme of the Visiting Professorship Programme is "Towards Operational Oceanography." The Programme is designed to enhance the capacity of the international ocean-science community to observe and monitor the word oceans; to promote training and education in the ocean community; to fulfil the obligations of the global oceanographic community to promote sustainable development in the world ocean; and to improve networking among oceanographic institutes. It is also designed to be independent of the already existing and successful POGO-IOC-SCOR Fellowship Programme and to serve the community in ways the Fellowship Programme cannot.

Experienced scientists can participate in the Visiting Professorship Programme in one of two ways. First, scientists prepared to join the Programme as Visiting Professors can send a brief Curriculum Vitae and an indication of their expertise to NipponProject@mar.dfo-mpo-gc.ca. Upon receipt, each scientist's name will be added to a list of potential visiting professors. Second, if you have a position in marine institution of a developing country, you can apply for your institution to host a Visiting Professor who will best serve your institution's needs for capacity building, training and mentoring. As a host institution, you must ensure that the professor your desire is available for the visit. In cases where host institutions do not have the right contacts, POGO can try to help establish contact with suitable professors.

Full details and application procedures are available at the POGO Web site http://ocean-partners.org/Nippon-POGO_details.htm.

Source: The content of this box comes from the POGO Web site http://ocean-partners.org/Nippon-POGO.htm.

have a lasting impact on the students' outlook on science.

Transnational training and assistance programs are another source to help in the transition from student to scientist. Advanced teaching of oceanography in the developing world has changed from the 1960s to the present. For decades, countries emerging from a colonial past sent their most gifted students abroad to obtain higher education. We now observe the emergence of oceanography departments at universities around the world, staffed by academics who returned from studying overseas and are now responsible for the establishment of their country's oceanography curriculum.

Throughout this period, the Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational, Scientific and Cultural Organization (UNESCO) supported the development of oceanography in developing countries through its Training, Education, and Mutual Assistance (TEMA) program. The focus of its training courses and workshops has been on technical aspects of oceanography such as data collection at sea, data management, and taxonomy. This has produced a valuable technical support base for scientific research. Leading oceanographic research institutions have been supportive of IOC's training activities through the Partnership for Observation of the Global Oceans (POGO), a forum created in 1999 to promote global oceanography (http://ocean-partners.org/bmain.html).

Enabling all countries to become part of the developing oceanographic data network is a key requirement for global climate monitoring and research, hence the continuation of the IOC training effort in data collection and management. But the development of a data management capacity does not assist developing countries, if this capacity is not accompanied by the development of an independent research and teaching capacity.

To avoid a situation where IOC's training effort serves only the data requirements of the scientifically leading countries and does much less to help the development of academic training and research institutions in the developing world, it is now necessary to add a new level of assistance to the ongoing technical training. At POGO's fourth meeting in Hobart, Tasmania, January 2003, I raised the need for assistance with academic teaching and research development and received strong support from IOC and African participants.

A few months ago POGO announced the establishment of the Nippon Foundation–POGO Visiting Professorship Programme (Box 1). Beginning this year, experienced scientists will be funded to visit an oceanographic institution in a developing country to give lectures and provide training in their area of expertise to scientists from the host institute and from other neighboring institutes. The length of the program's visiting professorships is expected to be between three and six months; each year two visiting professors will be supported. The POGO announcement states: "The opportunity for scientists and graduate students to interact closely with a leading expert in their field, in their own home environment, can inspire, build confidence and motivate the students and institute personnel. A Visiting Professorship allows many trainees to be exposed to this opportunity at the same time." It is also an opportunity to assist the developing world's marine science teachers with the task of establishing new marine science teaching institutions in their countries.

Inspiring students through interaction with leading experts is also the aim of any good summer school program. It appears to me that the time has come to establish ongoing summer school programs of highest standard at oceanographic research institutions on all continents. Getting a group of leading experts to participate in a summer school organized on another continent will require the allocation of more financial resources, but the academic benefits for the development of marine science in Africa, South America, and much of Asia will more than make up for the costs.

This concludes my survey of oceanography teaching from the university entry level to the transition into a teaching and research career. Most of our students do not of course enter their university studies with the expectation of becoming a university lecturer or research scientist. In future columns I intend to focus on issues closer to their hearts: How do I survive a topic if I have such a low level of mathematical knowledge? Why do lecturers expect me to know material I shall probably never have to know again in my life? These and other questions are everyday complaints in universities. Sometimes they are justified, sometimes not. More about that in my next column.

REFERENCE

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