RADIOBIOLOGY COURSE IN ISRAEL

by Peter Alexander

(An advanced international training course in radiobiology; organized by the International Atomic Energy Agency and the Government of Israel, was held in Israel during October 1961 - February 1962. In this article, Dr. Peter Alexander, of the Chester Beatty Research Institute, London, who acted as IAEA's adviser on the organization of the course, gives his impressions and a brief general assessment of the project.)

Towards the end of 1960, IAEA decided to sponsor, in conjunction with the Israel Atomic Energy Commission, an international training course in radiobiology in Israel. I was asked to act as adviser for the organization of this course and to plan it in detail with the Israeli authorities.

The first step was a visit to Israel in January 1961 to meet Dr. Charlie Braudo who is in charge of the radioisotope training centre which is run by the Israel AEC in conjunction with the Weizmann Institute. The centre, excellently staffed and equipped, had given a large number of different courses on the application of radioisotopes in medicine, industry and research. A course in radiobiology in which the effects of atomic radiations on living systems were studied and in which isotopes played almost no part was, however, entirely new to them. In ten hectic days Charlie Braudo and I decided on the general outline of the course. We also had to determine which of the lectures could be given by Israeli scientists and to persuade them to take part. Further, we had to find experienced scientists to organize and supervise the advanced experiments which it was intended to carry out. With very few exceptions we obtained willing and enthusiastic co-operation from everyone whom we approached. As it turned out, a number of experienced Israeli scientists had to give up a large part of their time during the course and shortly before to supervise practical work.

At the time of my first visit the laboratories of the training centre were in temporary quarters in the Weizmann Institute, but a new building was being put up for it at the site of an Israeli experimental reactor about ten miles away. It was planned to hold the radiobiology training course in the new building. In spite of the physical separation from the Weizmann Institute, the course was nevertheless able to call on many of the facilities of this world renowned research laboratory. The lectures were given in one of its many excellent lecture theatres; its canteen, library and common room facilities were available to all the students of the course. Several of the scientists who had agreed to supervise practical training were on the staff of the Weizmann Institute and, indeed, many experiments requiring specialised techniques were carried out in the supervisors' own laboratories at the Weizmann Institute - an informal arrangement that proved immensely valuable.

Outline of the Course

We decided to plan the course around four major experiments which would demonstrate the principal areas of radiobiology research. As it turned out, these experiments were all miniature research projects. Variants could be run by different experimenters, and discussion sessions to compare and contrast experimental results were a valuable feature. We anticipated that each of these experiments would last between three and four weeks and this was the principal factor which determined a length of four months for the course. The nature of the course is best described by the outline Dr. Braudo and I submitted to the Israel Atomic Energy Commission and to the Agency in February, 1961:

AN ADVANCED COURSE IN THE BIOLOGICAL EFFECTS OF RADIATION

Duration of Course

The course will last four months beginning 24 October 1961.

Purpose of Course

The course is intended to train those who wish to enter active research in radiobiology or who wish to acquire detailed knowledge of the effects of ionizing radiations on living matter. It will not deal with the clinical aspects of radiotherapy or radiodiagnostics and will not deal specifically with the application of radioisotopes to biological and medical problems.

Participants

The participants in the course must be fairly recent graduates in science or medicine with some post-graduate research experience or persons still actively engaged in research activities. A good knowledge of English is required.

Design of Course

During the course there will be approximately one hundred and fifty hours devoted to lectures. Forty hours of this time will be devoted to basic lectures on nuclear physics, interaction of radiation with

matter, nuclear instrumentation and molecular biology. The remaining time will be devoted to review and specialist lectures given by visiting experts and by Israeli scientists. An outline of these lectures will be issued as soon as details are available.

There will be two seminars each week in which visiting lecturers and local Israeli experts will take part and which will be devoted either to discussion of the advanced experiments or to discussion of some controversial topic related to radiobiology.

The experimental section of the course is based on four advanced practical experiments which will demonstrate the effects of radiation at all levels of biological organization, from sub-cellular to mammalian, as follows:

1. Quantitative Aspects of Cell Death:

The dose-survival curve of various bacteria will be determined following exposure to different types of ionizing radiations. The highly specialized facilities at the experimental reactor of the Israel Atomic Energy Commission will be available as will high voltage equipment at the Weizmann Institute of Science.

2. Genetic and Cytological Effects:

Recessive and dominant mutations will be demonstrated using the fruit fly. Chromosomal abnormalities will be studied quantitatively in plant material.

3. Inactivation of Enzymes in vivo and in vitro:

Factors determining the inactivation of enzymes in dilute solutions will be studied and will be compared with changes of enzymic activity in organs of animals at different times after irradiation.

4. Pathology of Irradiated Mammals:

Mice will be given high doses of irradiation, and changes in the blood pattern, in the histopathology of various organs and in haemoglobin synthesis (using radioactive iron) will be determined at different times. The effect of protective agents on these changes will be determined.

Each of these experiments will take three to four weeks to carry out and, in addition, there will be short experiments demonstrating basic techniques as follows:

1. The Geiger-Mueller counter.
2. Proportional and scintillation counters.
3. Absorption of gamma radiation. Shielding problems.
4. The range of alpha particles. Absorption and scattering of beta radiation.
5. Radiochemical procedures.
6. Preparation of sources and assay of radioactive materials.
7. Radiation dosimetry by physical methods.
8. Radiation dosimetry by chemical methods.

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The next step was to find specialist lecturers to cover those subjects which could not be dealt with by Israeli lecturers. We were extremely fortunate to persuade Zenon M. Bacq (Belgium), Maurice Errera (Belgium), Paul Howard-Flanders (USA), E. Hadorn (Switzerland) and V. Zeleny (IAEA) to act as visiting lecturers. The first four spent two weeks each in Israel and between 12-18 lectures as well as some seminars were squeezed out of them during this time. I returned to Israel for two weeks at the opening of the course and gave my stint of lectures which started off the programme. The topics to be covered by the different lecturers, especially those who came as visitors, were co-ordinated as best we could and I think on the whole there were relatively few omissions and relatively little overlap.

For practical work the students were divided into eight groups of four or five. Each of the four major experiments was being carried out simultaneously by two of these groups. At approximately monthly intervals each group moved on to another experiment.

The next problem was the choice of students. The Agency had agreed to offer twenty fellowships and there were to be ten Israeli participants. The demand for places proved to be surprisingly great and the fellowship committee had a difficult task to select the limited number from the many suitable applicants. In the end the Israeli Government helped by releasing some of their places.

All the participants proved to be highly trained and nearly everyone had a research qualification such as Ph. D. They came from many parts of the world: Switzerland, Czechoslovakia, Norway, Yugoslavia, Netherlands, India, Ethiopia, Philippines, Venezuela, Argentina, Mexico, Turkey, Australia, Japan, Sweden and Finland; in a very few cases more than one student came from a single country.

Start of the Course

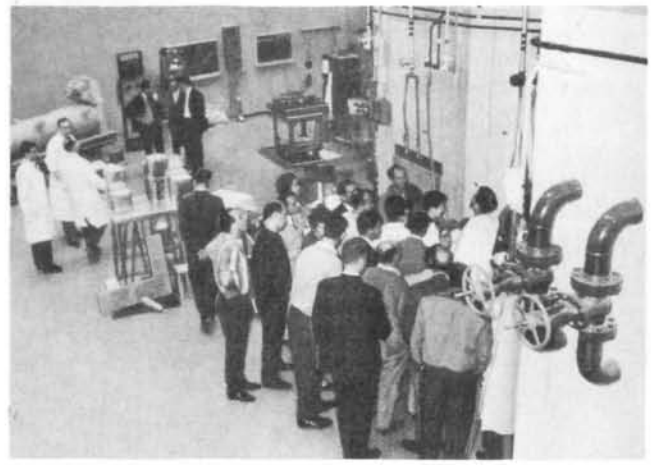
The course started on a Tuesday and I must admit to a feeling of disquiet - which was shared by Charlie Braudo and his staff - as we awaited the arrival on Sunday and Monday, by different planes, of this United Nations in miniature. How could they get on over a period of four months; would they form a team; would the course be what they expected? Right from the start all went smoothly; everyone was met by a member of the Israel Atomic Energy Commission and I am sure none of the students will forget the indefatigable Mrs. Schweitzer who acted as their fairy godmother and was able to meet a vast miscellany of requests. Initially, the students were put up

in a luxury hotel near the airport, but soon most of them moved into lodgings in the small town of Rehovoth. The visiting lecturers were fortunate enough to be able to stay in the excellent guest house of the Weizmann Institute.

The start of the course was to coincide with the opening of the new centre of the isotope training school. None of us had anticipated how finely timed the coincidence would be. On Sunday morning it looked to me as if the building was so incomplete that it could not be ready before the end of the four-month course. Miraculously, forty-eight hours later, on Tuesday morning, the flags were up and everything was spick and span for the opening ceremony performed by Mr. David Toll, special representative of Mr. Sterling Cole - then Director General of the Agency - in front of an impressive array of Israeli and diplomatic dignitaries. Quite unintentionally, the choice of the day for this ceremony and for the start of this course proved to be most appropriate; it was United Nations day. Everything, in fact, had gone exactly according to schedule and no one guessed that Charlie Braudo and the administrative staff of the Israel AEC had worked day and night for at least a week to convert an empty and unpainted shell into a functional laboratory of the most advanced kind.

A major problem of teaching radiobiology is that scientists from very many different disciplines are drawn to this subject. This indeed proved to be the case for this training course. The participants covered a vast spectrum of training, ranging from physics, chemistry, biology and genetics to medicine. The lecturers, therefore, had to start with the fundamentals of each topic and there were introductions to genetics, to radiation physics, to pathology, to biochemistry. These were kept brief and concise and the participants were expected to fill any gaps by reading. The policy of starting at the beginning but pushing on at a brisk pace proved, I think on the whole,

A lecture being given by Dr. Charlie Braudo, who is in charge of the Israeli radioisotope training centre



Participants in the training course visiting the Israeli research reactor

successful though it required a great deal of effort from the students.

For the practical work the students were grouped in such a way that every team of four or five had a specialist conversant with the techniques used in each of the experiments (i. e. a pathologist for the mammalian experiment, a chemist or biochemist for the enzyme experiment, and a geneticist for the genetic experiment). In this way members of the groups were able to instruct one another to a considerable degree.

Effective Collaboration

Probably the most successful aspect of the course was the effective working together of scientists who were extremely heterogeneous both in their personal background and training. As an example of international collaboration this course certainly could not be bettered. Largely, of course, this is a reflection of the fact that scientists of different nations never find it difficult to meet and co-operate on a scientific plane. However, the delightful atmosphere of informality and helpfulness which was created by the Israeli hosts was a major contributing factor to the excellent spirit that existed.

The scientific success is difficult to assess. If the course were run again many things would undoubtedly be altered. There were too many experiments and some were too elaborate and difficult. On the whole four months seems to be too long. When one considers the pioneering nature of this venture - no course at such an advanced level has ever been attempted before - I think all concerned can be quite satisfied. However, it must be stressed that this course required a tremendous effort in time and energy from Dr. Braudo and his loyal staff. I am sure all the students would wish me to express their appreciation to them.