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March 23, 1955

Dr. Paul W. McDaniel
Office for International Conference
U. S. Atomic Energy Commission
Washington 25, D. C.

Dear Dr. McDaniel:

I am enclosing herewith abstracts of the work done at our Radiological Laboratory and in the University Hospital with radioiodine. Dr. Earl R. Miller, a Professor of Radiology in our school and a member of the staff of the Radiological Laboratory and its predecessor, since 1945 has done what I consider some of the best work with radioiodine and thyroid physiology and pathology. would

I can highly recommend this work to you. I can also assure you Dr. Miller makes an excellent impression on audiences whether large or small and would be an excellent representative of the United States at this Geneva Conference.

I realize that these abstracts are late, but when we made out our previous abstracts we limited them largely with work of the synchrotron and forgot the extensive work that has been done under our Atomic Energy Commission contract with radioiodine.

Yours sincerely,

Robert S. Stone, M. D.
Director

RSS:jp
Enc.

Note: Ruth has extra copies of all these abstracts!
gp

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March 29, 1955

Dr. Paul W. McDaniel
Office for International Conference
U. S. Atomic Energy Commission
Washington 25, D. C.

Dear Dr. McDaniel:

Our work in the Radioiodine Laboratory is described briefly in the abstracts for three papers which are enclosed.

I would be happy to present any of these papers as indicated in the abstracts, or I would be happy to try to condense all three into one paper covering the entire subject if that would be more agreeable to you.

Sincerely yours,

Earl R. Miller, M. D.
Professor of Radiology

ERM:jp
Enc.

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Position in Typical Agenda: No 1, No 2

Title: The Use of Radioiodine in Determining the Function of the Thyroid

Author: Dan H. Miller, M.D., Professor of Radiology
Chief, Radioisotope Section
Radiological Laboratory
University of California
School of Medicine, San Francisco

Iodine is taken up in the thyroid conjugated with protein and built into the thyroxine molecule, the thyroid hormone, which regulates the rate of practically all body functions. An assessment of thyroid function demands that the rate of iodine uptake and its elevation, and the thyroxinemia and the effect of the hormone on the body all be determined. My work in the Radioisotope Laboratory, which was started in September of 1949, has been wholly concerned with these determinations.

For several years the thyroid uptake of radioiodine has determined over a period of seven days and several of the uptake were plotted. Most the studies were carried out with a group of treated subjects and on a large number of patients with recently discovered thyroid function determined clinically. These data were correlated with the protein-bound iodine determinations which established a quantitative estimate of thyroid function. The rate of radioiodine uptake in the thyroid during the first five hours after the administration of radioiodine had no high correlation with thyroid of TM, function or any other determination values. As a consequence, therapeutic, early rates of uptake have been used over a period of some years as a measure of the intake of iodine into the thyroid in patients with secondary hyperthyroidism. Studies on the effect of previous radioiodine treatment, the same thyrotoxicosis on the uptake curve, were made at intervals after treatment. Eight weeks after treatment of thyrotoxicosis the patient may be well clinically. In this case the uptake curve is almost always within normal limits. If the patient is still ill, the curve may be above normal limits at the first, third,

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and fifth hours. In these cases the patient tends to remain thyrotoxic. However, in certain patients still clinically thyrotoxic the curve may be above normal at the first hour determination but within normal limits at the third and fifth hour determinations. These patients become euthyroid between the eighth and twelfth weeks. This effect on the uptake curve is similar to that seen after administration of thiourea derivatives and suggests that I^{131} radiation interferes with both the uptake and the binding of iodine in the thyroid.

The interference with the uptake of iodine by the thyroid because of the administration of stable I^{127} in the form of Lugol's solution and the rate of escape from this effect were studied. These studies showed that the uptake curve returns to its "pre-Lugol's" level within seven days after the cessation of the Lugol's medication.

Radioiodine uptake curves for a large group of hypothyroid individuals showed a good correlation between the clinical level of hypothyroidism and the low rate of radioiodine uptake. Three hours after the administration of I^{131} it was shown that no patients diagnosed as having hypothyroidism had uptakes greater than 10 per cent and no euthyroid individuals had uptakes less than 2 per cent of the administered radioiodine.

Studies were carried out to determine the effect of thyroid stimulating hormone (TSH) on the uptake of radioiodine. Following the administration of TSH, it was shown that the normal individual had a moderate increase in I^{131} uptake, and individuals with primary hypothyroidism showed a relatively small increase in uptake, whereas those with primary hypopituitarism with secondary hypothyroidism showed a very marked increase in uptake. The amount of increase in uptake following TSH, therefore, was used to help differentiate those individuals with primary from those with secondary hypothyroidism.

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Position in Topical Agenda: M. 1, M. 2

Title: Radioiodine and Cancer of the Thyroid

Author: Ruth E. Miller, M.D., Professor of Radiology
Chief, Radioiodine Section
Radiological Laboratory
University of California
School of Medicine, San Francisco

Radioiodine has been used for the study and treatment of cancer of the thyroid in the Radioiodine Laboratory of the University of California Hospital since 1945. Here only those patients with widespread metastases not surgically removable or occupying too large a volume to be treated with external radiation are candidates for study and possible treatment by radioiodine. Patients treated in the laboratory had monthly, complete evaluations of general clinical status, peripheral blood, and the function of thyroid, liver, and kidney. The uptake of the radioiodine in the metastatic tumors and the urinary excretion of radioiodine were determined. Bone marrow studies were made at frequent intervals.

The results of these studies show that approximately 10 per cent of the patients who entered the laboratory for study were amenable to treatment by radioiodine. The effect of the administration of large doses of radioiodine was determined on the tumors and on the liver, kidney, thyroid, bone marrow, and peripheral blood. These studies showed that there was considerable hemopoietic and thyroid gland injury but no detectable permanent injury of kidney or liver.

Criteria for palliation from radioiodine treatment were established, and it is evident that a quite good degree of palliation was achieved in patients whose tumors took up radioiodine.

Correlated with the study of the effect of radioiodine on cancer of the thyroid was a study of the histologically recognizable effects of radiations

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[illegible] and Cancer of the Thyroid

on various kinds of thyroid tissue. Test-retest studies were carried out to [illegible] the certainty with which tracer effects could be determined. In those tissues in which the effects of radiation were certain, the radiation effects were described.

Apparatus was developed with particular attention to the problem of collimation of scintillation counters for the purpose of determining the content of radioiodine in [illegible] [illegible] the [illegible] as a normal [illegible] as a [illegible] [illegible]. The manner with which [illegible] [illegible] the administration of [illegible] [illegible] the [illegible] [illegible] [illegible]

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[illegible] for the Treatment of Thyrotoxicosis
and Some Phases of Heart Disease

Position in Topical Agenda: M. 1, M. 2

Titles: The Use of Radioiodine for the Treatment of Thyrotoxicosis and Some Phases of Heart Disease

Author: Earl R. Miller, M.D., Professor of Radiology
Chief, Radioiodine Section
Radiological Laboratory
University of California
School of Medicine, San Francisco

The patient showing evidence of thyrotoxicosis may have a nodular thyroid or a diffusely hyperplastic thyroid gland. The success with which patients with thyrotoxicosis can be treated by means of the administration of radioiodine has been so marked that in many areas it has become the treatment of choice for patients with a diffusely hyperplastic and hyperfunctioning thyroid gland.

Since September, 1945, we have been vitally interested in the most effective methods of treatment of hyperthyroidism, the determination of the proper dosage for the treatment, and the follow-up of patients treated. At first, empirically chosen small doses were given at frequent intervals. Next, we attempted to deliver to the thyroid a radiation dose of 6000 β reps. In this study, thyroid uptake curves of the test dose were made over a period of seven days. The number of β reps delivered to the thyroid from the test dose was calculated. The amount of radioiodine required to give a dose of 6000 β reps was then calculated, administered to the patient, and the uptake curve of the therapy dose was determined over a period of seven days. A comparison of the calculated and the actually administered therapy dose in β reps showed that frequently there was a large difference between them, dependent upon the differences in the maximum uptake and the biological half-life of the radioiodine as determined for the test and the therapy doses. It was further determined that the size of the dose as determined in β reps had a rather poor correlation with the

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[illegible] for the Treatment of Thyrotoxicosis and Some Phases of Heart Disease

clinical result. The data were recalculated and it was shown that if the dose was 110 microcuries per gram of thyroid, 90 per cent of the patients required retreatment; if it was 140, some of the patients developed hypothyroidism following administration of the first dose. Consequently, 120 microcuries per gram of thyroid was chosen as the most effective dose. A series of patients were treated on this basis. These, in turn, were compared with those who were treated on the basis of the 6000 γ rap dose. It was shown that the results were essentially equal in the two methods of treatment and that the latter was much simpler than the former.

Follow-up studies have been continued on the first 175 consecutive patients with hyperthyroidism treated in this laboratory. The follow-up period now extends up to 10 years following the treatment of the first of these patients. Of these patients, 189 were relieved of hyperthyroidism. Four of the patients were lost to follow-up while still [illegible] 1 died while still hyperthyroid but not from the radioiodine treatment or the thyrotoxic; 1 could not be evaluated. Two patients had recurrence and 18 developed hypothyroidism.

Certain patients with angina pectoris, cardiac failure, or intermittent claudication were treated with radioiodine to reduce the thyroid function and therefore the load on the heart. Some of these patients have had dramatic reduction in their symptoms thereby. In a completely stabilized control period, other measures did not succeed in alleviating their symptoms. It was found that marked relief could be obtained in some patients without producing myxedema. This is in significant contrast to the results obtained by other workers who have tended to reduce thyroid function to a much lower level than is done in our series.

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ON PEACEFUL USES OF ATOMIC ENERGY

UNITED STATES ATOMIC ENERGY COMMISSION
WASHINGTON 25, D. C.

April 14, 1955

ADDRESS REPLY TO:
OFFICE FOR INTERNATIONAL CONFERENCE
U. S. ATOMIC ENERGY COMMISSION
WASHINGTON 25, D. C.

IN REPLY REFER TO:
M.6-837

Robert S. Stone, M. D.
Director, School of Medicine
Radiological Laboratory
University of California Medical Center
San Francisco 22, California

Dear Dr. Stone:

The purpose of this letter is to invite you to prepare a paper on

Radiation Injury and Protection
— Maximum Permissible Exposure Standards

for submission to the United Nations as part of the U. S. contribution to the International Conference on the Peaceful Uses of Atomic Energy, August 8-20, 1955. Your abstract covering this paper is to be submitted by us to the United Nations to be published. The abstracts will be retyped in this office in suitable form for submission. If any modifications or additions in the text are required, please send them to us within the next week.

As you know, Rule C of the Conference states that the papers to be presented at Geneva will be selected by the Secretary-General of the United Nations with the advice of his Technical Advisory Committee. We understand, however, that all papers which we submit to the United Nations will be published in the Proceedings of the Conference. The paper should, therefore, be written to cover adequately the subject matter without regard to the length of the oral presentation for which it might be the basis. It is intended that material submitted for the Conference not be previously published, but there is no objection to subsequent publication elsewhere. It is likely that we will not be informed before June which papers have been selected by the U. N. for presentation. Shortly thereafter this office will finally select the composition of the U. S. delegation. With regard to authorship we suggest either individual or joint authorship, as you may judge appropriate. In case your paper surveys or includes the work of others which should be acknowledged, please follow the form indicated on the sample title page in the attached "Instructions for Preparing Papers for the International Conference on the Peaceful Uses of Atomic Energy". As you will see, these instructions also specify in detail the format for papers, which should be followed strictly, since reproduction for the Proceedings will be directly

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ON PEACEFUL USES OF ATOMIC ENERGY COMMISSION

from the manuscript. Manuscripts, addressed to Dr. Paul W. McDaniel in this office, must be received by May 20, 1955. Please refer to the abstract number above.

Papers for the Conference must be prepared so as to be unclassified according to the general outlines specified in the new Declassification Guide. If you foresee classification problems and do not have access to the Guide in your own organization, please contact the Director of Classification, AEC, Washington 25, D. C.

A title list of other papers which are being invited for the same sessions as yours is also attached.

Sincerely yours,

G L Weil

George L. Weil
Technical Director

P. S. Please excuse the form letter. I'm sure you appreciate the problems that necessitate its use.

Hope to see you again after these years.

Best personal wishes.

George

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SESSION M.5: GENETIC EFFECTS (INCLUDING THE FIELDS OF BOTANY AND ZOOLOGY

(3 Hrs.)

TITLE	AUTHOR	ORGANIZATION	ABSTRACT
How Radiation Changes the Genetic Constitution	H.J. Muller	Indiana U.	754
Genetic Effects of Radiation in Mice and Their Bearing on the Estimation of Human Hazards	W.L. Russell	ORNL	531
Genetic Differences in Longevity and Disease Resistance in Animals Under Irradiation	J.W. Gowen	Iowa State	266
The Relation Between Radiation Dosage and Chromosomal Changes	Norman Giles	Yale Univ.	842
The Genetic Structure of Mendelian Populations and Its Bearing on Radiation Problems	Bruce Wallace	L.I. Bio. Lab.	753
Radiation Effects on Cells: Genetics or Physiology	E.L. Powers	ANL	618

SESSION M.6: RADIATION INJURY AND PROTECTION

(3 Hrs.)

Commentary on the Modes of Radiation Injury	A.M. Brues	ANL	620
Studies on Protection by Treatment Before & After Exposure to X and Gamma Radiation	Alexander Hollaender	ORNL	513
Radiation Injury & Protection - Maximum Permissible Exposure Standards	R.E. Stone	U. of Calif. Med. Center	837
Radiation Exposure Experience in a Major Atomic Energy Facility	H.M. Parker	GE Hanford	58
Transportation of Large Quantities of Radioactive Materials	Hanson Blatz	LASL	727
Industrial Hygiene of Uranium Processing	M. Eisenbud W.B. Harris	NYOO	726
Lymphocytem with Biddbed Nuclei as Indicators of Radiation Exposures in the Tolerance Range	M. Ingram	ANL	309

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TITLE	AUTHOR	ORGANIZATION	ABSTRACT
Hazards to the Embryo and Fetus from Ionizing Radiation	Liane Branch Russell & W.L. Russell	ORNL	512
The Association of Irradiation With Cancer of the Thyroid in Children and Adolescents	D.E. Clark	Argonne Center Hosp.	219
Beta Lesions of the Skin	R.A. Conrad, et al	Navy Med. & Res. Inst.	22
The Delayed Toxicity of Radium Deposited in the Skeleton of Human Beings	R.J. Hesterlik	Argonne Center Hosp.	211
A Formulation of the Relation Between Radiation Dose and Shortening of Life Span	H.A. Blair	Univ. of Rochester	305
Validity of Maximum Permissible Standards for Internal Exposure	R.C. Thompson, et al	GE-Hanford	75
Reduction of Mortality From Whole Body X Irradiation in Rabbits by Pre-Treatment with Antipyratics and Bacterial Vaccines	G.V. Taplin, et al	Univ. of Calif.	233
Permissible Exposure to Ionizing Radiation	L.S. Taylor	NBS	26
Health Protection in Chemical Processing Plants	H.M. Parker J.M. Smith	GE-Hanford	66
The Effect of Noncellular Preparations on Survival After Lethal Doses of X Radiation	E. Goldwasser W.F. White	Univ. of Chicago	213
Maximum Permissible Concentration of Radioisotopes in Air and Water for Short Periods of Exposure	K.Z. Morgen, et al	ORNL	557
Is the Concept of "Critical Organ" Valid in Determining the Maximum Permissible Level for Exposure to Radioactive Materials	J.N. Stannard	Univ. of Rochester	316
Early Radiation Death	K.C. Bruce H.L. Andrews	Nat'l Inst. of Health	155
Internal Emitters and Tumor Induction	M.P. Finkel	ANL	616
Effect of X-Irradiation on Fat Metabolism	J.C. Goniglio, et al	Vanderbilt U.	169

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TITLE	AUTHOR	ORGANIZATION	ABSTRACT
Relative Biological Effectiveness	G.D. Adams H.I. Kohn R.S. Stone	U. of Calif. Med. Center	743
Irreversibility of Damage Produced by Alpha Emitters	J.N. Stannard, et al	Univ. of Rochester	317
Studies on the Biological Basis of Radiosensitivity	T.N. Tahmissian	ANL	705
Relationship Between Electrolytes & Radiation Effects on Cell Metabolism	J.N. Stannard, et al	Univ. of Rochester	315
Modes of Acute Radiation Death	Henry Quastler	Univ. of Illi.	194
Biological Effects of Fast Neutrons & Gamma Rays	J.W. Clark, et al	ANL	619
Studies on Hyperferremia Following Acute Whole Body X-Irradiation	T.J. Haley, et al	Univ. of Calif.	232
The Potentiated Lethal Action of Radioisotopes Used in Combination	H.L. Friedell	Western Reserve	444
Effects of Whole Body Exposure to Nuclear Energy on Life Span and Efficiency Throughout Life	J.W. Gowen	Iowa State	267
Effects of Daily Low Doses of X-Rays on Spermatogensis in Dogs	G.W. Casarett J.B. Hursh	Univ. of Rochester	303
The Deposition of Radioactive Substances in Bone	F.E. Hoecker	Univ. of Kansas	808
Medical Care of Wounds Contaminated With Radioactive Materials	A.J. Finkel	ANL	706
Data on Maximum Permissible Exposures to Polonium	D.S. Anthony	Mound Lab.	423
Mechanism of Uranium Poisoning	H.C. Hodge	Univ. of Rochester	319
Health Protection of Uranium Miners and Millers	S.E. Miller	Public Health Service	157
Radiation Dosage to Lungs From Radon & Its Daughter Products	W.F. Bale Jacob Shapire	Univ. of Rochester	455
Approaches to Treatment of Poisoning By Elements, Both Radioactive and Non-Radioactive, Encountered in Atomic Energy Operations	Jack Schubert	ANL	704

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Robert S. Stone, Professor of Radiology, Director of Radiological Laboratory, Chairman of Department of Radiology, University of California School of Medicine, San Francisco 22, California.

Born: Chatham, Ontario, Canada, [redacted]

Son of: [redacted] and [redacted] ([redacted]) [redacted]

Married: [redacted]

Children: [redacted]

Education: B. A., 1919, University of Toronto
M.A., 1922, University of Toronto
M.B. (Tor) 1924
M.D., 1928
Intern, Grace Hospital, Detroit, Mich., 1924-25

Appointments: Assistant in Anatomy, Peking Union Medical School, Peking China, 1919-21
Assistant Radiologist, Grace Hospital, and associate of Rollin H. Stevens, Detroit, Mich., 1925-28
Instructor in Radiology, University of California School of Medicine, 1928-29
Assistant Professor, University of California School of Medicine, 1929-32
Associate Professor, University of California School of Medicine, 1932-38
Professor, University of California School of Medicine, 1938-present
Chairman, Department of Radiology, University of California School of Medicine, 1940-43, 1946-present
Director, Radiological Laboratory, 1952-present
Leave of absence, 1942-46, to serve as Associate Project Director for Health, Metallurgical Project (atom bomb), University of Chicago
Visiting Professor of Roentgenology, University of Chicago, 1942-46
Member, National Advisory Cancer Council, U. S. Public Health Service, 1946-48
Consultant, National Advisory Cancer Council, U. S. Public Health Service, 1949
Member, Committee on Growth, National Research Council, 1952-present
Member, International Commission on Radiological Protection, 1953-present

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Member, National Committee on Radiation Protection, 1946-present
Member, Radiological Safety Advisory Committee to California State Disaster Council

Society memberships: Fellow, American College of Radiology
Fellow, American Medical Association
Diplomate, American Board of Radiology
Member and Past-President, Radiological Society of North America
Member, California Academy of Medicine
Member, American Roentgen Ray Society

Honorary memberships: Society de Cancerologica de Guadalajara
College of Physicians of Philadelphia
Philadelphia Roentgen Ray Society
Royal Society of Medicine (Radiology) London, England

Honors: Medal for Merit for wartime work on Metallurgical Project (atom bomb), 1946
Gold Medal of the Radiological Society of North America, 1946
Janeway Medal, American Radium Society, 1947
Carman Lecturer, Radiological Society of North America, 1951
Medal of American Cancer Society for Cancer Control, 1953

Author of articles on: Diagnostic and therapeutic radiology, including neutron therapy and use of radioisotopes;
Maximum Permissible Doses of Radiations
Health protective activities of atomic energy projects
Editor of "Industrial Medicine on the Plutonium Project", Vol. 20, Series 4, National Nuclear Energy Series

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MAXIMUM PERMISSIBLE EXPOSURE STANDARDS

by

R. S. Stone

It is hardly necessary to demonstrate to this audience the harmful effects of radiations on the skin of the human body. However, for the benefit of the non-medical and non-radiological delegates here I thought it best to present a few graphic illustrations of what can happen when proper precautions are not taken.

SLIDE 1 shows the acute reaction on the fingers of a girl improperly treated for warts. Note the redness, swelling and peeling skin. All of these are common to the effects of sunburn but as you all know ~~the~~ x-rays are ~~more~~ penetrating and the changes are much deeper than you can see. The tissues of this thumb and finger will never return fully to normal during the life-time of the person.

SLIDE 2 shows the legs of a girl who was given repeated treatments to remove hair. The treatments were given at intervals of several months and were never large enough to cause visible changes except for the falling of the hair three to four weeks after the treatments. The end result however is seen in the blotchy scarred appearance of the skin. If you could feel that skin you would find it very dry and hard. Remember at no time did she get enough x-rays to make visible changes.

SLIDE 3 shows the fingers of a radiologist after years of work using fluoroscopes and radium. Note the ridged nails, the red

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sore, the dry scaly wart-like structures and the drawn appearance of the skin. These changes developed gradually, starting years after he began his work.

SLIDE 4 shows the hands of an old doctor who worked with a fluoroscope for over 30 years. He had not seen any changes until the last 5 or 6 years before this picture was taken. Note the ulcerated area which is a cancer that had developed because of somatic changes in the skin.

SLIDE 5 Such changes as you have just seen are not new. They have been known since shortly after Roentgen announced the discovery of x-rays. (Refer to Table I, p/89)

SLIDE 6 The idea that there was a dose level that could be tolerated was slow in evolving even though protective shields ~~and other devices~~ were used even by Roentgen himself.

(Refer to Table II, p/89)

SLIDE 7 The most commonly used measure of dose of x-rays prior to the adoption of the roentgen as a unit was that amount necessary to cause the human skin to turn red, a very crude and very variable measure. However by calculating backwards we can estimate with a fair degree of accuracy what the dose would have been in roentgens, for the various tolerance doses that were established (Refer to Table III, p/89)

LIGHTS - Up to now I have been speaking of a "Tolerance Dose" because it was thought that there was a dose that might be tolerated by the human body without any change. Now it is known that "any amount of radiation, no matter how small,

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causes some changes. For this and other reasons it was decided to change the expression to Permissible ~~Exposure~~ DOSE and to define the maximum permissible dose as "a dose of ionizing radiation that in the light of present knowledge is not expected to cause appreciable bodily injury to a person at any time during his lifetime". It was necessary to further define "appreciable bodily injury " as "any bodily injury or effect that a person would regard as being objectionable and/or competent medical authorities would regard as being deleterious to the health and well-being of the individual". The fact that man is and always has been bombarded by cosmic rays and the radiations from naturally occurring radioactive elements sets a lower inescapable limit of about 10 mr per week. The upper limit - or maximum permissible dose must be based mainly on observations ~~made~~ on man since 1895, and it must be remembered that prior to the 1940's there was no widely used accurate personnel or area monitoring. Prior to the development of relatively accurate film badges and of various types of ionization chambers for personnel monitoring it was common practice to use blood counts as a method of monitoring. The National Committee on ~~Protection~~ Radiation Protection of the U.S.A. made a careful study of the value of blood counts and reached the following conclusions.

~~BLOOD COUNTS~~

~~Statement of~~
~~National Committee on Radiation Protection~~

1. Provided that radiation monitoring of personnel, and

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where applicable of sites, is carried out by instruments (film badges, pocket meters, etc.) in all circumstances involving potential exposure to penetrating ionizing radiations, blood counts should no longer be required as a METHOD OF MONITORING.

2. Blood counts as a part of pre-employment, interval, and terminal examinations are good medical practice - to be done at the discretion of the medical officer in charge - but not as a part of a monitoring service.

3. Blood counts are a necessary part of the medical examination of anyone over-exposed to penetrating ionizing radiations."

Experimental work using short-lived animals is very difficult to translate to long-lived humans especially when we know already that many deleterious changes do not show up for twenty or thirty years. We also know that many acute reactions take just as long a time to appear in a mouse as in a man. We cannot therefore use times proportional to the lives of the two species.

We can however gain much valuable knowledge from controlled experiments on man and animals. I have attempted to put together in the form of tables some of the results that have been reported.

SLIDE 8 (Refer to Table IV, P/89). In Column 1, I have put down the total dose per week but in most instances the dose was received in either 5, 6 or 7 equal daily increments.

Note that whereas Mayneord and Sievert both report blood

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changes detectable as averages of groups - but not as individuals, for doses of 100 mr, namely 1/3 of the maximum permissible dose, Pearlman and Sacher were unable to find significant changes in individuals or in groups receiving up to 600 mr per week, namely twice the current ~~M.P.D.~~ Maximum Permissible Dose. but ~~the~~ equal to the then accepted M.P.D. Also note that no significant changes in animals are reported here at doses below the presently accepted maximum of 300 mr/week.

SLIDE 9 (refer to Table IV, P/89 - middle portion)

This slide shows us that we need to go to doses of the order of from 1 times to 20 times ~~level of from 2 x to 20x~~ the maximum permissible dose to detect positive changes.

LIGHTS

In a previous slide you saw that the sperm count of dogs was slightly reduced by 500 mr per week. Two recent surveys of radiologists and, as controls, pathologists, in North America, show that the exposed group reported more offspring than the unexposed group. While many factors are involved, at least a loss of fertility of those occupationally exposed was not demonstrated.

In the short time allotted for this oral presentation much has been left unsaid. The problem of genetics and permissible exposure ~~is~~ has been covered in other papers. For more complete discussions of this whole subject I would refer you to the Recommendations of the International Commission on Radiological Protection which was recently published as Supplement #6 to

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the British Journal of Radiology and to Handbooks 52 and 59 of the National Bureau of Standards of the U.S.A.

CONCLUSIONS

No better conclusion to the above review can be given than that of the International Commission on Radiological Protection, 1950: "While the values proposed for maximum permissible exposures are such as to involve a risk that is small compared to the other hazards of life, nevertheless in view of the unsatisfactory nature of much of the evidence on which our judgments must be based, coupled with the knowledge that certain radiation effects are irreversible and cumulative, it is strongly recommended that every effort be made to reduce exposures to all types of ionizing radiations to the lowest possible level".

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