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SPECIAL SERIES

Good Scientific Practice

V. The education of young scientists

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"A key element of creating a positive environment for research integrity is providing information to the well-intentioned on how to resolve dilemmas relating to professional conduct."

C. K. Gunsalus [1]

The conduct of science is based on internationally valid principles of Good Scientific Practice (GSP) [2]. These basic principles of the scientific integrity, which all those engaged in research and scholarship must accept, comprise the highest professional standards in designing and conducting research, and the absolute honesty at all stages of the scientific work [3-5].

GSP - integral part of education

Guidelines for GSP cover the area of education of young scientists [6,7]. According to the recommendation of the Commission on professional self-regulation, the principles of GSP should be an integral part of courses for students and younger researchers and of teaching curricula as well. Universities and research institutions should develop and accept standards for mentorship and rules for the heads of scientific research units or groups and senior scientists [4]. The central aspect of education in research covers the period of training under the supervision of an experienced scientist/mentor.

Basic recommendations

The training and development of the young scientists *in continuum* is an important responsibility for all experienced scientists. These activities should not be limited to providing the technical skills necessary to enable juniors to conduct their research. The training should also include basic principles of GSP. Young researchers should not join the laboratory because the funds are available to support them, or because they provide an extra pair of hands to do the work, or in a project which is wholly speculative or routine [7]. The project should be selected in accordance with the training and the carrier needs of the young scientists, and designed so that results can be expected within a reasonable period of time. Also, the project must be based on adequate financial support and duration to complete the planned research program.

Formal education

In the past, the beginners in research have learned some of the principles and norms of the scientific integrity informally by working with senior scientists. Such an approach was supplemented by occasional publications which offered general advice. Currently, greater formality is needed to help the junior researchers understand the importance of the sci-

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entific integrity. Formal instructions on ethical conduct of research are part of their training. Therefore, courses on responsible research practice and ethics should be organized and students should be involved in actual scientific activities.

Standards at universities and research institutes

Universities and research institutions have the obligation to ensure the conditions for education by incorporating GSP principles in their teaching courses and appropriate management and procedures to implement their code of GSP. They should have in place a system which allows students and new researchers to adopt the best practice as early as possible. Formal instructions on ethical conduct of research are started as part of the professional training. Some universities and research institutions now routinely provide short courses on the responsible research practice and research ethics, i.e., principles of GSP [5,6].

Obligations of the mentor or senior researcher

The knowledge reached through the discussion and practice with the senior researcher or mentor is thought to be of invaluable importance for the young scientists [8,9]. In addition to the responsibility to guide the trainees in selecting and completing a worthwhile research program [10], mentoring comprises activities of nurturing and role modeling. Because of that, the right choice of the mentor is of great importance, certainly if the trainee is in the position to do so.

The mentor or senior researcher must inform the student or young researcher about the basic principles of GSP at the very start of their scientific work, and create a climate in the research group to ensure high standards in the conduct of research. As the group usually consists of older experienced scientists and younger, less experienced ones, the research team leader has the responsibility of ensuring that every younger member of the group -graduate students in particular, but also advanced undergraduates- receive adequate supervision: each one must have a senior partner primarily responsible for his/her progress. Therefore, every younger member of the group conducts its research program under the supervision of a senior researcher/ mentor. The young researcher's practice must be clearly defined and the mentor must ensure the appropriate direction of the research and check the raw data from time to time. It is advisable that the number of supervised young researchers be limited per one mentor; besides, the supervision of two additional scientists, one of them chosen by the student, is also useful. They should be accessible locally, but should not all belong to the same working group, or to the same faculty or institution. These co-mentors should be available for advice and help, discussing the progress of the young researcher, usually at annual intervals. Such an arrangement would also enable mediating in any conflict situation related to the scientific practice or other matters that might arise. The mentor should be a scientist with a considerable scientific productivity; otherwise, he will not be able to convey the publishing skills to the beginner. It is also essential that the mentor must be a person of high integrity, i.e., that he himself adheres to the high standards and expectations he requires of young researchers.

Obligations of young scientists

Since the mentor-trainee relationship is a two-way process, both sides have their own responsibilities and obligations. Accordingly, young scientists participate in all activities related to the project [11], and inform regularly the mentor or the research group leader on their research practice. Continuous consultations and practice to present current results may ensure support and help of other members of the group too.

Publications concerning the ethical foundation of the scientific practice, which are addressed to graduate and undergraduate students and the junior research workers, appeared only recently. However, besides this educational literature, the fostering scientific integrity requires incorporation of students into the actual scientific activity, because moral learning derives from both demonstration and practice.

In our scientific community, the institutional code "Good scientific practice - the ethical codex of science" is formulated in the Institute for Oncology and Radiology of Serbia and the Institute for Medical Research, Belgrade, in January/February 2001. An important part of this document is related to the science ethics education of the junior researchers. In addition, these two institutions have organized educational courses about the principles of GSP in the last 4 years for research beginners. There was a great interest of all participants on this matter, indicating the need for such practice.

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