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MINUTES

141st MEETING

ADVISORY COMMITTEE FOR BIOLOGY AND MEDICINE
U. S. ATOMIC ENERGY COMMISSION

711472

January 7, 1972 - Auditorium, HQ
January 8, 1972 - Room 1062, "H" St.

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The 141st meeting of the Advisory Committee for Biology and Medicine was held January 7-8, 1972, at AEC Headquarters and the "H" St. Office. Members present were Drs. R. D. Moseley, Jr. (Chairman), C. A. Finch, A. J. Haagen-Smit, T. A. Lincoln, W. J. Schull, P. R. Stout (Vice-Chairman), John B. Storer (Scientific Secretary), and Miss Rosemary Elmo (Executive Secretary). Dr. Clarence Larson was present representing the Commission. A very large number of Headquarters personnel from the Division of Biology and Medicine and also from other Divisions, as well as representatives from other agencies, were also in attendance. (Dr. Richard Fred, Bureau of Radiological Health, PHS; Dr. Neal Nelson, Radiological Toxicological Branch, EPA; Dr. Charles Liddle, EPA; Dr. Wayne Hanson, Technology Assessment Division, EPA).

Dr. Moseley called the meeting to order and asked Dr. Totter for any announcements. Dr. Totter introduced new staff members of DBM. (Drs. Anderson, Sanders, Watters, and Marks, and Mr. Kondulis.) He then asked Dr. Larson if he had any comments. Dr. Larson indicated an intense interest on the part of the Commission in the biological effects of plutonium, especially in view of the anticipated large number of fast breeder reactors. Dr. Totter introduced the scientific program which had been organized by Dr. William Bair. The initial portion of the program was presented by representatives from divisions other than DBM. Following this, DBM representatives summarized the current status of its studies on plutonium toxicity.

The first presentation was by Dr. McVey from the Division of Reactor Development. His presentation was concerned with the future requirements of plutonium as a reactor fuel. By going to fast breeder reactors it will be possible to use about 80% of the naturally occurring uranium in the world. The fast breeders will utilize depleted uranium as a source of energy and it is expected that the breeding ratio will be 1.27. By the year 2000 it is expected that the total inventory of plutonium-239, principally in reactors, will be between 1000 and 2000 metric tons. Even by 1980, there will be about 50 tons of plutonium inventory in power reactors in the United States. Even at the present time and increasingly so in the future, waste disposal and the decommissioning of facilities is concerned mainly with the hazard from plutonium rather than from fission products. In the light water reactors there is an appreciable amount of energy released from the fission of plutonium. The Division of Reactor Development and Technology is now focusing its effort on the liquid metal fast breeder reactors.

Dr. McVey considered potential sources of release of plutonium. The first of these is in the fabrication of reactor components (fuel elements). This work is now done in glove boxes but the hope is that it will be possible to go increasingly to automation. He went into a general

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discussion of how much plutonium waste is generated and how it can be reclaimed or disposed of. He also pointed out that in addition to the hazard from inhalation or ingestion of plutonium, there is an associated penetrating radiation from large quantities of plutonium. The amount of x- and gamma-rays released increases with time as impurities such as americium grow in. There is also some associated neutron exposure.

A second possible point of exposure or release of plutonium is in fuel reprocessing. Here again, the principal hazard in the reprocessing of fuel elements is plutonium rather than the fission products. The Oak Ridge National Laboratory has undertaken a study of how a "zero release" reprocessing plant might operate.

A third possible source of release is in the shipping of materials containing plutonium. The research in this area is concerned with how plutonium might be shipped in a form that is not respirable.

The fourth and fifth possible sources of release are in the decommissioning of obsolete facilities and in the refueling of reactors.

Following Dr. McVey's presentation, Dr. Stout raised the question of cost per kilowatt hour from reactors. He pointed out that the projected costs now are very much higher than were estimated a few years ago. Dr. Larson responded, pointing out that the increase in cost is largely because of a tripling of construction costs and an increased interest on money that is borrowed to finance construction.

Mr. George Pleat, from the Division of Production and Materials Management, described some of the activities of his Division with respect to plutonium-238 and plutonium-239. The anticipated requirement for plutonium-238 by 1980 will be about 450 kilograms. Medical requirements for plutonium-238 which are now very small may increase significantly. With respect to production of plutonium-239, there were 6500 kilograms of non-weapons grade plutonium available as of last summer. This material is suitable for reactors but not for weapons. Future production of plutonium-239 will depend principally on the Savannah River Plant, which has three reactors. Weapons grade plutonium will come from this facility for the next ten years. The N reactor at Richland, Washington, will be operated until 1974. Production there is for reactor grade plutonium.

The materials management program was initiated because the storage problem, particularly that associated with scrap materials, became serious. At the present time, there are about 500 kilograms of plutonium-239 associated with various scrap materials. The people in Materials Management are trying to reduce this inventory and to reduce the rate of production of new scrap. At present, about 300 kilograms a year of plutonium in scrap material is being generated.

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Mr. G. Dix, of the Division of Space Nuclear Systems, discussed past and projected requirements for nuclear devices in connection with the space program. To date, 324,000 curies of plutonium-238 have been launched in connection with the space program. Three of the thirteen devices containing plutonium-238 were aborted. About 100,000 curies of plutonium-238 was involved in these aborted missions. It is expected that in 1972 approximately 200,000 curies will be launched. The Division of Biology and Medicine is actively involved in the safety evaluation of each device. There is an additional interface in that the aerial radiological monitoring survey system developed by the Civil Effects Branch under Mr. Joe Deal is available to assist in the recovery of sources from aborted missions.

At present there are four plutonium-238 packages on the moon and three of these are operating at a capacity of 70 watts. Mr. Dix then discussed projected launches and the requirements for plutonium-238. He reviewed the conceptual design of future spacecraft. The design for the SNAP devices is now for containment of the radioactivity rather than for burn-up in the atmosphere. He closed by emphasizing the cooperation with DBM and their dependency on DBM for help with safety problems.

Mr. Robert Catlin, of the Division of Operational Safety, discussed problem areas with respect to plutonium from the point of view of his Division. The first area concerned the question of radiation standards with respect to plutonium. With the abolishment of the Federal Radiation Council, there is presently no interface between the AEC and other agencies. The Environmental Protection Agency has the responsibility for standards but it will be some time, apparently, before guidance is provided by EPA.

He identified two areas specifically that make it difficult to establish standards. One is that the rate and extent of translocation of plutonium in the body is poorly understood. The second is that the environmental pathways by which plutonium can reach human beings are poorly defined.

Another difficult area for the Division of Operational Safety concerns the question of cleaning up and releasing to the public previously contaminated areas. Such areas are typified by the Bikini Atoll, the area around the Rocky Flats plant and the Nevada test site. He pointed out that at present there is a lack of emergency guidelines which specify action levels for certain levels of plutonium contamination. In the medical area there is presently an insufficiently sensitive method for detection of plutonium body burdens in the human body. Improved methods of therapy for removal of plutonium would also be very helpful.

A final point which he considered a problem area was the question of public acceptance of plutonium as a fuel for energy generation in the future.

Dr. Moseley asked whether the National Council on Radiation Protection is preparing a report on plutonium. Mr. Catlin thought that they were. Dr. Haagen-Smit asked about EPA's relation to the Division of Operational

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Safety. Mr. Catlin pointed out that EPA took over the Federal Radiation Council's function and they are charged with providing guidance with respect to radiation problems. The mechanism for discussions between agencies which was provided by the FRC no longer exists. As an interim procedure the AEC may necessarily have to set some of its own guidelines since the reorganization setting up EPA has caused a serious delay in providing this information. Dr. Stout asked about the problem of determining degree of exposure to plutonium and asked whether there might be exposures that we simply don't know about. Mr. Catlin thought there might be such exposures but that it would be relatively unlikely. Detection methods are not sensitive enough to detect very low levels of exposure. He pointed out that if plutonium facilities are not controlled by the AEC and if they continue to proliferate, the problem of plutonium exposure could become acute. Dr. Stout asked where the necessary instrumentation for detection of low levels would come from. Dr. Totter felt that the Division of Biology and Medicine's instrument development program would probably be able to meet the requirement.

Mr. Facer, from the Division of Military Application, discussed the problem of plutonium contamination of soil. Among the areas where such contamination has occurred are Palomares in Spain, Thule, Greenland, the Nevada Test Site, the test sites in the Pacific, and the Rocky Flats operation in Colorado. Accidents, weapons tests, etc., have all contributed to spreading plutonium around. Mr. Facer felt strongly that the criteria for cleaning up an area are far too conservative in view of the biomedical evidence concerning the likelihood of a significant exposure from resuspension of plutonium from the soil or through movement up the ecosystem. In Spain they removed 5500 drums of soil where the contamination was relatively high and deep-ploughed a square mile area where any level of plutonium was detectable.

Dr. Bair then introduced the biomedical portion of the briefing. The first speaker was Dr. Engelmann, who described current studies on the resuspension of radioactive materials from the ground surface. Various contractors have undertaken systematic studies of the factors involved in resuspension. Earlier attempts to estimate a single constant which represented a resuspension factor proved not to be very helpful. One current approach that is being used is the direct one of "salting" an area with a contaminant and making direct measurements of how it moves down wind. These studies are being conducted at Rocky Flats. Dr. Engelmann pointed out that plutonium may quickly gets attached to larger particles which puts many of the particles beyond the respirable range. At present, they estimate that 20-40% of the plutonium contamination at Rocky Flats is in the respirable range. Dr. Engelmann closed by outlining additional ongoing and proposed research being monitored by his branch of DBM.

Mr. Jared Davis, formerly of the DBM staff, and now with the Nevada Operations Office, described the studies on plutonium contamination by alpha

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emitters unless the levels were very high. At present there are 250 square miles of the Nevada Test Site contaminated with "significant" amounts of plutonium. An applied ecology group has been formed at the test site which is supported both by the Division of Biology and Medicine and the Division of Military Application. In addition, there are representatives from a number of other agencies on the steering committee. The steering committee provides guidance on priorities of research activities. An ad hoc committee on plutonium has been established to recommend research approaches to the plutonium problem. The plutonium problem is considered to have a high priority. Studies by this group are confined to the Nevada Test Site. The Environmental Protection Agency is looking at areas outside the boundaries of the test site. The work to date indicates that plutonium contamination is 3-7 times higher under the brush that grows on the desert floor than it is on the desert floor. The old surveys were made between the stands of brush and therefore underestimated the extent of contamination. Mr. Davis described in some detail some of the proposed work which involves many organizations and many disciplines. Basically they will be looking at the distribution over the surface of selected areas of the test site, the distribution with soil depth, the amounts in the native animals and in the plants growing in these regions.

Dr. Vaughan, from the Battelle Northwest Ecology group, discussed "reentrainment" of plutonium in ecosystems through biological factors. He suspects that chelation plays an important role in the reentrainment phenomenon. They have found that plants growing around fuel processing installations show a higher level of plutonium than they would have expected. Because of the strong discrimination against plutonium when it is ingested, he suggested that the body burdens found in animals in contaminated areas may result from respiration of the material rather than its ingestion.

Dr. Lindenbaum, from the Argonne National Laboratory, discussed his experiments in small animals using plutonium and americium. The materials were given by injection rather than by the respiratory route and the measurements made were concerned primarily with distribution and excretion of these nuclides. He tried various proportions of colloidal plutonium in the injected solutions and found that the greater the percentage of colloid, the higher the retention in the liver as opposed to bone. Later, however, the material deposited in the liver moves to the bone endosteum. Like many investigators before him, he found that chelating agents are usefully in removing either of these materials from the liver. The loss in the chelated form is through the biliary system. He is of the opinion that 20 nanograms of plutonium per gram of liver is a threshold for killing of the liver cells which then enables translocation to bone. Chelation is not useful in removing radionuclides from bone. He indicated that they plan to extend their studies to dogs. They also plan to try to utilize "glucan" to remove radionuclides from the reticulo-endothelial system. If chelation is used in conjunction with glucan, then apparently there is significant excretion through the urinary tract.

Dr. W. Jee, from the University of Utah, described the research in dogs that has been conducted there. This was the first laboratory established

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by DBM to study the long term toxic effects of plutonium relative to radium utilizing beagle dogs as the experimental animal. In their original experimental design, they injected six groups of dogs with plutonium at doses ranging from .016 to 2.88 microcuries/kg body weight. An additional control group was included. At present all but one of the dogs is dead. Osteosarcomas were found in all the treated groups and no osteosarcomas were found in controls. They later set up a second phase of the study in which the radiation doses went down from .015 to .00064 microcuries/kg. None of these animals has yet died and none has yet shown an osteogenic sarcoma but the experiment has gone less than ten years. It might be noted that in the first phase of the study the lowest treatment group represented an endosteal radiation dose of approximately 1600 rads of alpha particles. It is perhaps not surprising, then, that these animals developed their sarcomas. Dr. Jee felt that small doses of radionuclides permitted bone remodeling so that retention of the radionuclides was not as high as it was at the higher doses. At high doses remodeling is inhibited and thus the removal of the nuclide is impeded. In the case of the liver, the effect works in the opposite direction. High doses kill the cells and thereby permit removal. Dr. Jee also outlined a number of proposed studies.

Dr. Newton, from Battelle Northwest, reported on the status of the transuranium registry. The purpose of this registry is to keep track of personnel exposed to transuranic elements with the ultimate hope of correlating exposure information with morbidity, mortality, type of disease, and assays of the radionuclide content of tissues at death. A large number of contractors and licensees are included in these studies. They are presently following 100 men with significant levels of plutonium. Assays are made every two years of the amounts excreted and medical examinations are provided every five years. The biological specimens are processed for radionuclide content at Los Alamos, Rocky Flats and Hanford. Cross checks of the methods and results are conducted. At the Hanford works there are 2000 identified workers who have had potential exposure to transuranic elements. Two hundred and seventy-four of these are known to have some deposition in the body. An attempt is being made to obtain permission for autopsies at the time of death of these workers under the act permitting the donation of bodies. Four hundred of the 2000 workers at Hanford have signed autopsy permits. Protocols for conducting autopsies are being standardized. In addition to the workers at Hanford, there are presently 2500 workers at Rocky Flats with potential exposure and another 2500 that have been terminated from their jobs for one reason or another. One hundred of these workers are known to have significant deposition of transuranic elements. There are a number of additional workers with lower body burdens. All told, there are about 10,000 potential exposure cases at the present time in the United States. There have been 14 autopsies in the sample being followed by the plutonium registry in the past year. They are making assays from various portions of the body to examine the magnitude of the inhomogeneities in deposition of the radionuclides. Presently, England, Russia, and Japan all plan to establish transuranium registries and will exchange data with the U. S. Registry.

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Dr. Park, from the Pacific Northwest Laboratory, summarized a long list of plutonium studies being conducted at this installation. The main emphasis in these studies has been on the inhalation route of exposure. At the highest doses of plutonium the dogs die early from pulmonary fibrosis. At lower doses they die late in life from lung tumors. Assays of the tissues show that the highest concentrations of plutonium are in the regional lymph nodes. They have recently started a low dose study at six graded doses extending all the way down into the range of human exposures. He noted that plutonium-238 and plutonium-239 seem to behave quite similarly with respect to deposition, translocation, excretion, etc. In rats exposed to insoluble plutonium by the inhalation route, they are finding a wide variety of tumors. Dr. Park proposed that there is probably some cocarcinogenic interaction between plutonium and other carcinogens such as asbestos, cigarette smoke, etc.

The group has screened a number of agents in rats in an attempt to influence the excretion rate of plutonium and has also studied the metabolism and effects of plutonium-238 injected as microspheres. Dr. Park closed by outlining proposed research in some detail. Proposed studies include examination of the effect of particle size, contaminants in the plutonium, dosimetry, attempts at therapy, theoretical modeling and ancillary studies.

Dr. McClellan described the research on alpha emitters being conducted at the Lovelace Foundation. At present a permanent facility is being constructed for the express purpose of studying inhalation toxicity of transuranic elements in dogs. They are looking at americium-241, curium-244, and plutonium-239 by the inhalation route in dogs and are studying californium-252 and americium-241, curium-244, and plutonium-239 by the inhalation route in dogs and are studying californium-252 and americium-241 in rodents. The work at the Lovelace Foundation is unique in that they can make monodisperse aerosols of any desired particle size. This, then, enables them to vary each of the experimental variables independently. For example, they can give different dogs the same smeared dose to the lung by changing the particle size, they vary the local dose and the fraction of the lung irradiated by an enormous factor. They can also keep the local dose around the aerosols constant but vary the total smeared dose to the lung. This work very nicely complements the more empirical approaches being used in other installations. Dr. McClellan also reported on the results of the case of lung lavage. A worker at the Rocky Flats plant received an overexposure to plutonium-239. He was treated at Lovelace and by lavaging the lung, they retrieved about the same amount by lavage as he excreted in the urine. The urinary excretion was higher than normal since the patient was treated with DTPA.

Dr. Richmond, from the Los Alamos Scientific Laboratory, described the work with plutonium being conducted there. Rather than using the inhalation route of administration, they inject particles of various sizes intravenously. These then lodge in the lung and give high doses of local radiation to the area where they lodge. They propose to vary the number of particles, particle size, etc., so that they can look at varying smear doses, varying local doses, and various fractions of the lung irradiated. This work is just getting under way.

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Dr. Richmond also described briefly the studies that have been conducted on a group of 25 workers who have been followed since 1953. All these workers had significant body burdens of plutonium. Drs. Langham and Hempelmann are conducting these studies. To date, there have been no abnormalities encountered. Dr. Richmond also mentioned briefly the continuing study of plutonium levels in unexposed residents in the Los Alamos community. This work was started years ago, when Dr. Lushbaugh was the pathologist at the Los Alamos Hospital, in collaboration with the industrial hygiene group. The work is continuing and is being expanded to include persons from other areas.

The Committee adjourned and reconvened at 8:30 A.M., Saturday, January 8, at the "H" Street office. The first order of business was completion of the briefings that had been scheduled for Friday but for which there was inadequate time. Dr. Beasley of the DBM staff described DBM-supported studies on plutonium in lakes and oceans. There are three contracts for studying plutonium in oceans. Two of these are at Woods Hole and the third is at the Scripps Oceanographic Institute in La Jolla. Old studies have indicated a very high concentration factor for plutonium in marine organisms. This is principally in the very simple organisms. As it moves up the food chain, the concentrations drop very drastically because of discrimination against the uptake of plutonium. The studies indicate that plutonium on the ocean floors is moving deeper into the sediment and becoming entrapped. There are also some studies being conducted on plutonium in the Great Lakes. Dr. Beasley also reported briefly on the cleanup of the Bikini Atoll. Dr. Conard, of the Brookhaven National Laboratory, will be following the Bikini population as well as the people who were exposed on Eniwetok. There are little data available on the early levels of plutonium for either the Bikini or Eniwetok Atolls. DBM is considering initiating some research on plutonium on Bikini but as yet there is no program underway.

Dr. Watters, of the DBM staff, described the collaborative studies between Colorado State University and the Rocky Flats plant. The people at Colorado State are studying the movement of plutonium from contaminated wounds using dogs. The wounds are simulated by using a subcutaneous injection of plutonium. The Rocky Flats plant provides the analysis of tissue samples from various parts of the body.

Dr. Wood, of the DBM staff, gave an overview of the activities in instrumentation as it applies to the assay of plutonium and the estimation of body burdens. A proposed method of in vitro assay of plutonium is to layer the appropriate material on plastic, expose this material to a neutron flux which then results in fission fragments which damage the underlying plastic. On etching the plastic it is possible to count the number of fission fragments produced and from known cross sections, the neutron flux, etc., it is possible to estimate the amount of plutonium present. This is a very sensitive system. The current method of estimating body burdens in living subjects is by

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external counting of the radiation emitted by the americium which is normally a contaminant of plutonium. The weak x-rays emitted by plutonium can also be measured by using a thin cesium crystal glued to a large sodium iodide crystal. Anticoincidence counting gets around the problem of the background and provides a sensitive test. Presently intercomparisons are being made by all the various laboratories that are doing external counting. Dr. Wood pointed out that germanium detectors show a great deal of promise for external counting but as yet they are not big enough to be particularly useful. He showed the committee an esophageal probe which can be inserted by mouth and which will detect plutonium deposited in the lymph nodes along the tracheal bronchial chain. The sensitivity is estimated at perhaps 10 nanocuries. Another new development is a wound probe which uses a silicon avalanche detector. In many respects it is similar to the esophageal probe.

Dr. Edington, Chief of the DBM Biology Branch, reported on the proposal of Dr. Neel, from the University of Michigan, to make further genetic studies at the Atomic Bomb Casualty Commission. Briefly, Neel is proposing to use new techniques to examine the serum of the F₁ generation in Japan. By examining the serum for certain isosymes, he may be able to estimate the number of biochemical mutants induced by the radiation exposure to the parents. The early studies that were done by Neel and Schull necessarily used somewhat cruder endpoints. Dr. Dunham, from the National Academy of Sciences, Dr. Neel, Dr. Edington, and Mr. Whitnah from the DBM staff recently visited Japan to explore the possibility of initiating these studies. The Advisory Committee to the NAS for ABCC last spring approved the proposed research. Approval is also required from the Japanese National Institute of Health before such work can be initiated. The JNIH approved a pilot study only, which would be limited to presently stored blood samples from the cytogenetic studies and any blood that is collected routinely for other purposes can also be used. There are approximately 1000 samples stored and the present rate of collection is about 1500 samples a year.

Dr. Neel visited Kyoto University and the University of Tokyo as well as some other schools to talk especially with Japanese biochemists to try to interest them in the project. They seemed enthusiastic and would undoubtedly become involved in the study. A pilot program to conduct this research is presently being set up. About \$50,000 from an existing contract with Dr. Neel will be used in FY-1972. They hope to have the equipment and three technicians ready to operate by the first of July. Current budget thinking is for about \$100,000 in FY-1973. By July 1974, they hope to have the approval to go into a full scale study.

Dr. Bruner, Assistant Director of DBM, reported briefly on the Second White House Conference on Aging.

The Committee then went into executive session. Dr. Burr reported that the article in the November 5, 1971, issue of Science concerning Rocky Flats had distressed the Commission. The matter was discussed with Dr. Larson, of the Commission. Drs. Bair and Goldstein outlined a couple of possible articles on plutonium which might be written and published in

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some suitable journal to give a more balanced view of the hazards. Drs. Langham and Hempelmann had sent a letter to the editor of Science pointing out that there had been a very long follow-up of the small sample of persons exposed at the Los Alamos Scientific Laboratory. (As of the first of March 1972, however, this letter to the editor has not been published.) Dr. Burr asked the committee's advice on whether some attempt should be made to rebut the article that had appeared in Science. Dr. Moseley felt that a point-by-point rebuttal was not a good idea. He felt that the Division of Biology and Medicine had shown good foresight in anticipating problems with plutonium and that a point-by-point rebuttal would simply drag out the controversy. Dr. Haagen-Smit expressed considerable displeasure with the editorial policy of Science. Science is the official publication for the American Association for the Advancement of Science and a very small group of staff writers has been writing biased articles of various sorts which do not necessarily reflect the views of the membership of the AAAS. Dr. Moseley pointed out that only the previous week they had written a very biased article on the value of chest x-rays. Dr. Moseley was of the opinion, however, that on the basis of a meeting he had had with the people from Rocky Flats, that perhaps some of the criticism might be justified. Dr. John Totter pointed out that the management had been changed at the Rocky Flats plant and he considers this an indication that the Division of Military Application recognizes some possible deficiencies in the earlier management. General Giller, from the Division of Military Application, apparently still does not understand that the Division of Biology and Medicine does not have a program in Rocky Flats and is unable to help to the extent that General Giller expects. The studies at Colorado State University represent the first DBM work that involves Rocky Flats in any way. Dr. Lincoln pointed out that only last fall was there a meeting of medical directors from various AEC installations to consider the treatment of plutonium exposure. At the present time, treatment is on a piece meal basis and Dr. Lincoln feels that better coordination is required. Dr. Goldstein replied that at the present time he is attempting to collate information from the various plants and is attempting to obtain the opinions from the industrial physicians on best methods of treatment and for action levels which determine when treatment should be instituted. Research is continuing on the effectiveness of DTPA, a chelating agent which presently seems to be the best method of treatment.

The discussion then turned to the question of the size of the work force at Rocky Flats that might have had significant exposures to plutonium. Many of these employees have since been terminated. Dr. Burr pointed out that the plant is sufficiently new that social security numbers could be obtained to determine whether the terminated work force is living or dead and a crude estimate of whether there was a significant hazard could be obtained. Dr. Totter pointed out that one of the problems faced by DBM has been a lack of any central coordination concerning the plutonium problem within the entire AEC. To rectify this situation, a committee was named with George Kavanaugh as chairman. Membership of the committee crossed divisional

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lines so that there was a potential for a very useful exchange of information. Unfortunately, Dr. Kavanaugh died shortly after being named committee chairman and it will probably be necessary to start over. Dr. Totter suggested that the Advisory Committee might wish to comment on this problem in its letter to the chairman. Dr. Totter felt that a scientist with a good knowledge of the biomedical aspects of plutonium toxicity should be attached to the General Manager's office to coordinate all the plutonium activities within the Commission. The Division of Military Application apparently is being more cooperative with DBM than it has in the past, largely because of the very fine impression Dr. Richmond made while he was attached to the DBM staff. Dr. Totter reiterated his opinion that there is a strong need for better training programs for people who are going to work with plutonium. He feels that at the present time they are inadequately trained and are not sufficiently aware of the hazard.

The committee then returned to the question of whether it would be advisable to have a carefully documented and well balanced article published on the plutonium problem. Dr. Finch thought that if a good article could be written, that Scientific American might be a good place to submit it.

Members of the DBM staff at this point left the meeting and the committee considered its nominees for the Lawrence Award. Its final decision was that its first choices were Drs. Howard Adler from Oak Ridge and Dr. Marvin Goldman from the Davis Laboratory. The committee expressed no preference between these two. Dr. Spar from the University of Rochester was the committee's third choice.

The Minutes of the 139th and 140th meetings were approved as distributed.

The next meeting will be held at the Argonne National Laboratory on May 5-6, 1972.

The committee adjourned at 11:45 A.M.

Respectfully submitted,

John B. Storer, M.D.
Scientific Secretary
Advisory Committee for Biology
and Medicine

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