REPORT BY REVIEW COMMITTEE ON RADIOLOGICAL PHYSICS DIVISION

Argonne National Laboratory
April 11-12, 1966

This report essentially completes a two year review of the Radiological Physics Division of the Argonne National Laboratory during which period there has been a noticeable improvement in some of the problem situations that were evident at the outset. Some of these were primarily of an organizational nature and others were the normal results of readjustments necessary when this division was split-off about three years ago. Any such division split is bound to introduce certain problem areas if for no other reason than that there is usually a loss of flexibility as the size of a unit decreases. We feel that these adjustments are being made reasonably well and that on the whole the future prospects for the division look promising.

Improved rapport between the Radiological Physics and the Health Physics Division is also promising, but there is still the general feeling that this situation will reach its best solution only when the appropriate portions of the two programs are consolidated.

Other problem areas that influence the technical operations of the divisions are largely outside of the control of the division and outside of the cognizance of our review committee. These have to do with questions of space, staffing, and certain aspects of the budgeting problem. These have been dealt with in past reports and will not be discussed further at this time.

Primary attention during the April meetings of the Review Committee was directed to specific project areas and the comments

below are limited primarily to them. No attempt was made to cover all areas.

Radiation Physics Program (Budget Code 60610)

Background. Much of the work discussed below concerns a major gap in our knowledge of the mechanism of physico-chemical action of radiations. This gap begins with the imperfectly known processes by which energy quanta become localized in atomic agregates of molecular size. It extends through the subsequent unknown breakdown of these quanta until the appearance of new modified chemical entities of appreciable lifetime. Bridging this gap will require substantial, intelligent and protracted efforts, but constitutes, in our opinion, a prerequisite for any real understanding of the later, chemical, stages of radiation action.

Because this problem is a basic one and because it belongs to chemical physics, some question has been raised in the panel whether it is assigned appropriately to a division whose mission is mostly one of applied physics. More specifically it has been asked whether this assignment does not hinder the recruitment of staff with the necessary dedication to fundamental problems. An answer to this question is seen in the fact that material and moral support and stimulation for this endeavor is found most easily in organizations that are primarily concerned with the action of radiations. The leaderships of this ANL division and of the AEC branch that supports it are deeply committed to this endeavor. Moreover the existence of a high grade basic program in the division has great significance for the quality of its applied work. By contrast, the basic study of radiation would constitute

but one of many targets for a Physics or Chemistry Division. The recruitment of adequate staff would probably be solved given one or two capable and imaginative leaders of the program, with the necessary support. Despite the recent loss of Dr. Platzman from the intellectual leadership of this part of the program at ANL, Drs. Rieke and Inokuti are making progress toward exerting an effective leadership.

Nevertheless, a very substantial managerial effort and some increase of support are still required to remedy the consequences of the early, somewhat uncoordinated program development in this area and the reluctance of some of the staff to modify their initially independent activities in the light of changing scientific circumstances and of opportunities for effective cooperation.

Comments on Individual Projects

The first presentation to the panel, by Mr. Kastner, concerned the development and testing of thermoluminescent dosimeters. This activity displays a good blend of attention to fundamentals and to practical aspects. The only question that arose concerned its rate of progress and the eventual balance of effort expended against the results produced.

Next, H. Schultz presented initial plans for a new line of experimentation, namely, a search for the dependence of ionization yield of radiation in a gas upon the gas pressure. This study, which presumably originates from a suggestion by Platzman, would provide information on secondary ionization processes which would result from collisions following high initial excitation, but

which have to compete with other deexcitation processes such as light emission. While the eventual experiments will probably differ greatly from the current preliminary design, the objective seems very worth pursuing with energy and skill. A most welcome incidental by-product of recent activities for this purpose has been the re-establishment of contacts with Dr. Jesse of St. Procopius College.

Dr. Bowe reported on "Projected Experiments with Electron Swarms"; a private discussion with him had been held last Fall. In the past, swarm experiments have been perhaps the main source of information on the collisions of slow electrons with gas atoms and molecules. Dr. Bowe has been regarded as one of the better workers in this field, even though his recent results depart from those of most other workers. Recent progress on direct collision experiments tend to reduce the future value of swarm methods. This consideration seems particularly relevant because Dr. Bowe plans to extend his experiments to higher electron energies where inelastic collisions and resonant processes occur; swarm methods admittedly cannot detect resonance effects and are affected by them in an undetermined manner.

Dr. Rieke reported on his measurements of total ionization cross sections for fast electrons in various gases. The measurements, now nearly complete, appear to complement recent evidence obtained by different methods. Analyzing the implications of the combined results and developing new plans of activity seem to be the main immediate tasks for this group.

Dr. Person reported on his experiments on the ionization efficiency of Far UV light in various molecules. This project was initiated early in 1964 at a sizeable cost in capital equipment

and has been yielding results for over a year. The experiments compare the yield of ionization to the number of photons absorbed for different photon energies and different isotopic constitutions. They have demonstrated, for example, that the effect of light absorption by the electrons of a C = O bond depends on the isotopic constitution of other parts of the molecule. Thereby this work contributes directly to the objective of analyzing the phenomena following the initial absorption of energy.

The recent addition of a technician to this project is noted with approval. Further staff expansion on a higher level would be highly desirable to increase the momentum of this successful project and to maximize the yield of the initial investment.

Dr. Inokuti closed the morning session by reporting on the results of calculations of the spectra of "Subexcitation Electrons." The concept of subexcitation electrons, which result as secondary products of ionization, and the importance of estimating their numbers and energies have been emphasized by Platzman and others for the last 10 years. This is probably the first time that detailed quantitative estimates have been provided on the subject. This report appears to cover only a fraction of Inokuti's recent activities, which extend over a variety of theoretical tasks initiated or stimulated by Platzman in the last several years.

Harold May's report concerned developments in the procedures for the measurement of thorotrast patients. Dr. Berlman did not report to this session of the panel. He had been interviewed individually last Fall, at which time he was completing an extensive and valuable critical compilation of fluorescence spectra and was

beginning to consider further projects. Bringing him into closer cooperation with the rest of the division would, of course, be desirable.

Radium Studies

The committee heard reports on the studies of radium in humans from Dr. Rowland of RPY, Dr. Hasterlik of ACRH, and Dr. Finkel and Dr. Miller of the Health Division (HD). The work of the RPY "bone group" on bone kinetics continues to be imaginative and vigorous. The projected return of Dr. Elizabeth Lloyd in July 1966 to continue with Dr. Marshall and Dr. Rowland will maintain and expand this strength. The cooperation of this group with other laboratories in helping them replicate special apparatus and skills is an important contribution to the progress of both bone science and radium studies in human subjects.

Dr. Hasterlik's findings of a high incidence of rare tumors in radium patients indicates that his prospective study of changes in the mastoids of radium patients will be a valuable addition to the human radiobiology of radium. Drs. Finkel and Miller described computational work done some time ago using previous whole body γ-counting data on 8 Elgin Hospital radium patients and 150 dial painters. We were not aware of any new data acquired on radium patients in the past year or more. Miller is a vigorous worker, but would benefit by more guidance and direction.

Cooperation between RPY, ACRH, and HD has improved significantly in the past year. Excretion studies by RPY on the Elgin patients have been arranged, but not accomplished. These important data should be obtained as soon as possible.

Each of the three groups has interests in particular facets of the overall problem of radium toxicity in humans, and there is almost no overlap of interests. Central leadership is nonexistent. Overall planning designed to maximize the information obtainable from studies of the Elgin patients and the Ottawa dial painters is absent. Unless plans are made to utilize these subjects intensively, and especially to obtain some whole bodies at post mortem, this unique human material may slip away and be lost through inaction.

It is suggested that RPY pursue more vigorously its plans to secure excreta samples, as well as more autopsy material from the Elgin patients. It is recognized that a major obstacle to accomplishing this is a shortage of hands, thus requiring the use of staff personnel.

Beyond cooperation, a true community of scientific interest in the human radium studies awaits development. It seems to us unlikely that the needed overall scientific leadership can be found locally, and we recommend exploration of the possibility of bringing in a carefully selected new person to fill this leadership role. Is there a university scientist, an AEC scientist, or a U.S. Public Health Service career scientist who could become enthusiastic about taking on such a leadership duty?

P. Failla briefed the committee on the program of the AMU-ANL Biology Committee. It was noted that in trying to attract graduate students to the Argonne National Laboratory through this program, laboratory resistance will be met if operated under the present overhead policy. This is a factor previously noted by our committee and it is hoped that some means can be found for overcoming the difficulty.

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