AD 654793

RADIATION AND INFECTION

AN ANNOTATED BIBLIOGRAPHY

Supplement I

May 1967

Compiled by:
RICHARD D. STONER

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Medical Research Center,
Brookhaven National Laboratory,
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Prepared for:
Commission on Radiation and Infection; Armed Forces Epidemiological Board;
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Washington, D.C.

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INTRODUCTION

Radiation and Infection, an annotated bibliography, was issued initially in May, 1965. The present issue, Supplement 1, May, 1967 contains a total of 261 abstracts and 73 cross references of the published literature concerning the effects of ionizing radiation on infections and immune mechanisms. The bibliography covers the period of December 1964 through March 1967. Abstracts are also included of earlier papers inadvertently omitted in the initial review. The majority of the abstracts in the present bibliography are from the Russian literature as well as from other countries in Eastern Europe. Many of these papers are now available for the first time in the original or as translations. Abstracts of this literature are included, even though the papers pre-date the period covered by the present bibliography.

The abstracts are arranged in categories as shown in the Table of Contents. A single abstract is given for each report or article. The principal subject matter of the report determines the category arrangement. When more than one category is concerned in an article, cross references indicate the category where the abstract is located.

In preparing the abstracts the following specific factors were included when sufficient information was given in the original article: source of radiation, dose rate, total radiation dose, partial or whole-body exposure, time of irradiation in relation to challenge with infectious agents and/or antigens, route of administration, animals, sex, special methods employed and principal conclusions of the author. Modified authors' abstracts were used occasionally. Abstracts of articles are included which could not be obtained in the original. The source of these abstracts is cited.

The following reference sources were used in the search of the literature: Biological Abstracts, Book Catalog of the Research Library of Brookhaven National Laboratory, Chemical Abstracts, Current List of Medical Literature, Excerpta Medica, Quarterly Cumulative Index Medicus, Index Medicus, Nuclear Science Abstracts, TID-3098 Biology and Medicine (TID-4500, 28th Ed.), Biological Effects of Ionizing Radiation (TID-3097), Scientific and Technical Aerospace Reports, and United States Atomic Energy Commission Unclassified Documents.

ABBREVIATIONS

c:	curie
cm:	centimeter
ccm:	cubic centimeter
gbw:	gram body weight
H:	Holzknecht Unit (1 H equals 125 r or 1/3 SED)
i.a.:	intra-abdominal
i.c.:	intracranial
i.cer.:	intracerebral
i.cut.:	intracutaneous
i.d.:	intradermal
I.D.:	infective dose
i.m.:	intramuscular
inj.:	injection
i.p.:	intraperitoneal
kg.:	kilogram
kv:	kilovolt
kvp:	kilovolts peak
LD:	lethal dose
lf:	flocculation unit
mc:	millicurie
uc:	microcurie
mev:	million electron volts
MLD:	minimum lethal dose
r:	roentgen
rad:	unit of absorbed dose
rem:	roentgen equivalent man
SED:	skin erythema dose (1 SED equals 600 r)
s.c.:	subcutaneous
X:	Kienbock Unit (1 X equals 60 r)

ACKNOWLEDGMENTS

Grateful acknowledgment is made to Majorie Comstock, reference librarian, of the Research Library for invaluable assistance in the search of the literature and to Marilyn Galli and Carol Beckner for assistance in the collection of the original reports and articles. Grateful acknowledgment is also made to Stephen J. Amoretty of the Research Library for translating many Russian articles and to Sarah Swan for secretarial assistance.

ABBREVIATION	RUSSIAN TITLE	ENGLISH TRANSLATION
Acta. Virol.	Acta Virologica (Czechoslovakia)	Virological Records
BEBM	Byulleten Eksperimentalonoy Biologii i Meditsiniy	Bulletin of Experimental Biology and Medicine
DAN, SSSR	Diklady Adademii Nauk, SSSR	Reports of the Academy of Sciences, USSR
Gig. i San.	Gigiyena i Sanitaryiya	Hygiene and Sanitation
IAN, Arm. SSR	Izvestiya Akademii Nauk, Armyanskoy SSR, Seriya Biologicheskikh i Selskokhozyaystvennykh Nauk	News of the Academy of Sciences, Armenian SSR, Biological and Agricultural Sciences Series
IAN,SSSR	Izvestiya Akademii Nauk SSSR, Seriya Fiziologii	News of the Academy of Sciences, USSR Physiology Series
Med. Prom., SSSR	Meditsinskaya Promyshlennost, SSSR	Medical Industry, USSR
Med. Rabot.	Meditsinskiy Rabotnik	Medical Worker
Med. Radiol.	Meditsinskaya Radiologiya	Medical Radiology
Mikrob.	Mikrobiologiya	Microbiology
Ref. Zhur. Biol.	Referativnyi Zhurnl--Biologiya	Abstract Journal--Biology
Tr. Kharkovsk. Med. Inst.	Trudy Kharkovskogo Meditsin Skogo Instituta	Works of the Kharkov Medical Institute
Vest. Mosk. Univ., Ser. Biol.	Vestnik Moskovskovo Universiteta, Seriya Biologii	Herald of the Moscow State University, Biology Series
Vest. Rentgenol. i. Radiol.	Vestnik Rentgenologii i Radiologii	Herald of Roentgenology and Radiology
Vest. Ven. i Derm.	Vestnik Venerologii i Dermatologii	Herald of Venereology and Dermatology
Vopr. Virus.	Voprosy Virusologii	Problems of Virology
VMZ	Voyenno-Meditsinskiy Zhurnal	Military Medical Journal
ZhMEI	Zhurnal Mikrobiologii, Epidemiologii i Immunologii	Journal of Microbiology, Epidemiology and Immunology

REVIEWS

BOCHE, R.D.
Radiation and susceptibility to infection. (A Literature Survey).
AD-108849 (1954)
Source of abstract: TID 3098, Book 2: 1113, No. 9296 (Sept. 1963)

A survey was made of the literature on the relationship between immune processes and radiation exposure. Topics discussed in detail include the invasion of the irradiated animal by bacteria normally present in the environment or gastrointestinal tract, the influence of irradiation on susceptibility to infection by organisms introduced from outside, the effect of various doses of radiation on immunity, reaction mechanisms involved in the susceptibility of irradiated animals to infection, the response to antibiotic treatment of infections associated with radiation injuries, and the relationship between exposure time and the introduction of antigen or infective agent on the processes of immunity and susceptibility in irradiated animals. 269 references.

BURNAZYANA, A. I. and A. V. LEBEDINSKOGO
Radiation medicine.
(Feb. 23, 1965) Transl. into English of the book "Radiatsionnaya Meditsina" Moscow, Gos. Izd. Lit. po At. Nauke i Tekhn., 1963.
(FTD-TT-64-1058/1+2; AD-613585
Source of abstract: STAR (NASA) 3:2481, No.N65-25775 (Aug. 8, 1965)

Discussed are the following topics: physics and dosimetry of ionizing radiation-natural radioactivity and cosmic rays, calculation on tissue dosage, radiation emanating from the human body, metabolism of radioactive isotopes, elimination of radioactive isotopes, and other studies; pathophysiology of radiation affections-effects of ionizing radiation and their characteristics on the various body organs and systems; infection and immunity in irradiated organisms-antibody production and suppression of infections; toxicology of radioactive substances-distribution, dynamics, and elimination of radioactive matter; pathologoanatomy of radiation affectations-acute and chronic forms of radiation sickness, and injuries caused by radioactive substances; chemical protection against ionizing radiation-primary physiochemical processes and chemical protectors and their mechanisms; symptomatology and treatment of radiation sickness-therapy of acute and chronic radiation sickness; and acute radiation damage to tissue-therapy of radiation burns.

BUSTAD, L. K. and R. O. MCCLELLAN
Swine in biomedical research.
Proceedings of a Symposium at the Pacific Northwest Laboratory, Richland, Washington, July 19-22, 1965. CONF-650708
Source of abstract: NSA 21:230, No. 1834 (Jan. 31, 1967)

Seventy-nine papers are included that discuss various aspects of the use of standard domestic swine and miniature swine in biological and medical research. Data are included on the anatomy, physiology, nutritional requirements, genetics, diseases and disease control, and the care and handling of swine used for research studies. The development of several strains of miniature swine is discussed. Results are included from studies on the acute mortality response and recovery from radiation injury in swine following

whole-body exposure to x-radiation; late effects observed in swine exposed to mixed neutron-γ irradiation; the response of the skin of swine to x radiation; the comparative effects of β irradiation on the skin of swine, sheep, and rabbits; and the toxic effects of ingested ^{90}Sr, Pu, ^{144}Ce, ^{147}Pm, or Pu deposited on the skin of swine. Author and subject indexes are included. (1237 references).

DODGE, H. and L. SMITH
The effect of space flight factors on central nervous system functions.
(ATD-66-99; TT-67-60029; AD-642186)
Source of abstract: STAR (NASA) 5:652, No. N67-14961 (March 8, 1967)

The report summarizes 16 articles which concentrate heavily on the isolated and combined effects of acceleration and radiation on mammals. Titles are as follows: effect of radial accelerations on brain temperature; effect of centrifugation on otolith function; effect of vibration on cerebrospinal reflexes; effect of vertical vibration and noise on conditioned reflexes; changes in cerebral bioelectricity and oxygen metabolism; effect of vibration and analyzer exclusion on brain metabolism; cerebral oxygen metabolism, bioelectricity, and conditioned reflex activity during vibration; respiratory changes during vibration; x-ray effect on cerebral venous flow; comparative effect of neutron, proton, and gamma irradiation (300 rad); comparative effect of neutron and gamma irradiation (25 rad); comparative effect of neutron, proton, and gamma irradiation (150 rad); comparative effect of chronic and acute gamma irradiation and nervous acitivity; effect of prolonged gamma irradiation on vestibular function; combined effects of vibration and chronic irradiation on vestibular function; combined effects of vibration and ionizing radiation on conditioned reflexes.

INGRAM, M.
Biological effects of ionizing radiation.
(An Annotated Bibliography) TID-3097 U.S. Atomic Energy Commission
(Dec., 1966)

An extensive annotated bibliography covering the years 1898 - 1957. (With 12,726 references). The years 1958 - 60 are covered in TID-3098 Biology and Medicine.

KAMALYAN, L.A.
The effect of ionizing radiation upon virus infections.
Vopr. Radiobiol. 2:225-36 (1961) (In Russian)
Source of abstract: NSA 18:2661. No. 19747 (June 30, 1964)

A review is given of the investigations made by Russian and other scientists dealing with the effect of ionizing radiation upon the origin, course and development of immunity in the case of virus diseases. Some data on immediate influence of various types of radiation upon viruses are also presented. On the basis of analysis and generalization of the literature data, an attempt was made to determine certain peculiarities of the course and immunogenesis of virus infections in an irradiated organism and to outline

some tendencies in studying the problem of ionizing radiation and virus infections. The importance of application of radiobiological methods in solving some vague aspects of antivirus immunity is also emphasized.

KLEMPARSKAYA, N. N.
Immunobiological reactivity of the irradiated organism.
Med. Radiol. 3:85-90, No. 3 (1958)
JPRS Trans. L-581-N, CSO:1749-N

The author presented a general review of radiation-induced repression of immune mechanisms. Emphasis was given to changes in immunological reactivity after irradiation that are similar to changes observed in starvation, avitaminosis, pregnancy, silicosis and mustard gas. The primary difference between these situations is that after irradiation there is a disruption in the cpapcity of the animal to accept antigen while in the other pathologic states the action is on the formation of the responsive reaction to the stimulus which depends upon the functional adequacy of all of the physiologic systems of the animal.

KLEMPARSKAYA, N.N., N.V. RAYEVA and V.F. SOSOVA
Antibacterial immunity and radioresistance.
(Transl. into English from the book "Antibakterial'nyy Immunitet i Radioezistentnost" Moscow, Medgiz, p 1-118 (1963)
Source of abstract: STAR (NASA)2:2515, No. N64-26722 (Sept. 23, 1964)

Immunological mechanisms, the reaction to autoantigenic substances, play an important role in the development of radiation sickness. It is possible to prevent the development of this reaction by immunological methods, one of which is vaccination. The administration of foreign antigens causes a complex reaction in which the nervous system and endocrine systems participate. After the initial symptoms of stress, Selye's alarm reaction, a prolonged characteristic reaction develops on the part of certain cellular elements, primarily the cells of the reticuloendothelial system and the plasmatic and lymphoid elements. The phagocytic functioning of the microphages and macrophages is activated. As a result of the specific change in gloubulin synthesis, immune bodies begin to develop not only to the antigen in question, the microbe, but also to tissue decomposition products. If vaccination is carried out before irradiation, immunity to the agent in question is not only maintained after exposure to ionizing radiation, but the course of the radiation sickness contracted is considerably altered. Vaccination conducted after irradiation does not have this effect on radioresistance. Two possible ways in which prophylactic vaccination may influence radioresistance are discussed.

MAKINODAN, T. and N. GENGOZIAN
Effect of radiation on antibody formation.
Radiation Protection and Recovery (A. Hollaender, Editor)
Pergamon Press, N.Y., P.316-351, (1960)

This paper presents a review of the effect of radiation on antibody formations (with 132 references). The following topics are dealt with: site of

antibody formation, theories of antibody formation, temporal relation between antigen injection and irradiation, secondary antigen injection, antibody responses during maximum depression after varying x-ray doses, effect of radiation on the recognition factor of antibody-forming cells, modification of the immune mechanism of irradiated animals and lethally x-rayed isologous mice and in vivo tissue cultures of antibody-forming cells. In summary, the work described indicates that (1) x-irradiation does not permanently destroy the immune mechanism of an animal; (2) during the maximum depression period, a curvilinear relation exists between x-ray dose and antibody response; and (3) x-rays damage the mechanism for recognizing and responding to the genetically more closely related antigen more severely than it does for such a mechanism for a distantly related antigen. Futhermore, it was found that x-irradiation can become a powerful tool for investigating the complex processes involved in antibody formation. On the cellular level in a normal animal, the events from antigen assimilation to antibody synthesis are not clearly known. The complex morphology of antibody-forming organs, with their ever-present nonantibody-forming hematopoietic cells, may be partly responsible. It is now feasible to observe cellular changes in a more innocuous background by merely transplanting known numbers of isologous nonsensitized antibody-forming cells into mice exposed to a lethal dose of x rays.

MICKLEM, H. S. and J. F. LOUTIT
Tissue grafting and radiation.
American Institute of Biological Sciences and U.S. Atomic Energy Commission Monograph Series on Radiation Biology. New York, Academic Press (1966)
Source of abstract: NSA 20:3797, No.31120 (Sept. 15, 1966)

The field of transplantation immunity and tolerance is reviewed and the various ways in which the two diciplines of radiation biology and transplantation are used together to study problems of immune reactions and radiobiology are described. The effects of x-radiation on the rejection of homografts and the subsequent humoral antibody formation are discussed with emphasis on the underlying cellular events. A detailed discussion of radiation chimeras is included and the establishment and survival of chimeras and the use of chimeras to study the potentialities of injected cell populations carrying abnormal marker chromosomes, hematological, and immunological problems are described. Recent progress in clinical organ transplantation and clinical uses of radiation and immunosuppressive drugs is reviewed. Techniques of chromosome analysis are described. Author and subject indexes are included. (735 references)

PETROV, R.V.
Immunology of acute radiation injury.
(JPRS-18620, OTS 63-21545 (April 9, 1963)
Source of abstract: STAR (NASA) 2:288, No. N64-11829 (Feb. 8, 1964)

An english translation of a book "Immunologiva Ostrogo Luchevogo Porazheniya", Moscow, Gosatomizdat.
Contents:
1. First part: The effect of radiation on antimicrobial immunity.
2. Second Part: Infectious processes in the irradiated organism.
3. Third Part: Noninfectious immunology of radiation sickness.

PETROV, R.V.
First part: The effect of radiation on antimicrobial immunity.
JPRS-18620, OTS-63-21545 (April 9, 1963)
Source of abstract: STAR (NASA) 2:288, No. N64-11830 (Feb. 8, 1964)

The antimicrobial immunity against infections in radiation sickness is so markedly impaired that susceptibility is increased not only to infection with pathogenic but also to conditionally pathogenic microorganisms. This increase in the sensitivity of irradiated animals occurs several days (on the average, three) after the effect of the ionizing radiation and lasts for 2 to 6 weeks or even longer, depending on the dose of radiation, species of animal, and the nature of the infectious process. If the infectious process is characterized by a progressive or prolonged course, the increased sensitivity of the organism to the pathogen of this infection is demonstrable when infection is carried out simultaneously with irradiation. Increased sensitivity observed from the infection of irradiated animals is an integral index of the injurious effect of radiation on immunity. Also, an analysis of the radiation on various immunity factors is presented.

PETROV, R.V.
Second part: Infectious processes in the irradiated organism.
JPRS-18620, OTS-63-21545 (April 9, 1963)
Source of abstract: STAR (NASA) 2:288, No. N64-11831 (Feb. 8, 1964)

Endogenous and exogenous infections in the irradiated organism are reviewed. The section on endogenous infections covers: (1) sources of endogenous infections: (2) times of the occurrence of bacterial invasion: (3) the role of endogenous infection in the pathogenesis of radiation sickness, and (4) principles of antibotic therapy in acute radiation sickness. The section on exogenous infections covers: (1) characteristics of the course of the infections: (2) the activating effect of irradiation on a latent infectious process: (3) the effectiveness of active and passive immunization: (4) the characteristics of infectious processes in leptospirosis, gas gangrene and tetanus: and (5) the effectiveness of various types of therapy on gas gangrene and tetanus.

PETROV, R.V.
Third part: Noninfectious immunology of radiation sickness.
JPRS 18620, OTS-63-21545 (April 9, 1964)
Source of abstract: STAR (NASA) 2:288 No. N64-11832 (Feb. 8, 1964)

This review covers discussion of the following:(1) the antigenic properties of the tissues of irradiated animals: (2) C-reactive protein and radiation sickness: (3) reactions of the irradiated organism to tissue antigens: and (4) the study of the effect of immunization sera on the tissues of irradiated animals.

PETROV, R. V.
Current trends in radiation immunology.
Uspekhi Sovremennoy Biologii (Progress of Modern Biology) 58:262-271 Moscow (Sept.-Oct. 1964) Transl. JPRS 28-016, pages 50-63 (1964)

A review paper with 47 references. Radiation immunology, like most of the modern scientific disciplines, is undergoing intensive evolution. As information accumulates new approaches for research appear, and the main trends and interests of radiation immunologists are changing. There have been major changes particularly within the last three to five years. While in the past, seven or eight years ago, the main trends of research in the field of immunology were associated with investigation of the influence of ionizing radiation on antibacterial immunity and infection, at the present time the new trends are not related to these problems. There has been a vast increase in work devoted to problems of noninfectious immunology including transplantation immunity and those associated with the transplantation to irradiated animals of hemopoietic tissue, utilization of radiation chimeras as in vivo cell cultures for the study of general immunological patterns on the cellular level.

PRITULIN, P.I.
Effect of ionizing radiation on infection and immunity.
Veterinariya, No. 12, 9-11 (1965) (In Russian)
Source of abstract: NSA 20:5545, No.45457 (Dec. 31, 1966)

Original work and literature on the changes in immunobiological reactivity of organisms subjected to ionizing radiation are discussed. The protective barrier functions of the organism are suppressed and permeability is disturbed so that in the second phase of radiation sickness the irradiated animals are susceptible to infections. Inflammatory reactions are distorted, phagocytic activity of leukocytes is decreased, and the humoral medium of the organism is changed. The gamma-globulin titer is reduced while the alpha- and beta-globulins are simultaneously increased. Barrier-functioning properties of lymphatic nodes and subcutaneous connecting tissue as well as allergic and anaphylactic reactions of the cells are weakened or eliminated in irradiated animals.

RANDOLPH, M. L.
Medical and biological effects of ionizing radiations.
Nucl. Safety, 7:476-81 (Summer 1966)
Source of abstract: NSA 20:5539, No. 45410 (Dec. 31, 1966)

Some aspects of current studies on biological effects of ionizing radiations are reviewed to give a sense of the experimental bases for appraisals of the hazards of exposure to radiations. Subjects treated briefly through references to recent literature include delayed somatic effects, biological dosimeter, reduction of fertility, relative effects of different types of radiation, dose rate and fractionation, and effects of small doses. Authoritative reviews and references to biologically useful applications of ionizing radiations are cited. Physical aspects, historical background, and additional active fields of radiobiology are indicated.

RUSSOUW, S. F.
Radioisotopes and radiation in helminthology.
PEL 130, Atomic Energy Board, Pelindaba, Republic of South Africa.
(Oct. 1966)

An annotated bibliography (with 87 references) on the use of isotopes and radiation in helminth diseases in man and laboratory animals. The literature reviewed covers the period 1948 to mid-1966. The majority of the papers deal with the use of ionizing radiation to attenuate various stages of parasites so they can be used to elicit immunity in experimental animals.

SEMENOV, L.F. and L.A. YAKOVLEVA
Comparison of radiation sickness characteristics in various species of mammals, including primates.
Vestn. Akad. Med. Nauk SSSR, No. 9, 11-13 (1965 (In Russian)
Source of abstract: NSA 20:4955-6, No. 40694 (Nov. 30, 1966)

The literature is reviewed, and experimental data are presented on acute radiation sickness in mice, rats, guinea pigs, rabbits, dogs, and monkeys. Irradiations were carried out with the RUM-3 x-ray machine and a ^{60}Co source (70 to 110 rad/min). Data on the effects of total and localized irradiation (abdomen and head) in monkeys (1650 to 25000 rad) and the survival time (in hrs) are given. The disruption of the leukopoiesis mechanism accompanying acute radiation sickness is described. Information on infectious diseases (gingivitis, pneumonia, enteritis and colitus) with which the various animals were affected (in addition to acute radiation sickness) is presented in tabular form. It is concluded that radiation sickness in humans most closely resembles that in monkeys.

SHECHMEISTER, I. L.
Susceptibility of irradiated animals to infection.
Rad. Res. 1:401-409 (1954)

A review of studies concerning increased susceptibility of irradiated animals to experimental infections. The diversity of susceptible animal species tested, as well as the variety of etiologic agents used is described. Increased susceptibility after irradiation is shown not only to many pathogenic bacterial, viral, fungal, rickettsial, helminthic and protozoan agents, but also to ordinarily harmless, common inhabitants of the gastrointestinal tract, such as Escherichia coli and Proteus spp., which became pathogenic and induce fatal infections of the irradiated host. The effects of radiation that may contribute to increased susceptibility are numerous, including such factors as (1) lower peripheral granular leucocyte and lymphocyte counts, (2) suppression of bone marrow and lymphatic tissue elements, (3) inhibition of antibody production, (4) altered activity of the fixed and wandering phagocytic cells, and (5) the impairment of lymphatic blockade and of the screening action of liver and spleen. To determine which of these mechanisms, or what combination of them, may be responsible, it is important to establish quantitative relationships between two factors-the degree to which irradiation affects susceptibility to infection and the post-irradiation time interval required for such susceptibility to reach a maximum.

SHILOV, V.M.
The epidemiolgical significance of a disturbance of immunity during affection by ionizing radiations.
Veonno-Med. ZH. 11:29-33 (1962)
Source of abstract: NSA 17:4266, No. 31977 (Oct. 15, 1963)

A decrease in the resistance of the organism to infection during radiation sickness occurred as a result of disturbance in cellular (a decrease in the phagocytic capability of the leucocytes and the cells of the reticulo-endothelial system) and humoral immunity (a decrease in the bactericidal properties of blood as a result of inactivation of properdin, a serum protein with bactericidal properties). The development of autoinfection in radiation sickness cannot be explained by the increase in the permeability of the mucosae, as these phenomena frequently do not correspond in time. Inborn immunity evidently remains essentially unchanged under the effect of radiation sickness. A disruption of artificial immunity was manifested by an almost complete cessation of antibody formation. A disruption of processes of immunogenesis occurred only when antigen was introduced into the organism after irradiation (vaccination performed after irradiation has an unfavorable effect on the course of radiation sickness). If radiation affects a process of immunogenesis already begun almost no decrease in antibody elaboration is observed.

SIMIĆ, M., V. S. ŠLJIVIĆ, M. Ž. PETROVIĆ, D. M. ĆIRKOVIĆ
Antibody formation in irradiated rats.
Bulletin of the Boris Kidric Institute of Nuclear Sciences
Supplement 1, 16:1-151 (Dec. 1965)

A review of long-term experimental work carried out at the Laboratory of Radiobioloby, Boris Kidric Institute of Nuclear Sciences on the effects of x-radiation on antibody formation in rats. The studies were directed to: (1) primary and secondary hemolysin responses to sheep erythrocytes, (2) whole-body irradiation, (3) irradiation of exteriorized spleen and, (4) protection and restoration of immunological capacity in irradiated animals. Most of the experimental results have been noted earlier in "Radiation and Infection" (An Annotated Bibliography, May 1965)

STONER, R. D., M. W. HESS and V. P. BOND
Radiation and infection. (An annotated bibliography)
(Issued May, 1965) Armed Forces Epidemiological Board

An annotated bibliography of the world's published literature from 1908 through December 1964 concerning the effects of ionizing radiation on infections and immune mechanisms. A total of 819 abstracts and cross references are arranged in the following subject categories: reviews, viral infections, rickettsial infections, bacterial infections, mycotic infections, protozoan infections, parasitic infections, susceptibility to toxins, susceptibility to tumor viruses, antibody responses, hypersensitivity reactions, cellular defense mechanisms, nonspecific serum factors, treatment and prevention.

TIUNOV, L. A.
Prophylaxis of radiation injury by means of combinations of therapeutic agents.
Voyenno-Meditsinskiy Zhurnal, No. 7, p.55-60 (1960)
JPRS:7432, CSO:1374-N/32

A review of the various chemical protective agents and therapeutic agents being explored for prophylaxis of radiation injury. The authors emphasized that practical results are too few and the combined use of several drugs requires a study of the effect of their action when employed in combination. Analysis of the data in the literature leads the author to conclude that the development of effective antiradiation recipes is possible on the basis of a combination of typical sulfhydral preparations. It is proposed that the task for future research is one of developing agents of a low degree of toxicity along with a high degree of effectiveness.

TROITSKIY, V. L. and TUMANYAN, M. A.
Vliyaniye ioniziruyushchikh izlucheniya no immunitet.
(The effect of ionizing radiations on immunity)
Meditsinskaya Radiologiya 4:91-93 (1959)
JPRS:L-926-N, OTS:59, 13,816.

A critical review of the book by Troitsky and Tumanyan is presented by P. N. Kiselev and Al. A. Smorodintsev. Research of the authors is presented as well as findings from the published literature. The book deals with theoretical and practical problems of modern radiobiology, immunology and infectious diseases. It was recommended by the reviewers that microbiologists and radiologists would find this book of great interest. The short comings and disputable theories contained in it do not detract from its overall good impression created in the reader (according to Kiselev and Smorodintsev).

WEGENER, K, H.
Radioaktivitaet und veterinaermedizin. (Radioactivity and veterinary medicine).
Berlin and Hamburg, Verlag Paul Parey, 1966. 228p.
Source of abstract: NSA 21:390, No.3449 (Feb. 15, 1967)

On the basis of a literature survey, the basic information on radioactivity and radiation of interest to the veterinarian is compiled. The sources and types of natural and artificial radiation are outlined. The radioinduced damage that can occur in animals is described. The use and elimination of radio-injured animals are discussed. The risks involved for the user of contaminated food are considered. Methods and techniques used for environmental monitoring are outlined. The effect of ionizing radiation on food of animal origin, protection of food, and radiopreservation of foods of animal origin are discussed. The use of radioisotopes in veterinary research and practice is reviewed. The principal provisions of atomic and radiation laws are reviewed. (254 references)

Effect of ionizing radiation on the central nervous system.
(A-AC-82/R.211 and Add. 1 and 2)
(United Nations Scientific Committee on the Effects of Atomic Radiation).
(May 1966)
Source of abstract: NSA 21:225, No.1793 (Jan. 31, 1967)

Data on the effects of ionizing radiation on the central nervous system are reviewed. Topics discussed include the mechanism of the action of ionizing radiation on neurons; radiation effects on the developing nervous system in embryos and fetuses and on the nervous system in young and in mature animals; the effects of radiation dose, acute or whole-body exposure on the nervous system; clinical symptoms indicating nervous system involvement in acute radiation sickness; the radiosensitivity of the cerebral hemispheres, the hypothalamus, and the spinal cord; the action of radiation as a general non-specific stimuli; and the participation of the nervous system in reactions of the entire organisms or of its specific systems, especially the gastrointestinal tract, hematopoietic system, endocrine glands, regulation of functions of the gastrointestinal tract, alteration of tissue trophics, and alterations in the permeability of blood vessel membranes. (499 references).

VIRAL INFECTIONS

ADACHI, T. and K. SAKAMOTO
Radiation effects on Friend virus disease. Part I.
(Tokyo Medical & Dental Univ.). Bull.Tokyo Med.Dent.Univ.,12:97-108
(March 1965)
Source of abstract: NSA 21:389-90, No.3439 (Feb. 15, 1967)

Effect of x-irradiation of mice injected with Friend virus was studied. This disease is characterized by enlarged spleen and appearance of abnormal cells in the peripheral bloodstream. It was established by injecting Friend virus intraperitoneally in mice of the dd strain. In control, 80% of mice with Friend virus disease died within 100 days. To study the irradiation effects on the process of this disease, whole-body x-irradiation was employed, and enlargement of spleen, mortality, and histological findings were observed. Single and fractionated irradiations were used. Single irradiation doses of 500, 300, and 200 r, fractionated irradiation of 500 r total dose in 5 and 10 days, and 300 r total dose in 3 and 6 days were given. The influence on mortality was almost negligible except in the single 200 r dose group. The suppressive effects on splenomegaly, however, were marked in all irradiated mice, especially with the single 500 r irradiation. The spleen of mice with Friend virus disease showed a marked increase of atypical cells in red pulp and normal structure was no longer seen. This change was most prominent on the 7th day after inoculation of virus. Irradiated specimens showed suppression of these changes in accordance with dose.

CLAPPER, W. E., A. SANCHEZ and J. LEVY
Immune response to a secondary stimulus with *Leptospira canicola* and infectious cannine hepatitis in beagles exposed to SR^{90}.
LF-29 Biology and Medicine (AEC)
TID-4500 (47th ed.) (June, 1966)

(See section A for abstract)

KAMALYAN, L.A.
The course of a smallpox vaccinal process and the formation of antismallpox immunity in rabbits due to the effect of x-irradiation.
Vopr. Radiobiol. 2:142-52 (1961) (In Russian)
Source of abstract: NSA 18:2659, No. 19737 (June 30, 1964)

A study of smallpox vaccination in rabbits, previously irradiated with an x-ray dose of 700 r, showed that the course of the process grows worse, the duration of the local reaction becomes extended, the disease spreads and some of the animals die. A repeated infection of the rabbits (cutaneous and cerebral) showed that the intensity of antismallpox immunity is lower in irradiated animals than in nonirradiated ones in both primary and secondary immunization.

KAMALYAN, L.A.
The effect of ionizing radiation upon virus infections.
Vopr. Radiobiol. 2:225-36 (1961) (In Russian)
Source of abstract: NSA 18:2661. No. 19747 (June 30, 1964)

(See section R for abstract)

MIESZKUC, B. J. and A. M. SHEFNER
Susceptibility to infection in irradiated animals.
U.S. Army Medical Research & Development Command
Report No. IITRI-L6018-8 (June 1966)

(See section B for abstract)

MOROZ, A. G.
The effect of ionizing radiation on the reproduction of the virus of epidemic parotitis in white mice and guinea pigs.
Voprosy Virusologii 9:66-72 (1964)

Animals were given .03 ml allantoic culture containing 320-640 hemagglutinating units of parotitis virus (Ender strain) by intranasal inhalation 48 hours after 300 r of x-irradiation. Animals were sacrificed over a period of 2-10 days. Lungs, liver, spleen, brain and blood were assayed for virus by injection into the amniotic cavity of 8 day chick embryos. Amniotic fluid was examined for hemagglutinins 8 days later. Virus multiplication was found only in the lungs and in greater amounts than in irradiated animals. The virus was pathogenic for guinea pigs but not for mice (measured by mortality). The experiments were complicated by a spontaneous infection of unspecified etiology which increased hemagglutinins non-specifically.

PINDAK, F. F., J. F. STARA and W. E. CLAPPER
Response to secondary antigenic stimulus after whole body x-irradiation in the beagle.
LF-17 Biology and Medicine (AEC) ITD-4500 (33rd Ed.) (Sept. 1964)

(See section A for abstract)

POPOVA, O. M and O. N. BEREZINA
The effect of previous x-irradiation on the susceptibility of white mice to infection by ornithosis virus aerosol.
Vopr. Virusol. 9:213-16 (1964)

Mice (7-9g) were irradiated with doses of 200, 300, 400, 500 and 700 r and infected on the 2nd, 5th, 10th and 19th day after irradiation. No great difference in mortality was found when mice were infected on different days after irradiation. Virus was detected in the lungs from the 7th to the 90th day after irradiation in both irradiated and control mice. Pretreatment of albino mice with x-rays enhances their susceptibility to ornithosis virus administered in form of aerosol. This is manifested primarily by a shortening of the incubation period in irradiated infected animals in comparison with controls.

The shortening of the incubation period depends on an x-rays dose, virus dose, and time interval between the irradiation and infection. Ornithosis virus in organs of irradiated infected animals retains longer and reaches higher titres.

REMEZOV, P. I.
Characteristics of the course of some virus infections against the background of radiation injury.
Voyenno-Meditsinskiy Zhurnal, No. 7, p.61-68 (1960)
JPRS:7432, CSO:1374-N/32

The course of several virus infections (lymphocytic choriomeningitis, acute disseminated encephalomyelitis, influenza and tick-borne encephalitis) was studied in x-irradiated mice. Radiation doses of 500, 400, 300, 200, 100, 50 and 10 r, as well as intermittant doses of 10 r (daily) and 0.33 (twice each week) for six months were delivered to white mice. The animals were infected with the various viruses 6 hours before, 6 hours after as well as 7, 21 and 90 days after x-irradiation. In all the viral infections studied the incubation period was shorter in irradiated than in non-irradiated control mice. The signs of disease were seen earlier in irradiated animals. The duration of infections leading to death was less than in control animals. Higher radiation doses led to more severe viral infections. The resistance of the animals was decreased markedly 7 days after irradiation. Intermittant doses of 10 r (daily) also reduced resistance to infection (no data shown to substantiate this point). Prolonged irradiation of mice twice a week (0.33 r) did not alter clinical or virological characteristics of the infections. More animals died in the irradiated groups than in similarly infected control groups.

SCHNECK, L. and S. BERKOVICH
Effects of x-irradiation on susceptibility of neonatal rat brain and muscle to Coxsackie B1 virus infection.
Proc. Soc. Exp. Biol. Med. 118:658-61 (1965)

Unlike adult mouse or rat brain, the immature neural tissues of the newborn animal are highly sensitive to ionizing radiation and susceptible to Coxackie B virus infection. Susceptibility of mature brain is increased following ionizing radiation. This increase has been related to the effects of radiation on antibody production and/or adrenal cortical secretion. Test animals and matched controls were obtained from litters born to rats from an inbred Wistar albino strain. The newborn animals at 2 to 3 days of age were inoculated intraperitoneally with Coxackie virus type B1 24 hours after irradiation. Control animals were treated similarly but were not irradiated. X-rays were delivered at 250 kv at a dose rate of 120 r/minute. A dose of 1080r was given to the head and 430r was delivered to the body. The dose of radiation used was uniformly lethal to the newborn rat. When radiation was given 24 hours prior to infection with Coxsackie B1 virus an immediate increase in the titer of virus was observed in the brain. Six days later a delayed rise was also detected in skeletal muscle harvested from a site distant from the point of maximal irradiation. There is no satisfactory explanation for the delayed effect noted in muscle.

SIVERTSEVA, V. N.
Reproduction of grippe virus in animals subjected to chronic continuous irradiation.
Radiobiology (USSR) (Engl. Transl.) 4:84-8 (1964)

Studies were carried out on the effect of continuous ^{60}Cobalt γ-radiation on replication of grippe virus in the lungs of white mice. The radiation dose rate was 4.8r/24 hours. Mice were infected a few hours after removal from the radiation field. An attenuated virus of grippe "A" (strain 32) was given, by intranasal inhalation. The amount of virus in the lungs was determined by hemagglutination 7 days after infection. Virus was not found in the lungs of control animals whereas considerable amounts of virus were demonstrated in animals given an accumulated dose of 300 r. In another experiment, mice were exposed to 800 r and infected as in the first experiment. When tested 2 and 5 days later the lungs of irradiated mice contained 100-1000 fold amounts of virus particles.

SKLYANSKAYA, Ye. I. and O. P. PETERSON
Cellular shifts in lymph nodes of normal and irradiated animals vaccinated against influenza.
Voprosy Virusologii 9:83-90 (1964)

(See section C for abstract)

SMORODINTSEFF, A. A., JR.
The effect of x-ray irradiation on the course of experimental influenza infection in white mice and rats.
Acta Virologica (English Edition) 1:145-55 (1957)

Whole-body x-radiation was delivered at 190 kvp at 57 r/minute in doses of 25, 100, 300 and 400 r to white mice and 500 r to white rats. The A-32 strain and A1-3711 strain of influenza virus were given by intranasal inhalation from 6 hours to 30 days after irradiation. Susceptibility to infection increased considerably in white mice and rats after irradiation. The survival of virus in the lungs was prolonged by previous exposure to x-rays. Mortality was greatest when mice were infected 3-20 days after irradiation. Preliminary irradiation with doses of 100-500 r depressed the formation of neutralizing antibody for influenza virus. When mice were irradiated with 400 r after two s.c. injections of slightly pathogenic virus the anitbody level of the blood was not depressed, however, a decreased resistance to infection was observed in these animals.

VELLA, P. and T. J. STARR
Effect of x-radiation and cortisone on mouse hepatitis virus infection in germfree mice.
J. Inf. Dis. 115:271-7 (1965)

Swiss-Webster male and female germfree mice (Lobund strain, 21st and 22nd generation) were used. Their ages ranged from 4 to 9 weeks, depending on the experimental procedure involved. Other germfree mice were placed in

cages containing bedding from a conventional colony. First generation progeny of these "ex-germfree" mice constituted the genetically related conventional controls. Water and diet were not sterilized for these conventional mice. The Gledhill strain of mouse hepatitis virus (MHV-1), free of the enhancing agent Eperythrozoon coccoides, was used, Virus stock was prepared from infected livers of conventional suckling mice as 10% suspensions (w/v) in medium 199 with antibiotics. Whole-body x-radiation 200 or 600 r was delivered at 245 Kvp at a dose rate of 40 r/minute. Irradiation preceded the virus challenge by 8 to 96 hours. X-radiation enhanced MHV-1 infection significantly in germfree and conventional mice. Both germfree and conventional mice showed similar susceptibility to a 200 r virus challenge after 7 days (69% vs 70% infection, respectively). Macroscopic liver damage was absent 14 days after challenge in both groups, except for 1 death among the conventional animals. A 600 r-virus challenge induced a greater mortality in conventional mice (64%) than in germfree mice (8%) 7 days after virus challenge. However, after 14 days germfree mice showed a higher mortality (83%) than did conventional mice (54%). The mortality differences after 14 days seem to be more significant, since 15% of 20 conventional controls (600 r) died. None of the 200 r controls died or had macroscopic liver damage. All virus controls failed to show macroscopic liver damge, and all x ray-virus deaths were accompanied by severe macroscopic liver damage. The time interval between virus inoculation and x-ray challenge was not significant.

RICKETTSIAL INFECTIONS

BOCHAROVA, T. V.
Effect of irradiation on immunity in experimental typhus; communication I: immunity in irradiated guinea pigs vaccinated with Rickettsia prowzekii.
Zhurnal Mikrobiologii, Epidemiologii I Immunobiologii; 4:23-26, 1962

Guinea pigs were exposed to 150-200 r and innoculated s.c. with typhus vaccine at varying times after irradiation. Controls consisted of animals vaccinated but not irradiated and irradiated but not vaccinated. Agglutination and CF tests were done at 15-19 and 28-30 days after immunization. Animals were then infected with R. prowzekii using the smallest amount inducing disease in 100% non-immunized animals. Diagnosis of typhus was by febrile response. The serological studies showed no difference in titer in irradiated and non-irradiated animals in animals injected 1-2 hours after irradiation. Titers were lower in groups immunized four days after irradiation. In groups immunized 6-7 days after irradiation no agglutinins appeared but in the latter group CF antibodies did appear although at 1-2 dilutions lower than in control.

FABRIKANT, I. B.
The influence of prior irradiation on host susceptibility to infection with the attenuated E strain of Rickettsia prowazekii.
Thesis, University of Maryland (1966)

Since the attenuated E strain of R. prowazekii induces solid long-lasting immunity against epidemic typhus in man, it has been considered for immunizing large populations under survival conditions following nuclear disaster. The present studies, therefore, have investigated the effects of prior whole-body x-radiation on hosts of graded innate susceptibility to typhus infection to assess whether radiation might lower resistance to rickettsial infection to such an extent that E strain might produce severe infection in the irradiated host instead of the mild or subclinical infection normally observed. The toxic, infective, and immunizing properties of virulent and avirulent typhus strains following intravenous or intraperitoneal inoculation have been compared in Swiss Webster strain albino mice. The virulent Wilmington strain of R. mooseri exhibited lethal toxic, lethal infective, and sublethal immunizing infective properties which were dose dependent. The virulent Brenl strain of R. prowazekii exhibited both lethal toxic and inapparent immunizing infective properties, but no lethal infection was induced. The avirulent E strain of R. prowazekii, however induced lethal toxic effects only. It did not appear to multiply in the mouse as evidenced by approximately equal responses of mice immunized with live or killed preparations of E strain. Thus, any protection due to immunizing action was no greater than that afforded by comparable killed doses. Prior whole-body x-radiation of mice in doses of less than 1 LD_{50} enhanced the lethal toxic action of E strain more than could be reasonably accounted for by chance variation in response. This effect occurred with increased radiation dose and increased interval between irradiation and inoculation with rickettsiae. The increased susceptibility of the irradiated animals to toxic inocula was evident and was not merely a response to the physical trauma of inoculation. Total-body irradiation failed to permit E strain rickettsiae to establish lethal infection even when

relatively large doses of x-radiation were employed (1 LD_{50} or more). The capacity of irradiated mice to develop anti-toxic immunity was reduced as the radiation dose was increased. The response of irradiated mice to inoculation with the virulent Breinl strain of R. prowazekii was similar to that with the E strain. Studies employing the serological response of normal pathogen-free guinea pigs to live and formalin-killed E strain suspensions suggested that E strain normally undergoes limited proliferation in this host. The infection, however, produced no overt signs of illness. The level of natural susceptibility of young guinea pigs to infection with E strain was more comparable to that of man, than was the susceptibility of the highly resistant white mouse. Irradiated (1 LD_{50}) guinea pigs inoculated with a high dose (10^{-2} dilution) or a limiting or threshold dose (10^{-6} dilution) of E strain failed to exhibit consistent body temperature patterns that could be interpreted as host response to radiation-enhanced infection. Inoculation with E strain failed to increase mortality of irradiated animals. Studies of the serological responses of irradiated guinea pigs infected with limiting dilutions of E strain yielded results most readily explained by a partial impairment of antibody formation in the face of somethat enhanced proliferation. It is concluded that sublethal doses of whole-body x-irradiation may enhance slightly the susceptibility of guinea pigs to infection with the attenuated E strain. The resulting infectious process, however, remains at a subclinical level and does not alter the mortality of irradiated guinea pigs. The basis for attenuation of the E strain remains unknown; however, severe interference with host defense mechanisms by whole-body irradiation does not permit the E strain to undergo uncontrolled proliferation in the guinea pig which normally appears to permit a limited amount of proliferation to occur.

OSTROVSKAYA, SH. M. and A. KH. TURSUNOV
The effect of radiation on the level of antibodies and retention of R. prowazekii in animals.
Zh. Mikrobiol. Epidemiol. i. Immunobiol. 121 (No. 12, 1963)

The immunological state and retention of the typhus virus in guinea pigs subjected to x-radiation was studied. Three sets of experiments were carried out: in the first set, the animals were irradiated (400 r) 1-3 months after the typhus infection; in the second, guinea pigs were irradiated (300 r) 16 days after the infection; in the third, they were irradiated (300 r) 3-5 days before the infection. Eleven guinea pigs were used in the first set of experiments. The animals developed an acute leukopenia (1500-2000 leukocytes per mm^3) 5-6 days after irradiation; however, an examination on the 9th day indicated that they had the same agglutinin titer as control animals. The blood of the irradiated guinea pigs was not infective when administered intranasally to mice. Twelve guinea pigs were used in the second set of experiments. Agglutinin titer was checked in them on the 4th and 27th day after irradiation; it was established that no change occurred in agglutinin titer. For 30 days no specific antibodies or rickettsia was observed in the new guinea pigs, which were administered suspension of brain of the irradiated animals. Twelve guinea pigs were used in the third set of experiments. The incubation time and febrile periods were the same for the guinea pigs subjected to irradiation as found in control guinea pigs. On the 24th day the agglutinin titer was

higher in the control animals by 1-2 dilutions than in experimental animals. Injection of a suspension of the brain and spleen of the irradiated animals to 26 new guinea pigs resulted in 2 typhus infections on the 8th and 11th day; on the 28th day their serum agglutination for R. prowazekii antigen reacted in a 1:160-1:320 dilution.

SIDWELL, R. W., B. D. THORPE and L. P. GEBHARDT
Studies of latent Q fever infections. I. Effects of whole body x-irradiation upon latently infected guinea pigs, white mice and deer mice. Am. J. Hyg. 79:113-24 (1964)

The California AD strain of Coxiella burnetii was used in this study. The present study investigates latent infections of C. burnetii in guinea pigs, white mice and deer mice, and describes attempts to reactivate the infections by the use of whole body x-irradiation, known to be a stressor agent which can cause alterations of many of the physiological processes of the body to infection. The Q fever antibody response in these animals and a study of the transmission of the disease agent is also reported. Hartley strain guinea pigs, Swiss mice and laboratory reared deer mice (Peromyscus maniculatus sonoriensis) were used as experimental animals. X-radiation was delivered at 250 Kv at 42/minute. Dosages given in the reactivation experiments were selected to be slightly less than and greater than the LD_{50}. These were termed the low and high doses, respectively. For guinea pigs, these were 100 r and 175 r (LD_{50}: 163 r), for white mice, 300 r and 450 r (LD_{50}: 431 r), and for deer mice, 350 r and 625 r (LD_{50}. 588 r). Whole body x-irradiation in dosages slightly less than or greater than the 21-day LD_{50} caused a definite reactivation of Coxiella burnetii in guinea pigs infected 3 months previously. This reactivation was determined by demonstration of the organism in various tissues and in the urine and feces of these animals, as compared to the detection of few or no rickettsiae in the same tissues from nonirradiated similarly infected control animals. There was no conclusive evidence of reactivation, on the basis of recovery of organisms in deer mice or white mice similarly treated although some evidence of reactivation in white mice was indicated by a transmission of C. burnetii to control mice housed as cage mates with the treated animals. Such a transmission was also observed among the treated guinea pigs, but none could be detected in the deer mice or in nonirradiated control animals. The Q fever antibody responses to phase I and II complement fixation and phase I capillary tube agglutination antigens were determined in the irradiated and control animals, and were shown to vary markedly in titer with animal species, dosage of irradiation and type of antibody.

BACTERIAL INFECTIONS

ABJULLAEV, M.D., A.D. KAZARYAN and A.D. SATTAR-ZADE
The course of staphylococcus focal infection in albino rats at remote periods following total x-irradiation.
Zh. Mikrobiol., Epidemiol. i Immunobiol. 41:107-11, No. 6, (1964) (Engl. Abst.)

Experiments were conducted on 240 male albino rats. Three, six and twelve months after the sustained radiation injury (510 r) the animals were infected according to the following method: a suspension of 24-hour Staphylococcus aureus culture, containing 1 billion organisms per 1 ml was injected into the tissue of both testes (500 million into each testes). To evaluate the course and the severity of the infection the following indices were examined: Blood, the size of microbial focus, time limits of liberation from the organisms, the duration of the disease, generalization of the infection, and mortality rate. The experiments confirmed aggravation of the focal injection following staphylococcus infection 3-6 months after irradiation. Experimental data obtained evidence that immunobiological body reactivity was restored a year after exposure to ionizing radiation. The effect of irradiation on the course of focal infection in rats was reduced when the interval between the time of radiation and the time of infection was extended.

ALLEN, J.R., A.S. HALL and C.F. CHESNEY
Pathologic alterations observed in rhesus monkeys given total-body x-irradiation and bone marrow transplants.
Amer. J. Vet. Res. 27:1103-12 (July 1966)
Source of abstract: NSA 20:4026-7, No. 33071 (Sept. 30, 1966)

Thirty-one Macaca mulatta monkeys were given 700 to 800 R whole body x irradiation. Bone marrow transplants from homologous and heterologous sources were administered to 24 of the monkeys. Regeneration of hematopoietic tissue occurred in more than 60% of the 24 monkeys given transplants; however, only 20% survived for 30 days. There were extensive hemorrhage, anemia, leukopenia, thrombocytopenia, hypergammaglobulinemia, and bactermia in the monkeys that died. The death of those monkeys that died during the 2nd and 3rd postirradiation weeks was attributed to the inability of their defense mechanisms to prevent rapid multiplication of enteric organisms within their tissues. The monkeys invariably died with massive gram-negative bacteremia.

ANDREWS, G. A., B. W. SITTERSON and B. M. NELSON
Infections in patients exposed to total-body irradiation.
Oak Ridge Inst. of Nucl. Studies. Med. Div. Res. Rept. (Dec. 31, 1964)
Source of abstract: STAR (NASA) 3:2478, No.N65-25658 (Aug.8, 1965)

Twenty-six treatments with total-body radiation, 200- to 940-r midbody air dose, were given to patients with late stages of leukemia and malignancy. Half the patients died within 8 weeks and the causes of death are indicated. Infection was the major cause of early death. Among the patients who survived, a variety of infections was encountered. The prominence of gram-

negative infections and fungi is emphasized in this series. Diffuse pulmonary hemorrhage associated with infection was frequent and may be rather characteristic of irradiation injury.

BERGER, H. and LINKENHEIMER, W. H.
Activation of Bartonella muris infection in x-irradiated rats.
Proc. Soc. Exp. Biol. and Med. 109:271-273 (1962)

Albino rats with latent infections of Bartonella muris were exposed to two doses of x-radiation (250 rads each) at 3-day intervals. X-radiation was delivered at 250 kv at a dose rate of 51 rad/min. Carworth CFN Bartonella-free rats were splenectomized and injected i.a. with whole blood from the 3-day post-irradiated rats. The results confirmed earlier reports that x-radiation activates latent bartonellosis in rats to produce fulminating infections.

BUTOVETSKII, L. D.
Effects of x-rays on the orchitis development in rabbits and the antigen property for the reaction of Treponema pallidum immobilization.
Zh.Mikrobiol.Epidemiol.Immunobiol. No.3, 131-4 (March1966) (In Russian)
Source of abstract: NSA 20:3797, No.31119 (Sept. 15, 1966)

Orchitis was enhanced in rabbits exposed to x-ray doses of 350 to 400 R 10 days after infection with the Budapest strain of Treponema pallidum. Antigen quality was best in animals killed 10 to 14 days after infection. In animals given 500 R doses, clinical development of orchitis was inhibited and the antigen contained an insufficient number of treponemata.

DALRYMPLE, G. V., J. J. GHIDONI, H. L. KUNDEL, T. L. WOLFLE and I. R. LINDSAY
Edema: A delayed complication of total-body 32-Mev proton irradiation.
Rad. Res., 28:434-45 (June 1966)
Source of abstract: NSA 20:3794, No.31098 (Sept. 15, 1966)

Severe edema of the head and, to a lesser degree, edema of the anterior abdominal wall and perineum occurred approximately 8 weeks after 32-Mev proton irradiation of Macaca mulatta. A group of 11 primates were irradiated with a large dose of 32-Mev protons (2350 rads); some of the animals were treated with antibiotics in an effort to decrease mortality during periods of acute cutaneous infection. Of the original 11 irradiated animals, the 5 survivors of the acute effects of the radiation developed edema. Several diagnostic studies suggest that increased capillary and/or lymphatic permeability in conjunction with a moderate hypoalbuminemia is probably the etiology of the edema.

DALRYMPLE, G. V., I. R. LINDSAY, J. J. GHIDONI, L. KUNDEL, E. T. STILL, R. JACOBS and I. L. MORGAN
Some effects of whole-body 32-Mev proton irradiations on primates.
Rad. Res., 28:406-33 (June 1966)
Source of abstract: NSA 20:3794, No.31097 (Sept. 15, 1966)

Seventy-six primates (Macacca mulatta) were irradiated with spaced doses of 32-Mev protons (280 to 6700 rads). The highest doses (5200 to 6700 rads) produced severe central nervous system disease with convulsions. Intermediate doses (1440 to 4250 rads) caused marked cutaneous destruction with extensive ulceration and secondary infection. Mortality patterns, blood counts, ^{59}Fe ferrokinetics, clinical manifestations, and histopathological studies showed no evidence of either gastrointestinal or hematological radiation changes. This situation was anticipated, since the average transverse diameter of the primate (10 cm) was considerably larger than the range of the protons (1 cm in soft tissue). Because of the absence of injury to the bone marrow or gastrointestinal tract, mortality was relatively delayed after irradiation. An $LD_{50(80)}$ of 1595 ± 101 (S.E.) rads was estimated from the cumulative mortality data. The postirradiation course of those animals dying from a cutaneous mechanism was in many ways similar to that found following third-degree thermal burns. All survivors (1440 to 1880 rads) had collections of edema fluid which appeared as a delayed finding after the eighth postirradiation week. Lower doses (560 to 990 rads) caused no cutaneous destruction but did produce transient edema. No clinical abnormalities were noted in the lowest dose group (280 rads). Serum lactic dehydrogenase (LDH) and glutamic oxalacetic transaminase (SGOT) levels were markedly elevated following irradiation, the degree of elevation being correlated with dose.

FRETER, R.
Reduction of post-irradiation infections by replacement of the normal enteric flora and by specific immunization.
NYO-2628 1 (1965)
Source of abstract: STAR (NASA) 4:163, No. N66-11696 (Jan. 23, 1966)

Ways to reduce post-irradiation infections were investigated in mice. It was shown very definitely that certain bacteria (such as Pseudomonas) may be eliminated from the intestinal tract by means of the antagonism exerted by certain strains of E. coli which could be established in the intestinal tract of the irradiated animal. Removal of certain species was complete to the point where these bacteria did not cause post-irradiation infection. A continuation of this study concerning the effect of intestinal anaerobes and the antagonism they exert upon other intestinal bacteria indicated that, with the proper combination of antagonistic strains, all invaders of the intestinal tract could be eliminated before they become a problem in post-irradiation infections. While establishment of a strongly antagonistic intestinal flora may eliminate those bacteria which are highly virulent for the irradiated mammalian host (such as Pseudomonas), there is the definite possibility that the antagonistic flora itself may eventually invade the host. This could of course, be minimized by establishing antagonistic strains of very low invasiveness. In addition to this, immunologic protection of the host was considered. While there was no apparent gain in resistance to systemic

challenge infections of lethally irradiated animals after active or passive immunization, there was a significant degree of protection against oral challenge infections after active immunization. The effect of bone marrow transplants and of homologous disease on the susceptibility to infections was also studied. The results showed a surprisingly quick (within 6 days) recovery of resistance to infection, which is only slightly lowered during the presence of hologous disease.

FULTON, J. D. and R. B. MITCHELL
The levels of x-irradiation exposure required to destroy the ability to respond to Salmonella typhimurium antigen.
Texas Reports Biol. Med. 11:431-439 (1953)

Male albino mice (CF-1 strain) were immunized with a single i.a. injection of 3 billion heat-killed S. typhimurium organisms. The antigen was given 3 days after x-radiation doses of 0, 75, 150, 225, 300, 375 or 450 r. Radiation was delivered at 260 Kvp at a dose rate of 55 r/minute. Doses of 375 and 450 r killed 25 and 75 percent, respectively, of the animals. Control and irradiated mice received an i.a. challenge infection of virulent S. typhimurium organisms 6 days after immunization. Exposure to 75 r did not appreciably alter the development of active immunity. X-ray doses of 150 and 225 r destroyed the ability to respond to the single injection of antigen. Higher doses of radiation completely destroyed their ability to respond to the antigen, based on their failure to withstand the challenge dose of organisms.

GAL'CHIKOV, V. I., I. S. SLIZKIY, A. V. TUZIKOV and O. V. SHNYRENKOVA
Tissue acceptance of foreign bodies in radiation sickness.
Voyenno-Meditsinskiy Zhurnal, No. 7, P.94-100 (1960)
JPRS:7432, CSO:1374-N/32

(See section T for abstract)

GONSHERY, L., R. Q. MARSTON and streptomycin-treated x-irradiated mice.
Am. J. Physiol. 172:359-364 (1953)

(See section T for abstract)

HADLER, W. A., L. M. ZITI and W. BECAK
Effect of ionizing radiations on the rate of evolution of murine leprosy.
Intern. J. Leprosy 32:117-26 (1964)

C-strain mice (7 weeks of age) and Wistar strain rats (7 weeks of age) were used in these experiments. The animals were given a single whole-body exposure to beta-gamma radiations from a cesium-barium bomb for 137 minutes to a total dose of 500 r. Control and irradiated animals were given an i.a. challenge of M. lepraemurium 24 hours after irradiation. Several groups of rats (control and irradiated animals) also received 40 mg daily in their

food of 4, 4'-diaminodiphenylsulfone (DDS). Treatment with DDS started 7 days after the challenge infection and continued for 300 days. The results were evaluated on the basis of the appearance of murine leprosy lesions and survival time. Histologic study showed that as a consequence of radiation the resting phase of murine leprosy lesions became shorter and the lesions evolved more rapidly. Correspondingly there was an increase in the rate of evolution of the disease, which was demonstrated by comparison of the mean length of survival of radiated and nonradiated animals inoculated with the same dose of organisims. On the other hand, studies of the generation time average for M. lepraemurium estimated from mice and rats, showed that radiation induced a striking shortening of generation time. DDS treatment appeared devoid of any effect in radiated rats. These results suggest that radiation disturbs the defense system against murine leprosy. The fact that this effect occurs in the absence of any observed alteration in the histologic structure of the murine leprosy lesions, indicated that a disturbance of the humoral defense mechanism had taken place. A defense system alteration would also account for the lack of effect of DDS in radiated animals.

HAMMOND, C.W.
Pseudomonas aeruginosa infection and its effects on radiobiological research.
Lab. Animal Care 13:6-10 (1963)

In an attempt to shed some light on the mechanism by which P. aeruginosa kills irradiated mice so rapidly, mice were exposed to a midlethal dose of radiation. On the 1st. 5th or 11th day after irradiation they were fed $\sim 10^7$ pseudomonads. When pseudomonads were fed on the first day, only 5% died of P. aeruginosa bacteremia, but when pseudomonads were fed on the 11th day, 57-60% died. Unirradiated mice fed 10^7 pseudomonads in the same manner remained healthy during the 30 day period. Bacteriologic culture of the gastrointestinal tract showed that many more irradiated mice retained pseudomonads and in greater numbers than did unirradiated mice. On the third day after inoculation, in about one-third of the irradiated mice they could not be detected. Apparently, large numbers of pseudomonads introduced into the stomach become established and multiply in the upper and lower intestine of irradiated mice while they tend to disappear from the intestinal tract of unirradiated mice.

HAMMOND, C. W.
Bactericidal activity of fixed phagocytes in irradiated and unirradiated mice treated with RNA.
Proc. Soc. Exptl. Biol. Med. 114, 213-15 (1963)

(See section T for abstract)

KEMENES, F.
Leptospira icterohaemorrhagica infection of experimental animals with artifically decreased resistance.
Annales de la Soc. Belge de Medecine Tropicale 46:235-244 (1966)

When guinea pigs are infected with virulent L. icterohaemorrhagica they develop fatal leptospirosis characterized by haemorrhagic jaundice. The

same organism does not cause a clinically manifest disease in adult albino mice, albino rats and rabbits since the leptospires colonize in the kidneys after the septicemic phase due to the fairly rapid appearance of antibody. A decrease in natural resistance was obtained in rats after pretreatment with ethiomine (an antimetobolite of methionine). Natural resistance was broken in mice with 450 r of x-radiation and a combination of ethiomine and 500 r of x-radiation. Exclusively haemorrhogic-type pathological lesions were found in guinea-pigs exposed to 400 r and infected with virulent L. icterohaemorrhagica.

KISELEV, P. N. and P. A. BUZINI
The influence of chronic continuous action of ionizing radiation on immunity.
Med. Radiol. 4, 36-44 (1959) Apr. (In Russian)

Experiments were performed with white mice, rats, guinea pigs and rabbits subjected to ^{60}Cobalt continuous γ-irradiation. The dose rate was 1.2 - 4.3 r per day (24-hour period). The period of observation was 1 1/2 - 2 years. The leukocyte response was studied in all animals. The most pronounced variation in leukocytes occurred in guinea pigs which exhibited the greatest sensitivity to radiation. The death of the animals occurred at different times after exposure and depended on the dose rate and the radiosensitivity of the organism. A lethal dose for mice at a dose rate of 4.32 r/day was 950r, and 1050r for guinea pigs. Autopsy failed to show the characteristic pattern of radiation sickness. The dead animals did not show hemorrhage and the spleen and lymph nodes increased rather than decreased in size. The bactericidal activity of the blood before irradiation and during it was studied under standard conditions with respect to the typhoid bacilli. The variation of the bactericidal activity in the blood as a result of chronic exposure at low dose rates was attributed to the destruction of properdin, rather than complement. The death of the animals as a result of radiation by chronic exposure at low dose rates was totally attributed to autoinfection with the development of septicemia. The strongest disturbance of natural immunity from low radiation doses occurred only in young animals and particularly with radiation delivered during intrauterine development. Experiments conducted with offspring of parents irradiated with 330r (4.32 r/day dose rate) indicated a sharp difference in the sensitivity of the animals to B. Breslau paratyphoid infection with a culture of low virulence. Young mice (10-12g) were more susceptible to infection when they were previously exposed to radiation in utero. Guinea pigs, were irradiated with a 3.5r/day dose rate and immunized with a dead culture of S. typhi abdominalis three months after the start of irradiation and after accumulated radiation doses of 295r and 475r. The irradiated animals produced less antibody than similarly immunized control animals. An experiment was conducted to determine the development of antibodies in white mice. They were irradiated with 150, 350 and 450r (2.96r/day rate). They were immunized with a vaccine of B. dysenteriae (Kruse-Sonne). Antigen was introduced subcutaneously before and during irradiation. Exposure to an accumulated dose of 150r stimulated antibody formation whereas doses of 350 and 450r repressed agglutinin responses slightly.

KLEYTMAN, YE. I.
Certain data on the influence of betaton rays on the natural immunity of white rats to tularemia.
Transactions of the Tomsk Scientific Research Institute of Vaccins and Serums. 11:1-327 (1960)
FTD-TT-63-1082 (Translation) P.400-406 (May 1, 1964)

Adult white rats were given 10 different doses of gamma-rays from a betatron at 25 Mev. (100, 200, 300, 400, 500, 600, 800, 1,000, 1,200 and 1,400 r). A virulent strain (No.6) of B. tularense was given in challenge (route not specified) one and two months and/or 24 and 48 hours after betatron irradiation. All animals died when inoculated 24-48 hours after irradiation. The authors relate the observed increase in susceptibility to the absence of leukocytes. Lethal infections did not occur when animals were challenged 1 and 2 months after irradiation.

KREMLEV, G. I.
The effect of gamma irradiation, thermal burn, and acute loss of blood on the development of tetanus toxicoinfections.
Voenno Med. ZH., No. 11, 29-30 (1963)
Source of abstract: NSA 19:831, No.7162 (March 15, 1965)

(See section T for abstract)

LANGENDORFF, H., H. MELCHING, O. MESSERSCHMIDT and C. STREFFER
Investigations on combined injuries, Part 3. On the efficiency of radioprotective substances for a combination of radiation burden and skin wound.
Strahlentherapie, 2:264-72 (Oct. 1965) (In German)
Source of abstract: NSA 20:861, No. 6878 (March. 15, 1966)

A combination of total-body x irradiation with an open skin wound considerably increased the mortality of white mice 2 days after irradiation. The radioprotective substance serotonin increased the mortality caused by the skin wound. No protective effect was obtained by administration of serotonin in the combination experiment. Histamine, the biogenic amine, decreased the radiation induced mortality, but increased the mortality caused by the skin wound. In a combination experiment, significant protection was obtained with this amine. There was a significant increase in the survival rate by administration of the sulfhydryl substances cysteine or cysteamine in the combination experiment. Cysteine had no influence upon the mortality caused by a skin wound; cysteamine, however, increased the mortality in mice.

LAWRENCE, J. H. and TENNANT R.
The comparative effects of neutrons and x-rays on the whole body.
J. Exptl. Med. 66:667-687 (1937)

A study of the comparative effects of filtered 200 Kv x-rays and neutrons on normal Swiss mice. X-radiation was delivered at 35 r/minute. Neutrons were produced in the cyclotron by bombarding beryllium with 5 million volt

deuterons at 10 micro-amperes. X-ray doses of 700, 800, 900 and 1000 proved to be lethal and neutron doses (in roentgens) of 223, 245 and 298 r also constituted a lethal dose. Irradiation with neutrons led to clinical, bacteriological and pathological findings similar to the findings observed in x-irradiated mice. The mechanism of death appeared to be related to tissue destruction and enterogenous infection.

MARTYNOVA, V. A. and Z. V. BADOVSKAYA
A study of experimental leprosy in irradiated mice.
Zh. Mikrobiol. 41:82-87 (1964) (In Russian)

Radiation sickness was aggravated by the introduction of leprous bacteria. Whole body irradiation was used with doses of 600, 800, 1000 r. One hundred and ninety-seven white mice were used in the experiment. On the 5th day the vascular system of the mice was impaired (acute vasodilatation of the subcutaneous tissue, hyperemia of the inguinal centers, hyperemia of the liver and spleens); on the 7th day the organs and tissues had petechial and focal hemorrhages. Autopsy revealed damages of the vascular system. Mice which died on the 11th day showed acute exhaustion, the subcutaneous tissue had almost disappeared and the liver and spleen was perceptibly decreased in size. The main experiment was divided into two parts and required 114 mice. Twenty four hours after irradiation with doses of 600, 800 and 1000 r the animals were given either a subcutaneous or abdominal infection with leprous bacilli in a saline solution. Abdominal infection insured a longer preservation of the leprous bacilli in the mice than the subcutaneous route. On the next day after infection the external appearance and behavior of the irradiated mice sharply differed from that of the control mice. An appreciable decrease in their mobility was evident, their fur became ruffled and they did not touch their food. Shortly after came an acute exhaustion and some of them died. The most sharp decrease of the natural resistance to the infection occurred between the 3rd and 11th day. During this period of time 6 mice died from the group which was injected subcutaneously after being irradiated with 600 and 800 r, and 9 mice died after irradiation with 1000 r. Between the 23rd and 150th day, 7 more mice died. From the group injected abdominally, 4 mice died from a 600 r dose, 10 mice died from an 800 r dose and 13 mice died from a 1000 r dose. The leprous infection, therefore, accounted for the death of 66 mice. This constituted 49% of the experimental mice.

MEYER, I., G. SHKLAR and J. TURNER
Tissue healing and infection in experimental animals irradiated with Co^{60} and orthovoltage.
Oral Surg. 21:333-340 (1960)

Adult male white rats received single short-term doses of 1,530 r of 200 kv radiation to the right mandible. A similar group of 18 rats received 1,530 r of Cobalt-60 γ-radiation. Two weeks later, surgical procedures were carried out as follows: (1) gingivectomy and bone scraping and (2) pulp exposure. Tissue healing proceded normally in animals irradiated with γ-radiation but healing was retarded in animals exposed to orthovoltage. Two animals developed gingival abscesses but infection was not a significant finding in control and irradiated animals.

MIESZKUC, B. J. and A. M. SHEFNER
Susceptibility to infection in irradiated animals.
U. S. Army Med. Research & Development Command.
Report No. IITRI-L6018-4 (June 1965)

Male Swiss albino Ha/ICR strain mice were used. The animals were exposed to γ-radiation from a high-level cobalt-60 source at a dose rate of 1390 ± 65 rads/hour. Groups of 60 mice were exposed to doses of 100, 300, 500, 700 or 900 rads 1, 3 or 7 days before inoculation i.a. with a virulent strain of B. anthracis (32 s). An avirulent strain (32 r) was also used after similar exposures to γ-radiation. Mortality was significantly higher than could be expected by the independent action of radiation and infection. At low doses of radiation bacterial challenges near the LD_{50} level were needed to produce a combined effect, while at high dose levels only a few challenge organisms produced a pronounced combined effect. The time interval between radiation and infections challenge significantly affects the degree of interaction with a 7 day post-radiation interval resulting in higher mortalities than a 1 or 3 day interval.

MIESZKUC, B. J. and A. M. SHEFNER
Susceptibility to infection in irradiated animals.
U.S. Army Medical Research & Development Command
Report No. IITRI-L6018-8 (June 1966)

Male Swiss albino Ha/ICR strain mice were used in this study. Experiments were performed with high-level Cobalt-60 γ-radiation dose rate (1390 ± 65 rads/hour) and chronic and or periodic irradiation (0.9 rads/hour). Experiments were conducted on the effect of Bacillus anthracis (avirulent Weybridge strain) infection following acute Co^{60} gamma irradiation of Swiss albino mice. A significant combined effect (P = 0.99) was obtained--mortality was higher than that expected from the independent action of radiation or infection--when the mice were exposed to as few as 100 rads. Experiments were conducted on the effect of B. anthracis infection following periodic and/or chronic irradiation. A significant combined effect (P = 0.98) was obtained when the mice were exposed to 150 rads during a 7-day period. Experiments were conducted on the effect of Klebsiella pneumoniae infection following acute irradiation. A significant combined effect (P = 0.97) was obtained when the mice were exposed to 100 rads. Experiments were conducted on the effect of Venezuelan equine encephalomyelitis virus infection following acute irradiation. No combined effect was obtained. A pilot experiment was conducted on the effect of prior irradiation on subsequent challenge with anthrax toxin. Mortalities obtained were greater than that expected from the independent action of radiation or anthrax toxin.

NEBOLYUBOVA, G. YE and N. V. SOKOLOVA
Bacteriological and pathologoanatomical characteristics of experimental acute radiation sickness induced by betatron irradiation at a power of 25 Mev.
Transactions of the Tomsk Scientific Research Institute of Vaccines and serums 11:1-327 (1960). FTD-TT-63-1082 (Translations) p.379-387 (May 1,1964)

The bacterial flora of the mouth and alimentary tract was studied in guinea

pigs prior to and after betatron irradiation. Whole-body irradiation was delivered at 25 Mev at a dose rate 35 r/minute. All of the animals died with 7-10 days after doses of 1800 r and/or 3600 r. E. coli, P. vulgaris, Staph. albus and B. sporogenes were isolated from intestinal contents prior to irradiation. Staph. albus, S. hemolyticus and diplococci were found in oral isolations. The same organisms were found in irradiated animals except in larger numbers. The authors concluded that penetration into the blood increased during the post-irradiation period. The relative slowness in the appearance of generalized bacteremia was thought to be related to the lower efficiency of betatron radiation.

NEMIROVICH-DANCHENKO
A study of certain indices of natural immunity in dogs affected by polonium, under conditions of combined therapy. I. A study of the intestinal microflora. O. R.
J. Microbiol., Epidemiol. Immunobiol. (USSR) (English Translation) 29:1790-7 (1958)
Source of abstract: TID-3098, Book 2, 1126 No. 9396 (Sept. 1963)

The subcutaneous injection of polonium in a dose of 0.05 mc/kg body weight caused severe radiation sickness in dogs. Changes were observed in the intestinal microflora. These included a fall in the number of typical E. coli and an increase in the proportion of hemolytic strains among the intestinal flora, a rise in the number of atypical strains of E. coli, and a rise in the numbers of Cl. perfringens during the first few days of radiation sickness. The institution of combined therapy led to some improvement in the general condition of the animals, increased their survival time, suppressed the development of local inflammatory changes at the site of injection of the polonium and led to the relative normalization of the microflora of the large intestine.

PETROV, R.V.
Exogenous infections in radiation sickness.
Uspekhi Sovremennoi Biol. 46, 48-61 (1958)
Source of abstract: TID-3098, Book 2, 1129, No. 9416 (Sept. 1963)

Increased susceptibility of irradiated animals to pathogenic microorganisms causing infectious diseases was accompanied not only by more severe cases of infection and a higher mortality rate, but also by characteristic symptoms. These characteristic symptoms were not just a combined effect of two patholgical processes, but the result of their complicated interaction.

PETROV, R.V.
First part: The effect of radiation on antimicrobial immunity.
JPRS-18620, OTS-63-21545 (April 9, 1963)
Source of abstract: STAR (NASA) 2:288, No. N64-11830 (Feb. 8, 1964)

(See section R for abstract)

PETROV, R.V.
Second part: Infectious processes in the irradiated organism.
JPRS-18620, OTS-63-21545 (April 9, 1963)
Source of abstract: STAR (NASA) 2:288, No. N64-11831 (Feb. 8, 1964)

(See section R for abstract)

PINDAK, F. F., J. F. STARA and W. E. CLAPPER
Response to secondary antigenic stimulus after whole body x-irradiation in the beagle.
LF-17 Biology and Medicine (AEC) ITD-4500 (33rd Ed.) (Sept. 1964)

(See section A for abstract)

REES, R. J. W.
Enhanced susceptibility of thymectomized and irradiated mice to infection with Mycobacterium leprae.
Nature 211:657-8 (1966)

Since 1960 it has been established beyond doubt that a limited infection with the human leprosy bacillus, Myco-bacterium leprae, can be produced in the mouse foot-pad. Several experimental studies have shown that the multiplication of Myco. leprae is limited, is dependent on the size of the inoculum and is confined to the site of inoculation. For example, inocula of 10^4 Myco. leprae yield 10^6 in 6-8 months, and although smaller inocula may eventually give the same yield, larger ones give no higher yields, and inocula of 10^6 or more fail to multiply significantly. Once the bacterial population in the foot-pad has reached approximately 10^6, it remains steady for many months although there is a gradual increase in the proportion of dead bacilli. Two preliminary experiments were undertaken using twenty-four male CBA mice, twelve of which were thymectomized and later x-irradiated and twelve kept as untreated controls. Thymectomy was undertaken when the mice were approximately 2 months old, and 16 days later they were exposed to 900 r and immediately afterwards transfused with bone marrow from CBA mice in the ratio of one donor to three recipients. Four weeks later the right hind foot-pad of each mouse was inoculated with 10^4 Myco. leprae (counted as acid-fast bacilli). Three groups (normal CBA, thymectomized-irradiated CBA and normal P strain mice) of six mice each were used for each of two strains of Myco. leprae. In these experiments there were, respectively, about ten and a hundred times greater yields of bacilli in the thymectomized-irradiated than in the normal CBA mice. On the other hand, there was no evidence of systemic spread of the infection in the thymectomized-irradiated mice as no acid-fast bacilli were seen in Ziehl-Neelsen stained impression smears from the livers and spleens, and only one inguinal lymph node showed a few bacilli. Bacilli recovered from the thymectomized-irradiated mice when passaged to normal P or CBA strains of mice, reverted to infections yielding not more than 10^6 bacilli/foot-pad. Finally, while histological examination of the foot-pad of one thymectomized-irradiated mouse killed at 8 months revealed a large number of bacilli, the organisms were for the most found within striated muscle fibres, which is the characteristic distribution observed

in normal mice. Thus thymectomy plus iiradiation provides a means for significantly increasing the yield of Myco. leprae in the mouse foot-pad infection

SHEVELEV, A. S.
The effect of irradiation on the multiplication of bacteria of the vaccine tularemia strain in the organism of mice and guinea pigs.
ZH. Mikrobiol. Epidemiol. Immunobiol. No. 4, 107-11 (1966)
Source of abstract: NSA 20:3256, No. 26701 (Aug. 15, 1966)

The effects of whole-body x-irradiation on multiplication of tularemia bacteria were studied at the site of injection, and in lymph nodes blood, and various organs of vaccinated guinea pigs and mice. In guinea pigs irradiated two hrs. prior to vaccination, bacterial multiplication was increased without increase in duration of infection. Irradiation intensified the tularemia syndrome in mice leading to death of the animals.

SHEVTSOVA, Z. V.
Cause of reduction of the natural resistance of irradiated animals to live brucella vaccine.
Zh. Mikrobiol., Epidemiol. i Immunobiol. 41:100-5 (Nov. 4, 1964)
(JPRS:24896, OTS:64-31389) (June 3, 1964)

A decrease in the natural resistance of irradiated guinea pigs and rate to a vaccine of Brucella was noted. This paper is concerned with the factors involved in the radiation-induced loss of resistance. Guinea pigs (300 g) were x-irradiated (200 r) at 180 kv at a dose rate of 42 r/min. Animals were given a live vaccine culture of Brucella abortus No. 19-BA on the 10th day after irradiation. One billion organisims were injected s. c. Control situations were tested with a heat-killed vaccine culture and a Bauven-type antigen prepared from a vaccine culture of Brucella abortus. In experiments with 65 g. pigs and 40 albino rats, no significant difference was found in the numbers of organisms cultured from the organs of irradiated and control animals. An increased mortality was observed in irradiated animals given the living vaccine and heat-killed vaccine. Apparently this was related to an increased sensitivity in the irradiated animals to endotoxin from Brucella abortus. The authors concluded that radiation interferred with normal cellular defense detoxification of the endotoxin.

SHEVTSOVA, Z. V.
Study of the virulence of the brucella vaccine strain after being in irradiated animals.
ZH. Mikrobiol. Epidemiol. Immunobiol. No.3, 56-8 (1965)
Source of abstract: NSA 20:3256, No.26700 (Aug. 15, 1966)

Experiments were performed on guinea pigs inoculated with Brucella and irradiated with a dose of 200 r (20 to 30% of the animals died within 30 days). Twenty-five cultures were isolated from irradiated animals, four from the controls. All retained their original morphological, cultural, and antigenic properties. Twenty cultures checked after 3, 10, 20, and 30 days in the irradiated animals did not differ from the original strain with regard to their ability to spread in the organism. The other five cultures showed some increase in their infective ability.

SILVERMAN, S., L. KORNFELD and R. H. STEWART
The susceptibility of mice to airborne infections following continuous exposure to low dose rate γ-radiation.
Annual Progress Report U.S. Naval Radiological Defense Lab. (1965)

Continuous exposure of mice to Co^{60} γ radiation delivered at 1.0 - 1.5 rad/hour increases the susceptibility of LAF_1 ((C57L x A)F) mice to an air-borne infection with Listeria monocytogenes. The greater the total dose of radiation administered, the greater becomes the susceptibility. Thus mice receiving 500 rad were found to be 3 times as susceptible as non-irradiated mice, while those exposed to 2500 rad were approximately 30 times as susceptible. The irradiated animals were unable to clear the organism from the lungs, liver and spleen as rapidly as non-irradiated mice. The incidence of bacteremia was also greater. Preliminary studies on the phagocytic and bactericidal functions of the alveolar macrophages suggest an impaired bactericidal activity of the cells from irradiated animals. This must be confirmed, however. Mice exposed to 1700 rad and 2800 rad were unable to develop an immunity to L. monocytogenes. Non-irradiated animals, which had recovered from a sublethal infection, were capable of surviving a second challenge with an LD_{90} of the organism, whereas 20% of mice receiving 1700 rad and 64% accumulating 2800 rad before the primary infection succumbed after the second challenge.

SMITH, W. W., I. M. ALDERMAN and R. E. GILLESPIE
Hematopoietic recovery induced by bacterial lipopolysaccharides in irradiated animals.
Rad. Res. 7:451 (1957)

(See section T for abstract)

SNOPKOVA, V. A.
Alteration of acquired immunity in paratyphoid infection at different periods following irradiation (experimental research).
Med. Radiol. 10: No. 2, 51-4 (Feb. 1965) (In Russian)
Source of abstract: NSA 19: 2980, No. 24310 (July 15, 1965)

By using a model of paratyphoid infection in rabbits, the author assessed the effect of total irradiation on the degree of acquired immunity at different stages of radiation sickness. The animals were infected on the 4th and 12th day after irradiation. The state of immunity was evaluated by the severity of the course of infection, bacteriological, and serological indices, etc. The observations showed that the majority of immunized irradiated animals sustained a non-lethal disease; at remote periods following irradiation (on the 12th day after irradiation) the effect of immunity was more pronounced, since a few animals died of paratyphoid infection.

SOFRONOV, B.N.
The effect of ionizing radiation on focal infection and its prophylactic and therapeutic efficiency (on a model of experimental pertussis infection).
Med. Radiol, 1, No. 2:33-40 (1956) (In Russian)
Source of abstract: TID-3089, Book 2, 1133-4, No. 9449 (Sept. 1963)

Mice were infected in a closed chamber with an atomised suspension of Haemophilus pertussis. Pneumonic foci appeared in the lungs, the no. of microbes in a focus increased up to the 10-14th day and antibodies accumulated in the blood. The mice were x-irradiated (400 r) 4 or 14 days prior to infection. The no. of microbes isolated from the lungs of an animal irradiated 4 days before infection considerably exceeded the no. from non-irradiated mice. Animals irradiated 14 days before infection did not differ from the controls. Irradiation of infected mice resulted in overloading of the infection, especially if the mice were irradiated in the incubation period or at early stages in the course of the infection. Irradiation reduced the resistance of rats to pertussis endotoxin. Irradiation of mice directly before and after immunization inhibited antibody production but did not reduce acquired immunity to subsequent infection. The therapeutic effect of biomycin in mice irradiated before infection was somewhat decreased.

SONNABEND, E.
Radiation injury of teeth and jaws.
Fortschr. Kiefer-Gesichtschir.8:37-43 (1962) (In German)
Source of abstract: NSA 20:4032, No. 33114 (Sept. 30, 1966)

This dental clinic survey of 522 patients who received oral irradiation, mainly for hemangioma, carcinoma, cancroid, and parotid gland mixed tumors, shows that the use of increasing doses in the irradiation of tumors in the mouth has led to increasing damage to the teeth and jaw. Follow-up examination of 159 patients treated for various tumors of the face during the last 10 to 15 years, among the 522 patients, showed abnormal findings in 33 cases (21%). Injury to teeth, gums, or osteoradionecrosis accounted for 14%. A definite relation between these changes and the radiation dose was demonstrated. A chief contributory cause of osteoradionecrosis is dental infection or infection of paradental tissues and the alveolus following dental extration. It is essential to avoid infection in a radiation-exposed jaw and all teeth living within the area to be irradiated must be extracted 8 to 10 days before any intensive treatment with ionizing radiation. Pathologic changes occurring in irradiated teeth are described and illustrated.

STEPANOV, P.S.
Development and course of syphilis in irradiated organism.
Med. Radiol. 8:56-8 (1963)
Source of abstract: NSA 17:4965, No. 37083 (Nov. 30, 1963)

Experiments with 20 male rabbits weighing 1900 to 2650 g infected intrascrotally with viable Treponema (1.4 to 1.5 million organisms) and exposed to 600 r of radiation showed: a much shorter incubation period in irradiated and infected animals, a typical course of syphilitic infection, with early signs of induration and a serum-positive reaction, the later negative

serum reaction appeared earlier in irradiated rabbits than in control animals, a more prolonged induration produced a longer contagion and communicability period, and finally, due to the weakened resistance the infected and irradiated organisms developed bacteremia that proved fatal in some cases.

STEWART, H., F. A. HODGE and M. S. SILVERMAN
Effects of continuous irradiation of mice on the immune response to live Listeria monocytogenes.
USNRDL Report (1966)

Mice exposed continously to γ radiation delivered at 1.0-1.5 rad/hour were exposed to a respiratory infection with a midlethal dose of a live avirulent strain of Listeria monocytogenes immediately after accumulating either 1700-2200 rad or 2800-3000 rads. The surviving mice were challenged 2 weeks later with a second aerosol containing the organism in order to determine their immune state. All of the non-irradiated mice exposed to the 2 aerosol infections surviving while 24% of the 1700-2200 rad irradiated mice and 54% of animals receiving 2800-3000 rad succumbed to the second infection. If the irradiated mice were immunized with 2 aerosol exposures at a 2 week interval both the irradiated (2200 rad) and the non-irradiated animals survived. Immunity following a single exposure was a short duration. If the challenge was postponed until 4 weeks after the immunizing exposure, 90% of the irradiated mice died. Clearance of L. monocytogenes from the lungs, liver and spleen was rapid in the non-irradiated immune group. By the fourth day after challenge, few organisms could be isolated. If the mice were irradiated prior to immunization, clearance was delayed. Bacteria could still be found in all organs 4 days after infection. Large numbers of bacteria could be isolated from both groups of non-immune mice.

STEWARD, R. H., J. F. PRIBNOW and M. S. SILVERMAN
Effect of chronic gamma radiation on airborne infection of mice with Listeria monocytogenes.
Rad. Res. 24:96-107 (1965)

The susceptibility of mice to an airborne infection with Listeria monocytogenes increased after continuous exposure to γ-radiation delivered at 1.0 to 1.5 rads/hour. The increase in susceptibility became greater, the larger the total radiation dose. The $LD_{50(30)}$ for nonirradiated mice was 5.7×10^5 organisms, whereas after exposure to 500 and 1500 rads it dropped to 1.8×10^5, and 1.2×10^5, respectively. Further exposure to 2000 rads decreased the $LD_{50(30)}$ to 4.1×10^4. After 2500 rads it was 1.7×10^4, a 33-fold increase in susceptibility compared to that found in the nonirradiated mice. The fate of inhaled L. monocytogenes in the lungs of irradiated (2000 rads) and nonirradiated mice was investigated at 4 hours after infection. Irrespective of the aerosol challenge dose, the lungs of irradiated mice reduced bacterial numbers by 61% in this time, compared to 80% for the nonirradiated animals. Bacterial dissemination in the organs of mice challenged with sublethal and lethal doses of the organism was also determined at 2-day intervals. After sublethal aerosol challenge, bacterial counts on homogenates from the lung, liver and spleen

indicated that a more rapid proliferation of the organism occurred in the organs of Co^{60}-irradiated mice. Furthermore, the ultimate disappearance of L. monocytogenes from the lung and spleen of irradiated mice was delayed by 2 to 4 days in comparison to the removal seen in nonirradiated animals. After challenge with lethal numbers of L. monocytogenes, bacterial proliferation rates in the organs of irradiated and nonirradiated mice were comparable. However, deaths among irradiated mice occurred on days 3 and 4, whereas in the nonirradiated group they were recorded on days 5 and 6.

TERAVSKII, I. K.
Action of ionizing radiation on argasid mites.
Zool. Zh., 45:371-4 (1966) (In Russian)
Source of abstract: NSA 20:5546, No. 45467 (Dec. 31, 1966)

Larvae, nymphs and adults of the Ornithodorus papillipes Bis. mite that were infected with Borrelia sogdiana, the pathogen of Central Asian spirochetosis transmitted by mites of this species; were irradiated with γ rays in doses of 50 to 10,000 r. Irradiation of the carriers with doses in this range had no effect on the spirochetes: they were still transmitted to guinea pigs and to the offspring of the mites. Doses of 2,000 r were lethal to 96% of larvae before molting and to transformation into nymphs; they also inhibited greatly the metamorphosis of all other developmental phases of the mites. Doses of 5,000 to 10,000 r, in addition to being lethal to 100% of larvae, inhibited metamorphosis completely and produced considerable lethality among nymphs of the II to IV phases. The eggs laid by females exposed to a dose of 5,000 r did not develop, while females irradiated with 10,000 r did not lay any eggs. Irradiation with doses in the 5,000 to 10,000 r range had a sterilizing effect on males.

TROITSKI, V. L.
Disruptions of natural immunity in irradiated animals and methods of stimulating it.
Herald of the Academy of Medical Science of the USSR. 5:13-28 (1962)

(See section T for abstract)

ULRICH, M.I.
Factors concerning post-irradiation bacteremia in mice.
Thesis, Stanford University (1965)
Source of Abstract: NSA 20:1088, No.8721 (March 31, 1966)

The possible role of a depletion of naturally occurring antibody in the pathogenesis of post-irradiation bacteremia in mice was studied. In addition, the influence of the presence or absence of hemolytic complement on the incidence of infection following irradiation and on the types of organisms isolated was studied. Finally, preliminary experiments were done to investigate the possible protective role of normal leukocytes in experimental infection with Salmonella enteritidis following irradiation. CF-1 mice were used throughout this study; mortality following exposure

to 550r of x irradiation varied from 60 to 90 percent in 30 days, and bacteremia accompanied about 50 percent of the deaths. It was concluded that the production of agglutinins and bactericidins specific for representative organisms from several genera associated with post-irradiation bacteremia was not interrupted following exposure to midlethal x irradiation. This conclusion is consistent with the observation that the concentration of gamma globulin in mouse serum taken after irradiation was not reduced, but in fact increased. The availability of mice with and without hemolytic complement provided an opportunity to investigate the possible role of this factor in resistance to infection. No significant differences in the occurrence of either mortality or bacteremia were observed when equal numbers of each type of mice were irradiated. No association was found between the presence of hemolytic complement and serum-resistance of the organisms causing infection. Finally, the passive transfer of normal blood leukocytes or peritoneal cells was effective in prolonging survival in irradiated mice following deliberate challenge with an avirulent strain of Salmonella enteritidis. No support was found for the hypothesis that depletion of naturally-occurring antibody might play a role in the pathogenesis of post-irradiation bacteremia in mice.

VANČUŘIK, J.
Effect of x-irradiation on the course of experimental vaccine anthrax.
Folia Microbiologica 9:164-172 (1964)

The course of vaccine anthrax infection was studied in irradiated chinchilla rabbits. A living STI spore suspension of a non-proteolytic Soviet vaccine strain was used. The STI vaccine does not form capsules (loss of capsules is related to non-virulence). The spore suspension (0.5 ml) was injected s.c. in a dose of 5 X 10^8 spores. X-radiation doses of 400 and 600 r were delivered at 180 kvp at a dose rate of 8 r/min. In control rabbits the vaccine infection remained localized with no hyperthermia, leukocytosis or loss of weight. Irradiated rabbits (400 r) were inoculated 2 days before, 6 and 15 days after irradiation. Three of 32 irradiated and infected animals died. The histological findings were identical with the usual picture of virulent anthrax. In a group of 26 rabbits irradiated with 600 r, 23 died. The greatest increase in susceptibility occurred when the challenge was given on the 6th day after irradiation. Death was accompanied by typical anthrax sepsis. Infection was associated with massive proliferation of organisms in the terminal phase with accumulation of toxin in the irradiated animals. Groups of control and irradiated mice were given 10^4 spores 24 hours after exposure to 360 r. A more rapid proliferation of of organisms was observed in the irradiated mice. Typical anthrax was produced by a strain without capsule formation in animals whose resistance was repressed with x-radiation.

VULCHANOV, V. H., V. N. VASSILEV, K. OBRETENOVA and I. BELOKONSKI
Auto-immunization and auto-allergization in guinea pigs infected with tuberculosis with preliminary x-ray treatment.
Compt. Rend. Acad. Bulgare Sci. 18:165-8 (1965)

(See section H for abstract)

WALBURG, H. E. JR., G. E. COSGROVE and A. C. UPTON
Longevity as influenced by irradiation in germfree mice.
From International Colloquium on Radiations and Aging, Semmering, Austria. (1966)
Source of Abstract: NSA 21:708, No.6612(March 15, 1967)

Incidence of disease and life span were examined in convential and germfree mice to determine the effects of the microbial environment on radioinduced aging. Data indicate that although the absence of detectable microbial flora and fauna may alter the form of the survival curve, and may increase the mean age of death, it does not increase the maximum age of death. It is also evident that senescent changes and the life-shortening induced by x-irradiation occur in germfree mice as well as in conventional mice, suggesting that the microbial environment is not cruical to the development of such phenomena.

WATSON, JAMES R. and CAROLYN W. HAMMOND
Susceptibility of radiation chimeras to experimental Pseudomonas aeruginosa infection.
Proc. Soc. Expt. Biol. Med. 120:585-7 (1965)

The purpose of this study was to determine the relative susceptibility of syngeneic and allogeneic chimeras to experimental infections. Female CF-1 and $B6D2F_1$ were exposed to 950 r x-radiation at 400 kv at a dose rate of 18 r/min. Four hours post-irradiation they were given 8 X 10^6 nucleated bone marrow cells. The surviving chimeras were injected 43-46 days later i.a. with Pseudomonas aeruginosa. Additional allogeneic chimeras were also challenged 175 days post-irradiation. Lethally x-irradiated $B6D2F_1$ mice treated with syngeneic bone marrow cells were found to be no more susceptible to Pseudomonas aeruginosa challenge 43 days post-irradiation than unirradiated control animals. Allogeneic CF-1 chimeras proved to be substantially more susceptible to experimental Pseudomonas aeruginosa infection 43-46 days post-irradiation but at 175-177 days post-irradiation only a slight increase in susceptibility over control animals of the same age was observed.

WOLF, H., W. STENBACK, P. TAYLOR, J. PINERO, C. GRABER and J.J. TRENTIN
Protection of irradiated mice against Pseudomonas aeruginosa and its control in a convential colony.
Lab. Animal Care 14 332-3 (1964)
Source of abstract: NSA 19:30, No. 197 (Jan 15, 1965)

The appearance of P. aeruginosa in the gastrointestinal flora of a colony of mice used for irradiation and bone marrow transplantation studies resulted in premature deaths (three to 8 days postirradiation) with Pseudomonas septicemia. Protective results of active and passive immunization of mice to be irradiated were unsuccessful. Of many antibiotics tested in vitro and in vivo, the most satisfactory protection was achieved with parenteral administration of a combination of gentamicin (Garymycin sulfate), 40 mg/kg body wt, and streptomycin, 160 mg/kg. Radiation experiments with Pseudomonas-infected

mice were made possible by injecting these antibiotics from two days before until 14 days after day of irradiation. Examinations of irradiated and non-irradiated mice were carried out to determine Pseudomonas-infected sites in the body. Extensive revision of work procedures and sanitation controls in the mouse colony reduced, but did not eliminate, the enzootic infection. The number of pseudomonads present in the irradiated mouse can be a critical factor in time of death, or in survival in the case of bone marrow-treated animals.

MYCOTIC INFECTIONS

(No references under this category in the literature.)

PROTOZOAN INFECTIONS

GALLI, L., E. BRAMBILLA and M. CAPROTTI
Influenza delle radiazioni ionizzanti sull'andamento dell'infexione da plasmodium berghei in topi del ceppo "ff".
(Influence of ionizing radiation on the course of Plasmodium berghei infection of mice of the "ff" strain).
Revista di Parassitologia 26:163-8 (1965) (In Italian)

Following irradiation of 200 r, no considerable alterations of the characters of the malarial infection (incubation period, survival time, parasitaemia, etc.) were noticed. Following irradiation of 400 r, however, a considerable shortening of the incubation period was noticed in three mice, while a relevant lengthening in the remaining seven mice. Survival time after the first appearance of parasites in peripheral blood was not significantly modified by irradiation of 400 r. Death within 9.8 days from inoculation of parasites occurred in all mice treated with 500 r, while parasitaemia never exceeded 50%. The gradual relative increase of immature red cells was not observed at any stage of the infection of irradiated mice. Spleen increased considerably in size following irradiation of 200 r, but little increase was noticed with higher doses. The increase in size of spleen following malarial infection did not vary significantly with that due to irradiation of 200 r. However following higher doses, the infection led the animals to death, while the spleen showed no change in size.

NASH, D. J. and K. E. MALONE
Interaction of radiation and experimental leishmaniasis on growth in the mouse.
Rad. Res. 27:36-7 (1966)

In mice irradiated with 300 r of whole-body X-irradiation on the day prior to infection with leishmaniasis there was a delay, but an eventual, greater build-up of parasites than in nonirradiated and infected mice. The present paper reports effects of radiation and experimental leishmaniasis on growth. Mature, CF1 male mice were assigned at random to one of four experimental groups. Two of the groups received 300 r of whole-body X-rays and two of the groups were not irradiated. One of the irradiated groups and one of the nonirradiated groups also was inoculated intravenously with a dose of approximately 40 leishman-donovan bodies 24 hours following irradiation. The source of parasites was homogenized spleen from parasitized golden hamsters. Body weights were obtained at intervals during the course of infection and at necropsy. At the time of death livers and spleens were removed, weighed, and impression smears were taken of each. Mice that had been either infected or irradiated lagged controls in body weight through 10 days of age. After 10 days irradiated animals gained as much or more than controls whereas infected animals continued to gain less than controls through 17 days after which time their growth was essentially the same as controls. Mice that had been both irradiated and infected, however, exhibited hyperadditive effects on growth.

TEMPELIS, C. H. and M. G. LYSENKO
Effect of x-irradiation on *Trypanosoma lewisi* infection in the rat.
Exp. Parasitol. 16:174-81 (1965)

The course of infection in albino rats (Wistar strain) treated with x-radiation and infected with the Becker strain of *T. lewisi* was studied. Radiation was delivered at 175 kvp at a dose rate of 17.5 r/minute. In most experiments the rats were exposed to 300 r total body irradiation 24 hours before inoculation. In one experiment the animals were exposed to a second dose of 200 r total body irradiation on Days 5 or 10 of the infection. Results showed that the single exposure to sublethal irradiation caused a great increase in the parasitemia, an extension of the period of reproduction, and a delay in the appearance of agglutinins. Blood glucose studies showed the development of a hyperglycemia after Day 14 in irradiated and infected animals. A second irradiation dose showed no further effects on the protective mechanism of the host.

PARASITIC INFECTIONS

DUNSMORE, J. D.
Effect of whole-body irradiation and cortisone on the development of Ostertagia spp. in sheep.
Nature, 192:139-40 (Oct. 14, 1961)

In a sheep exposed to 300 rads only a slight reduction in antibody response was noted, although the leukocyte count dropped to a minimum 2 days after irradiation. Exposure to 440 rads whole-body irradiation largely suppressed antibody responses in sheep. In an attempt to determine whether the arrested development of parasite larvae is due to an immunological response by the host, an experiment was carried out with the object of destroying or reducing the immunological response of the host by the use of cortisone and whole-body irradiation. Larval arrest was found to be much less in cortisone-treated (8.5%) and in the irradiated sheep (18.7%) than in the controls. It is postulated that in normal sheep which have had no contact with Ostertagia spp. or related parasites, a rapid, probably local, immunity reaction leads to the formation and release of factors causing a specific arresting of development of many of the parasites.

SUSCEPTIBILITY TO TOXINS

ADLER, F. L. and I. L. SCHECHMEISTER
Effect of sub-lethal total body x-radiation on susceptibility of mice to Clostridium septicum toxin.
Proc. Soc. Exp. Biol. Med. 80:660-664 (1952)

Short-term whole-body x-radiation doses of 250 and 350 r lowered the resistance of 5-7 week old albino mice to C. septicum toxin. Radiation was delivered at 200 kvp at a dose rate of 21 r/min. Irradiated mice died 7 days after exposure from 1/2 the amount of toxin required to kill non-irradiated controls. Antitoxin given i.m. 6 days after irradiation and 1 day prior to challenge with toxin protected both irradiated and control mice. Irradiated mice needed 1.1-2.2 times more antitoxin for protection than controls. Exposure to severe doses of x-radiation, in spite of its effects on capillary permeability, apparently failed to significantly raise the minimum amount of antibody required for effective prophylaxis.

BULATOVA, T.I. and D.R. KAULEN
Natural resistance of irradiated animals to botulin toxins.
J. Hyg. Epidemiol. Microbiol. Immunol. 10:67-73 (1966)

White mice were exposed to x-radiation doses of 340, 400, 500 and 700 r delivered at 195 kv at a dose rate of 34 r/min. Type A and/or type E botulinus toxin was given either i.v. or by mouth on either the 1st, 5th, 11th or 20th day after irradiation. A marked decrease in natural resistance was observed in irradiated mice challenged by mouth with type A toxin. This was especially evident during the peak phase of radiation sickness. The resistance of irradiated mice was not altered when the same toxin was given by i.v. injection. Irradiation lowered the resistance of mice to pancreatin-activated type E toxin administered into the stomach. The sensitivity of irradiated mice remained unchanged after i.v. injection of the toxin. The authors believe that the observed loss of resistance after irradiation to challenge by mouth resulted from an increased permeability in the wall of the intestine.

CHUDOMEL, V., E. RERABEK, M. SVOBODA and V. SOLAR
The influence of ionizing radiation on thermostable inhibitors in serum and on the behavior of the same in the effects of staphylococcus toxin. Part II.
Strahlentherapie, 130:265-79 (June 1966) (In German)
Source of abstract: NSA 20:4272, No. 35306 (Oct. 15, 1966)

The titer of thermostabile inhibitors occurring in serum of rabbits exposed to ionizing radiation was estimated in a system erythrocyte-staphylococcus toxin, and the action on cells of serum factors produced in irradiated animals was studied in tissue culture experiments. The titer of serum inhibitors dropped after body irradiation. This was shown by a reduced capability of the serum to inhibit hemolysis caused by the staphylococcus toxin. A dependence on the time elapsed between irradiation

and the bleeding was also found. Serum of irradiated rabbits was able to potentiate the hemolytic action of the staphylococcus toxin. This activity was found in sera of blood drawn 48 hours after whole-body irradiation. Serum of irradiated rabbits contains factors with the ability for strengthening the cytotropic action of the staphylococcus toxin on human HeLa-and Detroit-6-cells, on the Clone 929 of mouse L-cells, and on a line of rabbit kidney cells.

HELLMAN, S. and M. E. FINK
Granulocyte reserve following radiation therapy as studied by the response to a bacterial endotoxin.
Blood 25:310-24 (1965)

(See section C for abstract)

KAHN, R. L., R. G. BOTZLER and J. F. EISSES
Antitoxin-localizing method in determining antilocalization in x-irradiated areas of rabbits.
Rad. Res. 25:713-24 (1965)

(See section A for abstract)

KAULEN, D.R. and T.I. BULATOVA
Serum prophylaxis and therapy of bacterial intoxications in irradiated animals.
Studies in Med. Radiol 4:28-34 (1964)
Source of abstract: STAR (NASA) 2:1724, No. N64-20946 (July 23, 1964)

Investigations were undertaken to study: (1) the effectiveness of seroprophylaxis and serotheraphy of bacterial toxicoses in irradiated animals: and (2) the effect of bone-marrow transplantation on the seroprophylaxis of diptheria intoxication in animals irradiated with a lethal dose. Conclusions reached as a result of the studies were: (1) The effectiveness of seroprophylaxis of botulism intoxication is reduced in accordance with the radiation dose and route of administration of the toxin by 1.5 to 4 times. The greatest disorder is observed after oral administration of the toxin. (2) The effectiveness of serotherapy is reduced even further, by 1,070 times after intravenous, and by 28 times after oral administration of the toxin. (3) Reduction of the effectiveness of seroprophylaxis and serotheraphy can be compensated by increasing the quantity of antitoxin administered. (4) Transplantation of bone morrow increases the strength of passive immunity, but this increase is small (by 1.4 times). The effectiveness of seroprophylaxis in bone-marrow-treated animals 20 days after irradiation had returned to near the original level.

KREMLEV, G. I.
The effect of gamma irradiation, thermal burn, and acute loss of blood on the development of tetanus toxicoinfections.
Voenno Med. ZH., No. 11, 29-30 (1963)
Source of abstract: NSA 19:831, No.7162 (March 15, 1965)

Thermal burns and total gamma irradiation (500 r) facilitated the occurrence and aggravated the course of tetanus toxicoinfection in rabbits. The disease and death rates of burned and irradiated animals were four or five times higher than those in the controls. In the irradiated animals and those with burns, the active immunity they had earlier sharply decreased, and despite the more than 0.01 and less than 0.05 A.E./ml of tetanus antitoxin present, the animals proved to be practically unprotected against a dose of tetanus pathogen, which was nonlethal to immunized animals.

SHEVTSOVA, Z. V.
Cause of reduction of the natural resistance of irradiated animals to live brucella vaccine.
Zh. Mikrobiol., Epidemiol. i Immunobiol. 41:100-5 (Nov. 4, 1964)
(JPRS:24896, OTS:64-31389) (June 3, 1964)

(See section B for abstract)

TROITSKI, V. L.
Disruptions of natural immunity in irradiated animals and methods of stimulating it.
Herald of the Academy of Medical Science of the USSR. 5:13-28 (1962)

(See section T for abstract)

VANČUŘIK, J.
Effect of x-irradiation on the course of experimental vaccine anthrax.
Folia Microbiologica 9:164-172 (1964)

(See section B for abstract)

VARENKO, Yu. S.
Changes in the sensitivity of mice to typhoid endotoxin during radiation sickness.
Tr. Donetsk. Med. Inst. 21:70-81 (1962)
Source of abstract: NSA 18:1103, No. 8216 (Mar. 31, 1964)
Sensitivity to typhoid endotoxin introduced intraperitoneally to mice at different periods before and after whole-body irradiation doses of 500 r increased during the entire period of radiation sickness. The peak of death of the animals was observed during the peak of radiation sickness on the 12th day.

VARENKO, YU. S.
Change in the sensitivity of irradiated mice to endotoxins of the colon and typhoid bacilli.
Radiobiology (USSR) (Engl. Transl.) 135-7 (No. 3, 1964) Orig. p.424-5.

A study was made of the sensitivity of white mice x-irradiated with 500 r to endotoxins of E. coli and B. typhi abdominalis. Typhoid endotoxin was injected in a dose of 0.25 mg and colon bacillus endotoxin was given in a dose of 0.125 mg. The endotoxins were given two hours before irradiation for the purpose of demonstrating the earliest changes in sensitivity of the irradiated animals to the endotoxins and on the third, sixth, 12th and 26th days after irradiation for the purpose of detecting sensitivity to the endotoxins both during the periods of maximal increase in the bacterial counts in the gastrointestinal tracts of irradiated animals (third-sixth days) and during the period of normalization (12th-26th days). Administration of the typhoid endotoxin two hours before irradiation increased the mortality rate of mice over that of the healthy animals and the irradiated mice which had not been given the endotoxins. The increase mortality of irradiated mice was also observed after the injection of the bacillus coli endotoxin on the third, 12th and 26th days and of the typhoid endotoxin on the third-12th days. This indicates that in irradiated animals increased sensitivity develops to endotoxins of the colon and typhoid bacilli, whereby the sensitivity is not demonstrable on all the days of the period under observation. Thus, on the sixth day after irradiation administration of the endotoxins to the irradiated animals did not cause increased mortality by comparison with the group of healthy animals which had received the endotoxins. Increase in the sensitivity to endotoxins in animals irradiated with a dose of 500 r indicates the significance of this factor in the mortality of animals after the effect of x-rays.

VAŠKŮ, J., E. URBÁNEK, S. DOLEŽEL and M. PRASLIČKA
The influence of continuous irradiation and experimental diphterial intoxication upon the origin and incidence of non-specific necrotic changes in the cardiac muscle.
Experientia 21:651-3 (1965)

Eighty adult Wistar albino rats were divided into 4 groups. The first group received a small dose of diphtheria toxin, the second group received continuous γ-radiation, the third group was exposed to continuous γ-radiation prior to the injection (i.v.) of the same dose of toxin given to the animals in group 1. A fourth group received a rather large dose of toxin. Irradiation was delivered at 90 r/day over a period of 23-23.5 hours to an accumulated dose of 2250 r through 25 days. Lesions were observed in cardiac muscle with an increased incidence of minute necroses in myocardial fibers in irradiated animals of group 3. Pretreatment with continuous radiation apparently rendered these animals more sensitive to the development of cardiac lesions.

SUSCEPTIBILITY TO TUMOR VIRUSES

AXELRAD, A. A. and H. C. VAN DER GAAG
Effect of x-irradiation on susceptibility to lymphoma induction by gross' passage a virus in adult C3Hf/Bi mice: relation to thymic cell multiplication and differentiation.
Proc. Am. Assoc. Cancer Res. 3:301 (1962)

Previous results suggested the hypothesis that susceptibility of infant C3Hf/Bi mice to lymphoma induction by Gross' Passage A Virus depends on the presence of relatively undifferentiated cells multiplying and differentiating in the thymus gland. Older mice, comparatively insusceptible to the virus, have few such cells in their thymus glands. The fact that whole-body x-irradiation causes destruction of thymic cells, and that during regeneration, the number of relatively undifferentiated cells multiplying and differentiating in the gland is greatly increased, afforded a means of testing this hypothesis. C3Hf/Bi mice 3 to 19 weeks old were exposed to whole-body x-ray and Passage A Virus on various schedules, and the effect on lymphoma incidence and survival time determined. X-irradiation induced lymphoma in over 75% of mice, median survival time 18 weeks, when virus was present during thymus regeneration. A single dose of 200 r was lymphomagenic, and experiments in progress indicate that even smaller x-ray doses are effective under these conditions. The results are consistent with the hypothesis that susceptibility to lymphoma induction by Passage A Virus depends on the presence of relatively undifferentiated cells multiplying and differentiating in the thymus gland. They suggest that one way in which x-ray facilitates lymphoma induction in mice is by providing these cells, which are susceptible to the action of the virus.

ANTIBODY RESPONSES

BENES, S., M. MIHAIESCO-NIGRIM, AL. G. TURCANU and S. CIORANESCO
Attempts to protect the process of immunogenesis in irradiated mice by means of acellular preparation. (Essais de proteger, au moyen de préparations acellulaires, le processus d'immunogenese chez la souris iradiée).
Arch. Roumanian Path. Exper. Microbiol. 23:701-714 (1964)

(See section T for abstract)

BERLIN, B. S.
Radiosensitivity of vM antibody response in mice injected with killed influenza virus.
Rad. Res. 26:554-66 (1965)

Adult CF-1 male mice were exposed to x-radiation doses of either 28, 57, 85, 113 or 147 r at 5.3 r/min at 200 kvp. A single injection was given i.a. with type A, PR8 strain, influenza virus vaccine. Irradiation one to four days before immunization depressed vM antibody titers, and hemagglutinin titers at 4 days showed the most sensitive indication of radiosensitivity. The high degree of sensitivity of vM formation to radiation was indicated by a D_{37} value of 74 r, absence of a threshold dose of x-ray, and absence or repair of direct injury to vM production. Evidence was also presented suggesting that vM production was more radiosensitive than vG production and that early vM antibody is formed principally in the spleen. In addition, the x-ray inactivation curve for vM production was of the single-hit type.

BOCHAROVA, T. V.
Effect of irradiation on immunity in experimental typhus; communication I: immunity in irradiated guinea pigs vaccinated with Rickettsia prowzekii.
Zhurnal Mikrobiologii, Epidemiologii I Immunobiologii; 4:23-26, 1962.

(See section Ri for abstract)

CLAPPER, W. E., A. SANCHEZ and J. LEVY
Immune response to a secondary stimulus with Leptospira canicola and infectious cannine hepatitis in beagles exposed to SR^{90}.
LF-29 Biology and Medicine (AEC)
TID-4500 (47th ed.) (June, 1966)

Sixteen beagle dogs (11-18 months of age) were immunized with commercially prepared vaccines of Leptospira canicola and infectious canine hepatitis (ICH). Eight beagles served as controls and 8 were allowed to inhale aerosolized particles of Sr^{90}, 1, 2 and 7 days before booster injections of the antigens. The initial body burden was 31-46 microcuries per kilo-

gram. Secondary responses to both antigens were depresed from 40-50 percent of peak titers in control animals. The peak titer was reached for both antigens within 11 days in both control and exposed dogs. This amount of Sr^{90} did not accelerate the rate of decline of antibody. Irradiated beagles recovered the ability to respond to another booster injection five months later.

CROSLAND-TAYLOR, P. J.
The effect of x-rays on the secondary antibody response.
Brit. J. Exp. Pathol. 36:530-533 (1955)

These experiments were done in an attempt to determine if re-immunization with formol toxoid is the best treatment to follow after exposure to x-rays if one is at risk from tetanus. The paper describes experiments on rabbits exposed to x-rays at various times before the second injection of toxoid. A primary immunization was given i.m. with formol tetanus toxoid (8 L f/ml). The secondary antitax in response was elicited 45 days later. X-radiation doses of 400 r were delivered at 240 kv 10, 2 days and 6 hours before the second injection of toxoid and, in a second experiment, doses of 100 r or 25 r were given 10 days before the second injection of formol tetanus toxoid. With doses of 400 r, 10 day groups reached maximum titers in 16-17 days, 2 day groups in 27 days and 6 hour groups in 16 days. Control animals reached peak titers in 6-7 days. The peak titer was reduced in rabbits irradiated 2 days before the second injection of toxoid. Peak antitoxin titers were not reduced in rabbits given 100 r and/or 25 r 10 days prior to the booster dose of antigen. The rise to peak titers was delayed 1 or 2 days in irradiated animals.

DIXON, F. J., S. C. BUKANTZ, D. W. TALMAGE and G. J. DAMIN
Radiosensitivity of the immune response.
Amer. J. Pathol.27:679-680 (1951)

Three facets of the effects of x-radiation on antibody formation were studied in rabbits. First, rabbits were exposed to 100, 200, 300, 500 and 700 r and immunized 40 hours later with I^{131}-labelled bovine gamma globulin. Doses of 100 and 200 r caused partial suppression of antibody formation, while 300, 500 and 700 resulted in complete supression in most animals. Second, rabbits were exposed to 500 r and immunized 2 hours before, simultaneously with, 2 hours after, 7 hours, 18 hours, 40 hours, 7 days and 40 days after irradiation. Antibody formation was not inhibited when the antigen was given 2 hours before or simultaneously with radiation. Antibody suppression increased in rabbits given antigen 2, 7 and 18 hours post-radiation. Complete suppression was observed in the 40 hour groups. A slight recovery was noted in the 7 day group and some impairment of antibody formation persisted in the 40 day rabbits. Third, an attempt was made to determine when antibody formation was elicited, whether or not antibody could be made to a different antigen given after exposure to 500 r. The authors concluded that if the antibody-producing mechanism is active, it is relatively radioresistant, and if inactive, radiosensitive.

DZHIKIDZE, E. K. and A. S. AKSENOVA
The influence of repeated irradiation on antibody formation in rabbits.
Med. Radiol. 9: No. 9, 72-5 (Sept. 1964) (In Russian)
Source of abstract: NSA 19:261, No. 2126 (Jan. 31, 1965)

In the first series of experiments on 77 r rabbits, of which 43 were subject to daily irradiation in a dose of 4 to 5.2 for 3 to 18 months (the total dose comprising 356 to 2,039 r) no functional disturbances of antibody formation in response to three introductions of paratyphus vaccine in increasing doses (0.25, 0.5, 1 milliard) were evident. A partial inhibition of immunogenesis was noted during daily irradiation with a dose of 21 r (the total dose amounting to 2,000 r) in the second series of experiments.

DZHIKIDZE, E. K. and A. S. AKSENOVA
The efficacy of preventive tetanus vaccination in experiments on monkeys following prolonged irradiation with low doses.
Zh. Mikrobiol., Epidemiol. i Immunobiol. 29-31 (Nov. 12, 1964) Engl. Abst.

Twelve monkeys were used in these experiments, 9 animals were exposed to a Cobalt-60 source at a daily dose of 1.17 - 1.34 r for 21 - 24 months to accumulated doses of 589 to 675 r. Nine to 12 months after irradiation and during the exposure period 9 experimental and 3 control animals were immunized with adsorbed tetanus toxoid. The antigens was again injected twice at intervals of 1 month. Their immunity was subsequently tested by injection (i.m.) of tetanus toxin. The monkeys produced neutralizing antibody under the conditions described.

DZHIKIDZE, E. K. and S. M PEKERMAN
Immunological reactivity of monkeys following acute radiation sickness.
Byulleten Eksperimental Biologii i Meditsiny 59:73-7 (1965)
(English Trans. UDC 616-001. 28-092:612.017.1)

This study was carried out on 77 Macao rhesus monkeys. X-ray and Cobalt-60 gamma radiation doses (150-700 r) were delivered 2, 5, 7, 11 months and 1-5 years before immunization with killed typhoid bacteria and sheep erythrocytes. Phagocytic activity of the leukocytes to Flexner dysentery bacteria (strain No.2248) was also studied. Inhibition of antibody formation was observed in monkeys irradiated with a dose of 450 r 10 months prior to immunization. No difference was observed in antibody titers between controls and irradiated monkeys (450 r) when tested 2-5 years after irradiation. The phagocytic activity of leukocytes from irradiated monkeys (450-675 r) was lower than control animals when tested 9-11 months after irradiation.

FILATOV, P. P. and E. S. GAIDOVA
Immunopathology in a chronic exposure to ^{65}Zn.
Vestn. Akad. Med. Nauk (USSR) 20:65-70 (No. 9, 1965) (In Russian)
Source of abstract: NSA 20:3796, No. 31112 (Sept. 15, 1966)

(See section C for abstract)

HADNAGY, C., S. SZABO and F. OBAL
Phagocytosis by the re system and antibody formation.
Z. Immun. Forsch. 118:151-166 (1959) (In German)
Source of abstract: TID-3089, Book 2, 1160, No. 9628 (Sept. 1963)

Agglutinin formation was studied in rats and rabbits immunized with human and sheep r.b.c. Simult. administration of substances believed to increase RE activity (histamine, embryo liver extract) or to reduce it (antihistamines, Na polyanethol-sulphonate) had no effect on Ab formation. Nitrogen mustard and X-rays, in doses large enough to inhibit Ab formation, led to increased phagocytic activity.

HALE, W. M. and R. D. STONER
The effect of cobalt^{60} gamma-radiation on tetanus antitoxin formation in mice.
J. Immunol. 77:410-417 (1956)

Swiss albino mice were given γ-radiation from a cobalt-60 source at a dose rate of 13 r/minute. Whole body irradiation markedly depresses tetanus antitoxin in mice when given 6 hr, 1 day, 7 days, 14 days, and 21 days before a primary injection of fluid tetanus toxoid. The animals irradiated 14 and 21 days before the primary stimulus recovered sufficiently from radiation to react to the primary injection, since they later produced considerable amounts of antitoxin when given a second antigenic stimulus. The inhibitory effect of 650 rep γ-radiation on the primary antibody response was as effective when alum precipitated toxoid was used for the primary stimulus. A radiation dose of 350 rep given 1 hr before a second stimulus of fluid toxoid had little effect on depressing antitoxin formation. γ Radiation doses of 450 to 750 rep effectively inhibited the secondary antitoxin response. The depressing effect was more marked with increased amounts of radiation. γ-Radiation of 650 rep severely inhibited the secondary antitoxin response when radiation was given 6 hr to 30 min before the second antigenic stimulus. A total dose of 1,000 rep given in 4 doses of 250 rep at 5-day intervals depressed the secondary response by only 40%. When 650 rep whole body radiation was given in a single exposure the depressing effect on antitoxin formation was much greater than when the radiation was given in 10, 5, 3, or 2 divided doses. When radiation exposure was given at the peak of the antitoxin level (10th day after the secondary stimulus) and the mice were bled 10 days later, the antitoxin level was slightly reduced. There was no appreciable effect on the antitoxin level when mice were given 650 rep 21 days after the secondary stimulus and bled 5 days later. If the radiation was given 21 days after the second injection and the animals were bled 10 and 21 days later, the depressing effect was more pronounced than when radiation was given 10 days after the second injection. The depressing effect on the antitoxin level was greater when serum was obtained 21 days after exposure to radiation than on the 10th day post-radiation.

HESS, M. W., G. TERRES and R. D. STONER
Antigenic thresholds of antitoxin responses elicited in irradiated mice with complexes of tetanus toxin and specific antibody.
Rad. Res. 25:655-67 (1965)

Mice were exposed to ^{60}Cobalt γ-radiation doses of 300-400 rads 24 hours prior to primary immunization to fluid tetanus toxoid or tetanus toxoid in complex with mouse antitoxin. Enhanced primary tetanus antitoxin responses were obtained in nonirradiated an irradiated mice immunized with active tetanus toxin in complex at equivalence (neutralization point for the toxin) with isologous antitoxin as compared to anti-body responses elicited with the same amount of formalin-treated toxin only. The antigenic threshold dose for complexed toxin needed to elicit detectable primary antitoxin responses was lower by a factor of approximately 125 in nonirradiated mice and of 1900 in irradiated mice than the threshold doses required with toxoid only. Immunization with relatively minute amounts of toxin-antitoxin in complex did not elicit primary antibody responses but provided more effective sensitization than greater amounts of toxoid only with regard to the subsequent capacity of both nonirradiated and irradiated animals to give secondary antibody responses to booster injections of fluid tetanus toxoid. The minimal antigenic threshold dose for complexed toxin required to elicit secondary responses in both nonirradiated and irradiated animals was lower by a factor of about 4 than for active toxin only. With increasing amounts of toxin only and equal amounts of toxin in complex, toxin (antigen only) appeared to be more effective in eliciting secondary antitoxin responses.

ILLYUTOVICH, A. YU., B. N. RAIKIS and I. I. LABETSKII
Immunogenesis peculiarities in guinea pigs immunized with adsorbed tetanus toxoid in conditions of ionizing radiation injury.
Zh. Mikrobiol. 40:61-4 (1963) (In Russian)

Adult guinea pigs were given a primary s.c. immunization with 0.5 ml of adsorbed tetanus toxoid. X-radiation doses of 300 r were delivered 30 days later at 190 kv at a dose rate of 25.8 r/minute. A second injection (s.c.) of adsorbed toxoid was given either 4 days or 30 days after irradiation. Serum was obtained for toxin neutralization 2, 5, 12, 20 and 30 days after the booster injection of antigen. The serum titer of antitoxin was severely repressed when the antigen was given 4 days after irradiation and only slightly repressed when antigen was given 30 days after irradiation. Control animals reached peak titers in 12 days, this was accompanied by an increase in mature plasma cells. Less plasma cells were found in lymph nodes of the irradiated animals.

JAROSLOW, B. N. and G. J. V. NOSSAL
Effects of x-irradiation on antigen localization in lymphoid follicles.
Aust. J. Exp. Biol. Med. Sci. 44:609-628 (1966)

The effects of whole body x-irradiation before or after the injection of ^{125}I-labelled Salmonella flagellar antigens on (a) antibody production and (b) antigen distribution through the lymphoid system were investigated. Whole body x-irradiation (450 r) caused marked depression of both γM and γG responses if given one day before antigen. With a high dose of the

strongest antigen, but not with a low dose or with the weaker antigen, two further observations were made: (a) colchicine could restore antibody-forming capacity and (b) x-ray given after antigen actually caused an enhanced immune response. X-irradiation caused subtle but important changes in antigen localization. The anatomical structure, presumably cytoplasmic fibrils, in the lymphoid follicles responsible for antigen trapping was remarkably radioresistant. Little damage could be observed with doses less than 1250 r, and it took 8000 r to destroy the structure completely. However, the follicular mechanism was not functionally intact. Spleen autoradiographs and whole organ counts showed a lowered capacity of the web to retain antigen. Lymph node autoradiographs showed abnormal persistence of labelling in a subsinus rim of cortical phagocytes. This was interpreted to indicate an x-ray induced interference with antigen migration. X-irradiation had no observable effect on the sinus macrophages of the lymph node medulla. This once again suggests that their function is less specialized than that of the follicular antigen-retaining cells.

JAROSLOW, B. N. and W. H. TALIAFERRO
Effect of colchicine on the hemolysin response in unirradiated and irradiated rabbits.
J. Inf. Dis.116:139-50 (1966)

This study concerns the adjuvant and restorative effect of colchicine on the hemolysin response in irradiated and unirradiated rabbits. The treatment of groups of rabbits varied with respect to the amount of (1) X rays (25 to 700 r), (2) antigen ($10^{5.2}$ to $10^{10.2}$ sheep red cells per kg rabbit), and (3) colchicine (0.067 to 1.8 mg per kg rabbit) and also with respect to (4) the time of injecting colchicine (1 day before to 6 days after the injection of antigen). In testing radiation-induced effects in the first 3 procedures the antigen and colchicine were always injected 1 day after irradiation. Mean values $\pm$ standard errors for 5 parameters of the hemolysin response indicated the following: colchicine in progressively increasing amounts stimulated the production of more hemolysin, as gauged by peak titer, at higher rates in both irradiated and unirradiated groups as compared to controls, but the latent period was not modified. The largest dose of colchicine was decreasingly active as the x-ray dose was increased but was strikingly more active as the antigen dose was increased in irradiated (400 r) and unirradiated groups. In addition, the drug was most active when injected (1) during a 12-hour period in unirradiated rabbits extending from 12 hours before to simultaneous injection with the antigen and (2) during a 36-hour period in irradiated rabbits (400 r the day before the injection of antigen) extending from 12 hours before to 24 hours after the antigen was injected. It was progressively less active in both groups when injected 3 days after the injection of antigen and was essentially inactive when injected 6 days afterwards.

JENNINGS, B. R.
The effects of radiation and immunosuppressive drugs on antibody formation and allergy.
August 10, 1966
Source of abstract: NSA 21:708, No.6613 (March 15, 1967

Experiments were performed to explore the temporal relation between the administration of x radiation (100 r) and actinomycin D (4ug) and the antigenic stimulus (aluminum phosphate adsorbed tetanus toxoid) in mice. The doses of actinomycin D and radiation were both well below the levels generally used for immunosuppression, so that the potentiating effect was more evident. The two agents suppressed antitoxin production to a greater degree than either of the agents alone when given one or two days prior to the secondary antigenic stimulus. Potentiation was not evident, howevever, when the agents were given at the time of antigenic stimulus or several days afterward. Immunosuppression by either agent alone required significantly higher doses of the individual agent than when the two were administered together.

KAHN, R. L., R. G. BOTZLER and J. F. EISSES
Antitoxin-localizing method in determining antilocalization in x-irradiated areas of rabbits.
Rad. Res. 25:713-24 (1965)

This study was concerned with differentiating the degree of localization of injected protein in x-irradiated and in nonirradiated areas of rabbits. X-radiation doses of 1000 r were delivered to 8 cm areas at 80 Kvp at a dose rate of 263 r/minute. The procedure used was the antitoxin-localizing method. A restricted amount of horse serum diphtheria antitoxin was injected in irradiated areas of rabbits and in corresponding areas of controls for the neutralization of homologous toxin. In the nonirradiated rabbits the antitoxin generally failed to neutralize the toxin; in the irradiated rabbits it usually neutralized the toxin. Antitoxin apparently became localized in the injected areas of the nonirradiated animals and as a result did not reach the toxin fast enough, but it did not become localized in the irradiated animals and thus neutralized the toxin. The antilocalizing aspect of irradiation by use of the antitoxin-localizing method was studied. For a given toxin dose, a particular dose was required for each lot of antitoxin, when injected in irradiated areas of rabbits and in controls, to demonstrate differences in localization and in neutralization of the toxin. The use of the same ratios of antitoxin and toxin, but different amounts compared with those commonly used in the antitoxin-localizing method, led to some antilocalization of injected antitoxin in irradiated areas.

KISELEV, P. N. and P. A. BUZINI
The influence of chronic continuous action of ionizing radiation on immunity.
Med. Radiol. 4, 36-44 (1959) Apr. (In Russian)

(See section B for abstract)

LANGEVOORT, H. L., F. J. KEUNING, J. v. d. MEER, P. NIEUWENHUIS and P. OUDENDIJK
Histogenesis of the plasmacellular reaction in the spleen during primary antibody response in normal and sublethally x-irradiated rabbits.
Koninkl. Nederl. Akademie Van Wetenschappen-Amsterdam, Proc. Series C. 64:297-404 (1961)

This study is concerned with the histogenesis of the primary antibody response together with the plasmacellular reaction in normal rabbit spleen and the relationship between the histological and immunological effects of sublethal total-body x-radiation. Young adult chinchilla rabbits were used. The animals were immunized i. v. with the supernatant of a paratyphoid-B formol-vaccine composed of soluble H-antigen. The antigen was given 12 hours before and/or 24 hours after 500 r. The plasmacellular reaction in the spleen is localized in the periarteriolar lymphocyte sheaths of the white pulp; neither the splenic follicles nor the red pulp contribute to this reaction. Administration of antigen does not only give rise to a plasmacellular reaction but also to follicular reactions; these reactions do not play a role in the production of antibodies. Total body X-irradiation (500 r) completely destroys the splenic follicles, leaving the periarteriolar lymphocyte sheaths largely intact. Antibody production is not depressed if the antigen is given immediately before or after such irradiation; a plasmacellular reaction develops in the surviving lymphocyte sheaths in these cases.

LA VIA, M. F. and M. A. PARKS
Effect of x-irradiation on "steady state" phase of antibody production.
Fed. Proc. 22:500, No. 2029 (1963)

Intravenous injection of a single dose of bacterial antigens in rats elicits a prolonged and sustained antibody response. The titer is maintained at a higher level in a manner resembling a "steady state" for a long period of time. Total body x-ray irradiation administered during this "steady state" phase does not affect the antibody titer although it induces marked destruction of lymphoid tissue and of actively dividing cells. The titer persists for several weeks after irradiation at the same level as that of non-irradiated controls. This phenomenon is hard to explain in terms of current views on the mechanism of antibody formation requiring cell proliferation for continued antibody synthesis. A possible explanation is that antibody titer may be maintained by relatively long-lived antibody synthesizing cells; as these cells die lymphoid cells which have not been affected by irradiation may start proliferating and synthesizing antibody.

LEBEDEV, K. A.
Immunological response of rabbits irradiated with x-rays after repeated administration of antigen. 1. Study of the dynamics of appearance and morphology of antibody - containing cells by means of the "Indirect Method" of coons.
Radiobiologiia 5:132-41 (1965)

Male rabbits were given one or two s.c. injections of diphteria toxoid at an interval of 30 days. X-radiation doses of 850 r were delivered after

immunization at 180 kv at a dose rate of 34 r/minute. Irradiation with x-rays carried out 1, 2, and 4 days after repeated immunization with diphtheria anatoxin, did not bring about subsequently a significant decrease in the number of cells synthesizing antibody. On the contrary, the synthesis of antibody took place in a large number of cells which were present for a significantly longer period of time than in unirradiated immunized rabbits. In early periods after irradiation a tendency was exhibited towards a reduction in the ratio of young forms of cells containing antibody. On the 8th-14th day after immunization, irradiated animals exhibited the presence of considerably greater amounts of young forms of antibody-containing cells than unirradiated animals in the same periods after immunization. After irradiation the synthesis of antibody took place in the same types of cells as in unirradiated animals, although in a large percentage of cells, degenerative changes in the nucleus and protoplasm were seen, while the amount and localization of antibody in the cell were altered. Among the types of antibody-containing cells after irradiation the percentage of lymphocyte-like cells increased considerably. After irradiation carried out at the time of the inductive stage of the synthesis of antibody and the beginning of the productive stage of this synthesis, a pronounced clumping of cells containing antibody was noted in lymph nodes.

LOISELEUR, J., O. GIRARD and M. PETIT
Increase of the percentage of tetanus and diphteria antibodies following the action of x-rays.
Compt. Rend. Acad. Sci. Paris 260:3230-1 (1965)

Fifty guinea pigs were given a primary immunization i.m. with 1 ml. of a mixture of tetanus and diptheria toxoid. Groups composed of 10 animals each were exposed to whole-body x-radiation (60r) 8, 10, 12 and 14 days after immunization. A second injection of the antigens was given on the 15th day and sera obtained for titration one month later. Exposure to 60 r on the 12th and 4th days greatly stimulated antibody production to tetanus and diptheria toxoid. Antibody formation was also stimulated when 100 r was delivered on the 12th, 13th and 14th day after primary immunization. The booster injection of the antigens was given on the 15th day and sera obtained 45 days from the initial immunization.

LOISELEUR, J., O. GIRARD and M. PETIT
Hyperproduction of diptheria and tetanus antibodies following irradiation before the second injection.
Compt. Rend., Ser. D, 262:2791-2 (June 27, 1966) (In French)
Source of abstract: NSA 20:5236, No. 42887 (Dec. 15, 1966)

Guinea pigs were injected with a mixture of diptheria and tetanus anatoxins. After a period of 90 days the animals were given a second injection. Two days before this injection the animals were divided into three groups: unirradiated controls, a second group given 50 R whole body x rays, a third group given 100 R x rays to right front leg. After whole body irradiation, there was a considerable increase in tetanus antibodies, while the localized irradiation caused an increase in

diptheria antibodies. It is important to use small doses for whole body irradiation and larger doses for localized irradiation. X radiation causes a significant increase in the amount of antibodies.

LOISELEUR, J. and M. PETIT
Action des rayons x sur la formation d'anticorps consecutive a une injection unique d' antigene.
Annales de L'Inst. Pasteur 103:54-58 (July, 1962)

Domestic rabbits were used in a series of experiments to determine the effects of x-radiation on antibody formation. Whole-body exposures to doses of 100-750 r were delivered at 250 kv at a dose rate of 40 r/min. Antibody responses were measured on the 4th day after injection of horse pseudo-globulin and/or egg albumin. Exposures of 350 r 1, 5 and 24 hours after injection of the antigen prevented antibody formation. Detectable antibody was found when 350 r was given 48 hours after injection of the antigen. Exposure to 600 r from 8 hours before through 48 hours after injection of antigen abolished antibody formation. X-ray doses (100, 200 and 300 r) delivered 6 hours before a single injection of antigen stimulated antibody formation.

MAKINODAN, T. and N. GENGOZIAN
Effect of radiation on antibody formation.
Radiation Protection and Recovery (A. Hollaender, Editor)
Pergamon Press, N.Y., P.316-351, (1960)

(See section R for abstract)

MOROZ, B.B. and V.V. VASIL'YEVSKAYA
Changes in some immunological reactions in animals during radiation sickness induced by polonium.
AEC-TR-3661 (BK 2) (P.310-17)
Source of abstract: TID-3089, Book 2, 1140, No. 9495 (Sept. 1963)

Results are reported from a study of the effects of injected polonium of various doses on antibody production, immunological state, and phagocytic activity of reticuloendothelium of liver in rabbits. Results indicate that radiation disrupts immunological reactions. Possible mechanisms involved are discussed.

MURPHY, J. B. and E. STURM
A comparison of the effects of x-ray and dry heat on antibody formation.
J. Exptl. Med. 41:245-55 (1925)

Rabbits were given 3 to 5 daily exposures to x-rays, dosage was determined on the following factors: spark gap 3 inches, milliamperes 10, target distance 16 inches. The duration of exposure was 2 minutes to the upper half and 2 minutes to the lower half of the animals. Control and x-irradiated animals received 10 cc. of horse serum i.v. 1 or 2 days after the first series

of x-ray treatments. A second and third injection of 5 cc. of horse serum was given 1 and 2 weeks later. Rabbits were also immunized with a series of six daily i.v. injections of 1 cc. of a Type I pneumonococcus vaccine. The immunizing injections were started 2 days prior to the series of x-ray doses. Exposure to heat, consisted of a 15 minute exposure to dry heat at 50 to 52 C^{o} to stimulate lymphoid structures. One heat exposure was given prior to immunization and thereafter at weekly intervals. Serum was obtained 7 days after the last injection of antigen. Rabbits x-rayed in doses sufficient to reduce the amount of their lymphoid tissue without damage to the bone marrow showed a definite deficiency in the production of precipitins, bacterial agglutinins, and protective antibodies. On the other hand, rabbits subjected to exposures of dry heat sufficient to increase the acitvity of the lymphoid organs, on immunization develop antibodies in larger quantity than do untreated animals immunized by the same process.

PINDAK, F. F., J. F. STARA and W. E. CLAPPER
Response to secondary antigenic stimulus after whole body x-irradiation in the beagle.
LF-17 Biology and Medicine (AEC) TID-4500 (33rd Ed.) (Sept. 1964)

Twelve beagle dogs (1 year of age) were immunized with antigens of Leptospira canicola and infections canine hepatitis virus (ICH). Agglutinins were measured to leptospiral antigen and complement fixing antibodies measured to ICH. Six of these dogs were exposed to 335 r (an LD_{50} dose) of whole body x-irradiation. Two days later a booster dose was administered to three of the exposed animals and three control animals. Seven days after exposure the remaining three irradiated animals and three control animals were given a booster dose. No secondary response was observed in the control or experimental animals receiving L. canicola, although the antibody levels produced by the primary immunization were adequate. The secondary response to ICH was eliminated in the dogs irradiated two days before the injection. However, a significant increase of titre was not observed in either the control group or those given the booster dose seven days after irradiation.

POLYAK, A. I.
Changes in immunological reactivity and morpholgical construction of lymphoid tissue at various stages in radiation injury.
Meditsinskaya Radiologiya 7:51 (1962)

Antibody responses and histological reactions of lymph node tissue were studied when living E. coli was given three days prior to and 10 days after whole-body x-irradiation (500 r). Lymph node tissue was transferred to the anterior eye chamber of normal animals. The immunological response observed here (free of secondary radiation effects) was normal with complete retention of lymphoid structure. Cellular destruction and structural disorganization were great in animals inoculated after irradiation; some transitional cells and plasma cells were intact but primitive cells were absent and antibody production was slight. One month later a slight increase in antibody production was noted. Histologically at this time, the predominant feature was reappearance of primitive cells and absence of transitional and mature plasma cells.

ROBBINS, J. and R. T. SMITH
The effect of x-ray irradiation upon the sequence of immune globulins following initial immunization in the rabbit.
J. Immunol. 93:1045-52 (1964)

The gamma$_2$-globulin synthesis of rabbits irradiated with 400 to 1000 r was decreased or totally inhibited while synthesis of $_{1m}$-globulins stayed at near normal levels measured by response to Salmonella flagellar antigens. With increasing doses of total body irradiation, a delay in the appearance of γ_2-globulin antibody was observed, whereas only a slight delay in the timing of the initial detection and minimal diminution in the over-all titer of γ_{1m}-macroglobulin antibody was noted. After lethal irradiation during which various portions of the animal's lymphoid tissue was shielded, a prolonged period of exclusive γ_{1m}-macroglobulin synthesis was demonstrated. The restoration of immunopoietic tissue during the shielding procedures could be accomplished with the cells of the spleen, appendix, hind limb and peripheral blood. Simultaneous immunization of shielded and normal tissue after lethal irradiation demonstrated a normal sequential formation of antibodies to that antigen used to inject the shielded tissue but specific inhibition of γ_2-globulin antibody to that antigen used to inject irradiated tissue. Various hypotheses which attempt to explain the relative resistance of the γ_{1m}-macroglobulin phase of the immune response as compared to the γ_2-globulin phase to total body irradiation were discussed.

RUSSELL, W. J. and W. LITSKY
Restoration of agglutinin production against Shigella paradysenteriae in irradiated rats.
Rad. Res. 20:541-8 (1963)

(See section T for abstract)

SAKAKURA, T.
Experimental studies on the antigencity of organs and serum of x-ray irradiated animals in the homologous animal. Part II. Studies on the homologous antigencity of the serum of the rabbit pretreated by x-irradiation of liver.
Arerugi, 15:84-90 (Feb. 1966) (In Japanese)
Source of abstract: NSA 21:227, No.1813 (Jan. 31. 1967)

The serum of rabbits, which reveived 12 daily doses of 500 r to the liver for 12 days to give a total of 6000 r liver dose, was injected in other, normal rabbits to test for possible changes in its antigenicity. Formation of complement-fixing antibody and antileukocyte antibody in the serum was seen, although antibody titer was rather low. Consequent disturbances of liver function and allergic histological changes chiefly localized in the liver were also noted. In the blood of the rabbit sensitized with the x-irradiated serum, it was possible also to demonstrate the complement-fixing antibody and the antileukocyte antibody which were formed in response to injection of irradiated liver emulsion. Paper-electrophoretically, the site of peak concentration of the irradiated liver emulsion protein coincid-

ed with that of the β-globulin fraction of the serum of irradiated rabbits. It is suggested that irradiation of the liver induced the denaturation of the rabbit's own protein, possibly at the time of protein synthesis in the liver, resulting in homologous antigenicity of the serum. Futhermore, irradiation also apparently caused liberation of the denatured liver tissue protein into the bloodstream, migrating in the β fraction of serum protein, and resulting in allergic changes selectively localized in the liver.

SHILOV, V.M.
The epidemiological significance of a disturbance of immunity during affection by ionizing radiations.
Veonno-Med. ZH. 11:29-33 (1962)
Source of abstract: NSA 17:4266, No. 31977 (Oct. 15, 1963)

(See section R for abstract)

SIMIĆ, M., V. S. ŠLJIVIĆ, M. Ž. PETROVIĆ, D. M. ĆIRKOVIĆ
Antibody formation in irradiated rats.
Bulletin of the Boris Kindric Institute of Nueclear Sciences
Supplement 1, 16:1-151 (Dec. 1965)

(See section R for abstract)

SKLYANSKAYA, Ye. I. and O. P. PETERSON
Cellular shifts in lymph nodes of normal and irradiated animals vaccinated against influenza.
Voprosy Virusologii 9:83-90 (1964)

(See section C for abstract)

SMITH, F., H. RUTH and M. GRENAN
Antibody production after exposure to divided x-ray doses.
Rad. Res. 7:451, No.118 (1957)

Mice immunized with sheep erythrocytes 1 week after exposure to doses of 100 r or less have serum hemolysin titers comparable with those of their unexposed controls. Increasing the radiation exposure decreases the peak titers and increases the recovery time. A single exposure to 450 r abolishes the immune response for about 4 weeks after X-irradiation. Average titers were reduced by exposure to 425 r or 650 r in five daily doses of 85 r and 130 r, respectively, after immunization at 2.5, 9.5, and 16.5 days after mid-total dose. In other groups of mice exposed to 425 r in ten doses over 5 days and immunized 9.5 days after mid-exposure the average titer was log -2.66, compared to -2.14 for mice given five exposures of 85 r ($p = < 0.01$ for the difference); a small improvement was observed in titers of mice exposed to 65 r twice daily over those of mice exposed to 130 r daily for five doses. In 104 mice exposed to a radium source for 51 days, receiving 1.1 r/hr for 8 of each 24 hours, the average titer was -2.44,

compared to -2.78 in 42 controls ($p = < 0.01$ for the difference). The lowering of average titer after the divided doses was related to the amount of the individual exposure, time between exposures, and the accumulated dose.

SMORODINTSEFF, A. A., JR.
The effect of x-ray irradiation on the course of experimental influenza infection in white mice and rats.
Acta Virologica (English Edition) 1:145-55 (1957)

(See section V for abstract)

STEPHANYAN, E.D. and T.H. MARUKYAN
On the influence of ionizing irradiation upon formation of antibodies in a combined administration of various antigens.
Vopr. Radiobiol. 2:121-30 (1961) (in Russian)
Source of abstract: NSA 18:2659, No. 19735 (June 30, 1964)

Irradiation of rabbits prior to intravenous injection of erythrocytes and bacteria suppressed the formation of antibodies. When antigens were administered prior to irradiation, the formation of agglutinins was not suppressed while hemolysin formation was partly inhibited. Double immunization of the rabbits with similar antigens (erythrocytes or bacteria) stimulated the formation of antibodies. Subsequent irradiation produced an inhibiting effect only on repeated antigenic stimulation. Immunization of normal rabbits with erythrocytes and then with bacteria, stimulated the formation of agglutinins. Subsequent irradiation considerably suppressed the production of agglutinins. When nonirradiated rabbits are injected with bacteria and then with erythrocytes, the production of hemolysins was inhibited. The similar inhibitory effect in the production of hemolysins was also observed when rabbits were irradiated after such immunization.

STEVENS, K. M., I. GRAY, and M. S. SCHWARTZ
Effects of x-irradiation on anabolism of antibody and of serum albumin and globulin.
Amer. J. Physiol. 175:141-146 (1953)

Four rabbits were immunized with 4 weekly s.c. injections of alum precipitated bovine gamma globulin (BGG). After a rest of 2 months, a booster series of BGG was given for two weeks. X-radiation (500 r) was delivered and 40 hours later 200 μc of ^{35}S-L-methionine was injected i.v. Incorporation into antibody was decreased 30-50% by x-radiation. Incorporation into serum globulin and serum albumin was greatly stimulated. The authors concluded that the effects of x-rays upon protein synthesis are mediated via their effect upon DNA synthesis.

STOLOFF, I. L., F. I. HAURANI, E. REPPLINGER and P. HAVENS
Effects of total-body irradiation on the production of antibody in man.
New England J. Med. 260:1258-61 (1959)

Six patients with acute leukemia and 1 patient with disseminated neuroblastoma, ranging in age from five to forty-one years, were studied. Four of the patients with leukemia were in the terminal phase of disease, and 2 of them were in partial remission. All had received antimetabolites in the past. During the period of study, small doses of prednisone were given, and antibiotics and transfusions of whole blood were administered at appropriate times. Radiation of the whole body was carried out with a 250-kv. constant potential roentgen-ray machine in 6 patients, and 1 patient was irradiated with a cobalt teletherapy machine. The technics of treatment varied in each method, but the total dose was computed from depth-dose data or measurements in a phantom or both. The capacity of 7 Schick-negative patients with acute leukemia or disseminated neuroblastoma to respond to a booster dose of diptheria toxid after varying doses of radiation and infusion of human bone marrow was determined. Exposure to amounts of radiation ranging from 170 r to 490 r apparently did not significantly alter either the qualitative or the quantitative immunologic response in 5 patients. It is possible that a dosage of 800 r delayed or suppressed the production of antibody, although the data are too meager to cite in support of this. The attempts to demonstrate the transfer of antibody-producing cells from donors to recipients, as manifested by measurable increases in circulating tetanus antitoxin in the recipients, were unsuccessful.

SUTHERLAND, G.B. & W.G. GLENN
Precipitin response to human serum by a rabbit population. (Comparison of stresses on secondary precipition responses).
SAM-TR-66-27 (April 1966)

This report analyzes the secondary precipitin response of a population of rabbits subjected to various stresses and stress combinations. As administered in this experiment, the following stresses and stress combinations produced a statistically significant depression of precipitin production (compared to controls) during the anamnestic response of rabbits to a complex antigen (human serum). These are rank-ordered with the stress producing the greatest effect at the head of the list: 6-mercaptopurine; 800 r whole-body gamma radiation immediately followed by 10 days at a simulated altitude of 15,000 ft.; splenectomy followed 21 days later by 800 r of gamma radiation; 800 r whole-body gamma radiation or 15,000-ft. simulated altitude for 10 days followed by 800 r whole-body gamma radiation; and splenectomy. The following stresses showed no significant effect: 15,000-ft. simulated altitude during the induction period; 15,000-ft. simulated altitude for 10 days before the induction period; major surgery involving implantation of dosimeters. Whole-body gamma radiation (800 r) immediately followed by 15,000 ft. simulated altitude resulted in a mortality of 58% within the first 48 hours of decreased atmospheric pressure. Altitude exposure before 800 r gamma radiation did not indicate any synergism or antagonism related to the anamnestic response.

TALIAFERRO, W. H. and B. N. JAROSLOW
The restoration of hemolysin formation in x-rayed rabbits by nucleic acid derivatives and antagonists of nucleic acid synthesis.
J. Infect. Dis. 107:341-350 (1960)

(See section T for abstract)

TER-POGOSYAN, R.A.
On the mechanism of stimulating effect of local skin x-irradiation on production of agglutinins against Bacterium paratyphosum.
Vopr. Radiobiol. 2:153-8 (1961) (In Russian).
Source of abstract: NSA 18:2660, No. 19738 (June 30, 1964)

Two series of experiments were conducted to examine the effect of local x-irradiation (400 r) on the production of paratyphoid B agglutinins in rabbits. The first series of experiment[illegible] that local irradiation stimulated the production of antibo[illegible] only when antigen was introduced into the irradiated skin area [illegible] case of ir[illegible] and introduction of antigen (in various [illegible] increase of agg[illegible] production was observed. The second s[illegible] the experiments s[illegible] that irradiation brought about a longer re[illegible]tion of antigen in [illegible] area and consequently, its longer effect upon the organism [illegible] the factor determining the stimul[illegible] effect of local [illegible]ibody formation.

THORBECKE, G.J., R. ASOFSKY and [illegible]
Effect of x-irradiation on the [illegible] response to BGG in rabbits.
Fed. Proc. 22:500 No. 2028 (19[illegible])

X-irradiation before injection of bovine gamma globulin (BGG) abolishes the primary response in rabbits and partially inhibits the secondary response a few months after a normal primary (R.J. Porter, J. Immunol. 84, 485). The present studies describe the effect of various time intervals between primary injection (10 mgm BGG, i.v.) and subsequent x-ray (400 r) on the inhibition of the secondary response to 20 mgm BGG i.v. Serum antibody, as measured by tanned cell hemagglutination, was first detectable on day 5 after the primary injection. The secondary response, induced 7 days after irradiation, was greatly impaired in rabbits irradiated 21 days, but not in rabbits irradiated 3, 5, 8 or 12 days after the primary. Whenever x-ray was given 8 days after the primary, the booster response reached normal peak titers regardless of the interval (2 to 20 days) between irradiation and booster injection. Studies on antibody formation in vitro and histological observations with respect to plasma call and secondary nodule proliferation in the spleen were performed to correlate booster responses with degree of recovery from x-ray histologically. The significance of these findings with regard to the mechanism of immunological memory will be discussed.

THUERIGEN, G., N. JANSSEN and H. STENDER
Influencing properdin and agglutinin formation by whole-body irradiation.
Strahlentherapie 130:131-8 (May 1966) (In German)
Source of abstract: NSA 20:4697, No. 38695 (Nov. 15, 1966)

(See section N for abstract)

TROITSKI, V.L., O.V. CHAKHAVA and N.A. KOSLOVA
The influence of ionizing radiation on antibody formation.
Med. Radiol 1:49-58 (1956)
AEC-TR-2961 (1956)

Rabbits were exposed to 600 r whole-body x-radiation delivered at 180 kv at 47 r/min. Typhoid and paratyphoid vaccine (1 billion organisms) were injected s.c. 2,7,14 and 21 days later. The agglutinin response was severely repressed when vaccine was given 2 and 7 days after irradiation. The irradiated rabbits recovered their ability to produced antibody 3-4 weeks after irradiation. Irradiation of animals at the peak of antibody formation resulted in a slight reduction of circulating antibody.

TROITSKI, V. L. and M. A. TUMANYAN
Radiation sickness and the immune state of the body. (Russian Text).
Trud. Pervoi Zakavk. Konferentsii po Med. Radiol. 75-84 (1956)
Source of abstract: TID-3089, Book 2, 1136, No. 9465 (Sept. 1963)

The present state of knowledge concerning the influence of irradiation of the body upon immunity is analysed. The basic fact established is as follows: if exposure to X-rays (300-800 r) takes place a short time before the introduction of an antigen the resulting production of antibodies is slowed down and may be completely inhibited. If, on the other hand, exposure to X-rays takes place some time after the immunization is completed it does not influence the immune state of the body to any marked extent and does not interfere with the dynamics of formation of antibodies or their final blood level. Results of experiments conducted on 27 monkeys exposed to 150-750 r are described. It was found that a single exposure to radiation of sufficient intensity inhibits the development of infective and post-infective immunity and that there is no direct relationship between the titre of the antibodies and general resistance of the animal.

TYAN, M. L. and L. J. COLE
Homograft response and hemaggultinin production by sensitized thymectomized irradiated adult mice.
USNRDL-TR-920 (Oct. 13, 1965)

Thymectomized and nonoperated male B6D2F1 mice were sensitized by the following means: (1) an allogeneic (A/HeJ) skin graft; (2) three sc injections of A/HeJ spleen cells in Freund's complete adjuvant; and (3) three ip injections of A/HeJ spleen cells. One week after the last injection, thymectomized and nonoperated mice from each group received 870 rad whole-body X radiation. The mice were grafted with A/HeJ and rat skin 102, 143, 184, 205 and 225 days after irradiation. Sera were obtained frequently for anti-A/HeJ and

anti-rat hemagglutinins. The results indicated that although both hemagglutinin production and the homograft response were initially greatly impaired by thymectomy and lethal irradiation, repeated antigenic challenge resulted in return of the specific homograft response to near normal reactivity while antibody production became progressively more impaired. The results suggested that (1) antibody production and homograft sensitivity are manifestations of immunologic responses by associated but distinct cell populations, (2) antibody production is more thymus-dependent than is the homograft response and (3) the method of sensitization employed determines both the relative and absolute number of "sensitized cells" produced within each cell population.

TYAN, L. and L. J. COLE
Rejection of allogeneic skin grafts and production of isohemagglutinins by sensitized mice after sublethal irradiation.
J. Immunol. 95:945-50 (1965)

Twelve-week old male (C57Bl/6X DBA/2) F_1 mice were used in this study. On days -19, -14 and -7 prior to irradiation they received 3 s.c. and/or 3 i.a. injections of mouse A/He J spleen cells. The spleen cells were given in Freund's complete adjuvant when injected s. c. X-radiation was delivered (670 rad) at 250 kvp at a dose rate of 28 rad/minute. Sublethal x-irradiation produced maximum depression of hemagglutinin titers between days +7 and +15; recovery of this manifestation of sensitization was usually evident by the 22nd day following irradiation. Sensitization with an emulsion of spleen cells and Freund's complete adjuvant produced the most radio-resistant hemagglutinin responses. In general, the hemagglutinin titers following recovery from irradiation were somewhat lower than those seen in the comparable nonirradiated groups; however, the secondary responses were usually as vigorous.

ULRICH, M.I.
Factors concerning post-irradiation bacteremia in mice.
Thesis, Stanford University (1965)
Source of abstract: NSA 20:1088, No. 8721 (March 31, 1966)

(See section B for abstract)

VULCHANOV, V. H., V. N. VASSILEV, K. OBRETENOVA and I. BELOKONSKI
Auto-immunization and auto-allergization in guinea pigs infected with tuberculosis with preliminary x-ray treatment.
Compt. Rend. Acad. Bulgare Sci. 18:165-8 (1965)

(See section H for abstract)

WEYZEN, W. H. and M. S. SILVERMAN
Measurement of the antibody reponse by the elimination of I^{131}-labeled proteins. 1: The elimination of I^{131}-labeled proteins from the blood of normal mice.
(USNRDL-TR-1020: AD-635754)
Source of abstract: STAR (NASA) 4:4299, No. N66-37236 (Nov. 23, 1966)

The effect of a number of variables on the elimination of I^{131}-labeled proteins from the blood of normal mice was studied. The purpose of these studies was to arrive at a critical evaluation of the antigen elimination technique which will be used for the measurement of the immune response in studies on the recovery from radiation injury. The method is based on the fact that the biological half-life of a protein is reduced in the presence of specific antibodies in the blood. It was found that the elimination of I^{131}-horse serum albumin in normal LAF_1 mice under the experimental conditions employed was not affected by the amount of protein injected or by the time of sampling. Although the degree of labeling had no effect on the half-life measured, a shift of the elimination curve was observed which was time dependent. This change was attributed to radiation damage of the protein by the radioactive label. The elimination characteristics of a number of different proteins for possible use in the immunization experiments were studied. Considerable differences were observed in the way closely related proteins were eliminated from the blood. The half-life of the albumins ranged from 13.36 hr for I^{131}-porcine serum albumin to 22.03 hr for I^{131}-dog serum albumin.

HYPERSENSITIVITY REACTIONS

ALLEN, I.V.
The effect of irradiation on the fever of delayed hypersensitivity.
Immunology 8:475-83 (May 1965)
Source of abstract: NSA 20:854-5, No. 6833 (Mar. 15, 1966)

The effect of total-body irradiation on the development of delayed hypersensitivity and on the febrile response to specific antigen was studied in adult guinea pigs. They were divided into three experimental groups: (A) irradiated, prospective hypersentitive donors; (B) nonirradiated, prospective hypersensitive donors; and (C) normal recipients. Animals were irradiated with 200 R doses of 230 kv x-rays 24 hr before sensitization with antigen. This dose, when given 24 hr before injection of antigen, was sufficient to suppress antibody formation for 15 days. Donors were sensitized with diphteria toxin. Although 200 R whole-body irradiation suppressed circulating antibody response, it did not prevent the development of delayed hypersensitivity. Irradiated and nonirradiated hypersensitive animals had an equal febrile response to systemic challenge with specific antigen. Serum from antigen-challenged, irradiated, hypersensitive animals contained a pyrogenic factor of the endogenous serum type capable of producing fever in normal recipients. These results support the conclusion that production of circulating specific antibody is not essential either for development of delayed hypersensitivity or for the febrile response of the hypersensitive animal to specific antigen.

FINGER, H.
The supression of lethal anaphylactic shock in the mouse through total-body radiation.
Z. Naturforsch. 20b:81 (1965)

Mice were immunized with 6 mg of bovine serum albumin (BSA) and rendered more sensitive to anaphylactic shock with an injection of Pertussis vaccine. X-radiation doses of 400 r were delivered either 36 hours or 2 hours after injection of BSA. A challenge dose of BSA was injected i.v. 10 days later. Seventy percent of the non-irradiated control animals died in fatal anaphylaxis, 48% of the animals died when radiation was delivered 36 hours after immunization. None of the animals died when radiation was delivered 2 hours after immunization. It should be noted that exposure to 400 r no doubt repressed antibody formation to BSA.

GRIBOVA, I. A.
General nonspecific immunological reactivity in persons working in conditions of chronic action of ionizing radiation.
Med. Radiol., 11:No.9, 74-8 (Sept. 1966) (In Russian)
Source of abstract: NSA 21:383, No.3423 (Feb. 15, 1967)

Immunological reactivity was studied by an intradermal test with antihuman serum. It was noted that the prolonged action of ionizing radiation in doses 4 to 5 times exceeding permissible ones could lead to changes in the general

immunological reactivity. These changes are manifested by the appearance of a certain percentage of persons with reduced indices of the test. In persons working in conditions of ionizing radiation in doses not exceeding the maximally permissible levels, no essential changes were observed in the general immunological reactivity. There was seen only an insignificant reduction of the incidence of cases with high test indices at the expense of an increased number of persons with mean reactivity level.

LEIBOWITZ, H. M. and J. H. ELLIOTT
Antibody production in corneal hypersensitivity.
Arch. Opthalmol. 73:687-95 (May 1965)
Source of abstract: NSA 20:4684, No. 38608 (Nov. 15, 1966)

An immunosupressive dose of total-body x irradiation given to rabbits prior to antigen administration inhibited corneal response to the antigen. Humoral antibody production and invasion of the limbus by plasma cells was also inhibited. Irradiation of the eye, with the body shielded produced none of these inhibitions. It was concluded that the cornea plays no significant role in the etiology of primary corneal hypersensitivity.

LVITSYNA, G. M.
Characteristics of cutaneous allergic reactions to bacterial allergens in irradiated animals.
Med. Radiol. (Moskva) Vol, 4:12-17 (May 1959)

Allergic skin reactions were obtained in irradiated guinea pigs with the following live vaccines: 1) TBC vaccine (series 139) 2) tularemia vaccine (series 588) and, 3) brucella vaccine (series 381). The animals were vaccinated s.c. before and after the administration of ionizing radiation and at different stages of development of radiation sickness. Talarin was used as an allergen for subcutaneous tests of guinea pigs which were vaccinated with tularemia vaccine, and brucellin was used to detect an allergy in guinea pigs which were vaccinated with brucella vaccine. Allergic skin reactions in irradiated guinea pigs did not disappear, but rather increased. Moreover, the qualitative peculiarity of the above-mentioned vaccines did not directly contribute to the observed changes in allergic reactions. On the 3rd day after irradiation, the animals which were vaccinated before irradiation exhibited intensified allergic reactions only when a lethal dose was administered (200 and 500 r). However, at the height of radiation sickness, a distinct intensification of the skin allergic reactions in the vaccinated and irradiated animals was noted at all radiation doses. The live vaccines caused allergy at different times. In the case of TBC vaccine, it required 7 days; with brucella vaccine, 21 days.

PICOTTI, F., D. FIANDESIO and E. COMINO
Influenza delle radiazioni ionizzanti sui fenomeni di ipersensibilita nella immunizzazione sperimentale.
(Influence of ionizing radiations on hypersensitivity in experimental immunization)
Minerva Fisioter, Radiobiol. (Torino) 6:146-153 (1961) (In Italian)

The major portion of this paper deals with a review of the literature on hypersensitivity reactions. Guinea pigs were immunized either with diphtheria toxoid, egg albumin or human gamma globulin. X-radiation doses of 250 r were delivered at 250 kv. The antigens were injected in incomplete adjuvant 8 hours after irradiation. An Arthus reaction of a retarded type was observed on the 12th day after the inoculation, whereas in the control animals, which had not been irradiated, the reactivity was of the immediate type. The passive local anaphylaxis test in the rabbit was negative in the former and positive in the latter group of animals, demonstrating the presence of antibodies in the circulation in the latter group. When similar experiments were carried out with the simultaneous testing of 2 antigens in the same animal, the results were practically identical with those of the group treated with a single antigen. However, these cases exhibited a considerably decreased intensity, both for the immediate and for the delayed type the decrease was more pronounced. Local irradiation of the skin area where the hypersensitivity test was subsequently to be applied, caused no difference of the response with that in the control animals.

PROTASOVA, O. V.
The effect of gamma irradiation on the anaphylactic reaction of guinea-pigs.
J. Microbiol., Epidemiol. Immunobiol. (USSR) (Engl. Transl.) 41:24-32 (Oct. 1964) Orig. p.27-31.

Active anaphylaxis as well as the intensity of the anaphylactic reaction were tested in isolated sections of the small intestine by the Schultze-Dale method. Guinea pigs were exposed to 200 r of ^{60}Cobalt γ-radiation. When the animals were sensitized with normal horse serum 24 hours, 3, 7 and 14 days after irradiation and challenged 7, 14 and 21 days after sensitization, less severe anaphylactic shock appeared than in control animals. It should be emphasized that antibody production was greatly inhibited under these experimental conditions. The Schultze-Dale reaction was also reduced in tissues obtained from radiated animals.

SAKAKURA, T.
Experimental studies on the antigencity of organs and serum of x-ray irradiated animals in the homologous animal. Part II. Studies on the homologous antigencity of the serum of the rabbit pretreated by x-irradiation of liver.
Arerugi, 15:84-90 (Feb. 1966) (In Japanese)
Source of abstract: NSA 21:227, No.1813 (Jan.31, 1967)

(See section A for abstract)

SCHIPIOR, P. and H. C. MAGUIRE
Resistance of the allergic contact dermatitis sensitization reaction to whole body x-ray in the guinea pig.
Int. Arch. Allergy 29:447-452 (1966)

Albino (Hartley strain) guinea pigs (250-300 g) were sensitized by pipetting 1 mg dinitrochlorobenzene (DNCB) on to the skin. Sensitivity to challenge was tested via pipetting a non-irritating concentration of DNCB to the skin of the back. Whole body x-radiation was delivered at 200 Kv at 59.3 r/min. Groups composed of 12 animals each were given 250 r 11 days, 24 hours and 3 hours before DNCB sensitization as well as 3 hours and 24 hours after treatment with DNCB. Under these conditions near lethal x-radiation failed to depress the subsequent challenge responses. The experiments point up the failure of lymphopenia to depress the ability of the experimental animal to acquire allergic contact hypersensitivity. Lymphopenic guinea pigs can be sensitized to DNCB as well as, or perhaps better than, normal guinea pigs. Elsewhere, we have found that cyclophosphamide induced lymphopenia does not depress the DNCB sensitizibility of Hartley strain guinea pigs although during the time of its administration cyclophosphamide prevents allergic contact dermatitis sensitization. Once established, the specific allergic contact dermatitis challenge response is highly resistant to x-ray, cyclophosphamide, and methotrexate.

SIDORIK, E.P.
The effect of ionizing radiation on the development and course of local allergic reactions.
Vrachebnaia Delo,2:141-144 (1957)
Source of abstract: TID-3098, Book 2, 1132, No. 9438 (Sept. 1963)

In rabbits radiation sickness was produced by gamma-irradiation (900 r); 5 days later the phenomenon of Arthus-Sakharov (PhAS) was produced by injecting 1 ml/kg of horse serum (HS). In all control rabbits the PhAS appeared after 5-6 injections of HS; preliminary irradiation prevented the development of PhAS; irradiation in the period of sensibilization only slightly inhibited the development of PhAS. The intensity of injury was smaller, the time of recovery-prolonged. According to the author, preliminary irradiation inhibits the formation of antibodies below the critical level, which is necessary for the development of PhAS.

TUMANYAN, M.A. and A.V. IZVEKOVA
Secondary disease in irradiated animals treated with bone marrow.
ZH. Mikro-biol. Epidemiol. Immunobiol No. 10, 76-80 (Oct.1965)
Source of abstract: NSA 20:3521, No. 29006

Mice irradiated with lethal doses of gamma rays and treated with homologous bone marrow developed a secondary disease. Use of the method of passive anaphylaxis revealed that the disease arose from an unusual immunological situation, the simultaneous occurence of two conflicting reactions, host against transplant and transplant against host. The symptoms of the secondary disease, especially the morphological changes in the liver and other organs, are similar to the changes characteristic of anaphylactic shock. These changes plus the increased sensitivity to infection suggest that the secondary disease and anaphylactic reaction have a common mechanism of action.

TUMANYAN, M. A. and O. V. PROTASOVA
Effects of irradiation on the anaphylactic reaction of animals with low sensitivity to anaphylaxis.
Radiobiology (USSR) (Engl. Transl.) 5:216-19 (No. 3, 1065) Orig.p.478-80

Adult rats (Wistar strain) of both sexes were irradiated with gamma radiation doses of 200 and 450 r from a cobalt-60 source. In the first experiment, the animals were irradiated 1,7 and 14 days before sensitization with normal horse serum. The routes of sensitization and challenge with the specific antigen were not specified. The second injection of antigen was given 21 days after sensitization. When rats were exposed to 200 r 7 and 14 before sensitization an enhanced severity in anaphylaxis was observed. When doses of 450 r were delivered to previously sensitized animals and challenge doses of antigen given 1, 7 and 14 days after irradiation, an intensified anaphylactic response occurred when the antigen was injected 7 and 14 days after irradiation. Gamma radiation (200 r) of previously immunized rats also enhanced the sensitivity of the animals to severe and fatal anaphylaxis when the challenge of antigen was given 7 and 14 days after irradiation.

UHR, J.W., and M. SCHARFF
The effect of x-radiation upon delayed hypersensitivity and antibody formation in guinea pigs.
J. Clin. Invest. 38:1049 (1959)

Whole body X-radiation given before antigenic stimulation is capable of eliminating the primary antibody response in various laboratory animals. The capacity of such radiated animals to develop the delayed type of hypersensitivity is not known. Guinea pigs of the Hartley strain were given 200 r. whole body X-radiation (approximately an LD50) at various times before and after injection of protein antigens into the footpads. The surviving animals all showed weight loss and severe pancytopenia. Even when X-radiation was administered 24 hours before injection of 3 ug. diphtheria toxid or ovalbumin in adjuvant (with or without killed mycobacteria) delayed-type skin reactions to 3 ug. of specific antigen were usually present seven days after sensitization. The delayed skin reactions were usually smaller than those seen in sensitized unirradiated control animals. The histology of the lesions, however, was typical of "tuberculin-type" skin reactions. Almost all of the sera obtained from toxoid-sensitive animals one week after the "boosting" skin test dose were incapable of eliciting passive cutaneous anaphylaxis or neutralizing toxin in the rabbit skin. Active cutaneous anaphylaxis performed on each animal did reveal antibody in a minority of the animals. Serum antibody appeared in many animals by three weeks coincident with other signs of recovery from the radiation effects. These results indicate that the capacity to develop the delayed type of hypersensitivity in X-radiated guinea pigs may persist even when detectable circulating antibody is not produced two weeks after an immunizing injection to toxoid.

VULCHANOV, V. H., V. N. VASSILEV, K. OBRETENOVA and I. BELOLONSKI
Auto-immunization and auto-allergization in guinea pigs infected with tuberculosis with preliminary x-ray treatment.
Compt. Rend. Acad. Bulgare Sci. 18:165-8 (1965)

Guinea pigs (350-400 g) were pretested for the absence of complement-fixing antibody against normal guinea pig lung, spleen and brain. Forty g. pigs were exposed to 400 r of x-radiation delivered at 180 kv at a dose rate of 65 r/min. Irradiated animals and controls were infected s.c. 24 hours later with a human tubercle, strain H37Rv. Serum samples were obtained 15, 30, 45 and 60 days later and tested for the presence of complement-fixing antibody to the normal g. pig tissue antigens. None of the control animals died during the infection, whereas 32 of 40 irradiated and infected g. pigs died from the 8th to the 18 day after infection. Pre-treatment with 400 r apparently increased the possibility of auto-antigeniuty and accelerated the auto-immunization process. Of 8 surviving animals (day 30) 3 of 8 showed antibody to lung, 5 of 8 showed antibody to brain and 1 of 8 showed antibody to spleen. Irradiation inhibited (up to the 30th day) the appearance of a delayed type of tuberculin hypersensitivity.

CELLULAR DEFENSE MECHANISMS
(Phagocytosis and Inflammatory Reactions)

AKOPOVA, V.A.
Morphological and histochemical changes in the spleen and lymph node of white mice in response to radiation and antigenic effects.
Vopr. Radiobiol. 2:165-72 (1961) (In Russian)

Experiments were carried out on 90 white mice exposed to x-radiation vaccination with a brucella vaccine and a combination of these factors. The spleen and lymph nodes were studied both morphologically and histochemically. Exposure of mice to a total x-ray dose of 335r, produced destructive changes and a lowering of desoxyribonucleic and ribonucleic acid levels occurred in the spleen and lymph nodes. In the case of a single vaccination of mice with brucella vaccine, a vaccinal hyperplasia was observed in the spleen and lymph nodes, the level of desoxyribonucleic and ribonucleic acid remained normal. In vaccinating after total irradiation, destructive changes along with a gradual lowering of desoxyribonucleic and ribonucleic acid level were observed in the spleen and lymph nodes.

ALLEN, J.R., A.S. HALL and C.F. CHESNEY
Pathologic alterations observed in rhesus monkeys given total-body x-irradiation and bone marrow transplants.
Amer. J. Vet. Res.27:1103-12 (July 1966)
Source of abstract: NSA 20:4026-7, No. 33071 (Sept. 30, 1966)

(See section B for abstract)

AWATAGUCHI, S.
The effects of x-irradiation on the protective activity of host against bacterial infection. III. Decreasing of the activity of reticuloendothelial system by x-irradiation and the effect of radiosotope P^{32} internal radiation.
Japanese Jour. Bact. 13 (5):398-402(1958)
Source of abstract: TID-3089, Book 2, 1159, No. 9620 (Sept. 1963)

The activity of the reticuloendothelial system of rabbits x-irradiated with 600 r decreased as measured by the time necessary to phagocytize chicken red blood cells. When rabbits were injected intravenously with P^{32} (KH_2PO_4 solution), the decrease in number of blood cells with a relative increase in granulocytes and a weakening of bactericidal effect of the serum were observed.

BENDER, M. L.
Synergistic effect of zero-G and radiation on white blood cells. An experiment for the Gemini III manned space flight.
Annual Report, Period Ending 30 June 1965
(NASA-CR-80821; ORNL-TM-1550)
Source of abstract: STAR 5:493-4, No. N67-14035 (Feb. 23, 1967)

The design and execution of an experiment on the synergistic effect of zero-G and radiation on white blood cells, which was successfully carried

out during the Gemini III manned space flight of March 23, 1965, are described. The experiment consisted of the irradiation of samples of human leukocytes with ^{32}P beta particles during the orbital phase of the mission, and the subsequent cytogenetic analysis of the material to determine chromosomal aberration rates. Preparation of the experimental included the design, fabrication, and testing of the necessary hardware and equipment. The experimental data showed that although there was no significant difference between the yields of multiple-break chromosome aberrations induced on the ground and induced during orbital flight, the frequency of single-break aberrations was significantly higher in the flight samples. Several lines of evidence rule out the possibility that this difference arose from differences in absorbed dose, temperature, oxygen tension, or other parameters known to influence chromosome aberration yields. That the space flight itself induced aberrations is ruled out by the experiment control samples and also by preflight and postflight blood samples obtained from the Gemini III flight crew. A synergism between radiation and some space-flight parameter thus appears to exist for human chromosome aberration production.

BRANCADORO, P. and A. SICILIANO
Chromosomal aberration types in the leukocytes of periferal blood of patients exposed to radiotherapy.
Nunt. Radiol., 31:1403-18 (Dec. 1965) (In Italian)
Source of abstract: NSA 21:532 No.4786,(Feb.28, 1967)

The persistence of the chromosome aberrations is discussed as a function of time after irradiation. Seventeen cases, examined before the irradiation and considered as controls, as well as 6 cases examined from 6 months to 4 years after the therapeutic irradiation are reported. In the irradiated subjects the percentage of the abnormal cells examined by microscopy was of 5.8%, while it was of 0.9% in the controls; the number of the abnormal cells revealed by the karyotypic analysis was 23 out of 123 examined cells in the irradiated subjects, while it was 5 out of 291 in the controls. The significance and the need of performing the karyotypic analysis for the recognition of the stable anomalies are discussed.

BYKHOVSKII, A.V., G.S. KOMOVNIKOV and B.V. POLUSHKIN
Effect of zymozan on the macrophage response of the lungs and phagocytosis in acute radiation sickness.
Vest. Akad. Med. Nauk SSSR, No. 9, 83-6 (1965) (In Russian)
Source of abstract: NSA 20:4277, No. 35341 (Oct. 15, 1966)

The effects of zymozan and various other substances on the number of alveolar macrophages and on the phagocytosis of micrococcus T-5 by the cellular elements of the lungs and blood in healthy and irradiated animals were studied. The experimental animals, mice and rats, were irradiated with 680 rad. In addition, the number of leukocytes in the peripheral blood as well as the serotonin levels in the blood and lungs were determined. Irradiation of rats resulted in a threefold increase of alveolar macrophages in 24 hours.

CHONE, B. and J. BECKER
Origin, development and completion of hematological radiation protection.
Strahlentherapie, 131:51-58 (Sept.1966) (In German)
Source of abstract: NSA 21:383, No.3409 (Feb. 15, 1967)

The problem of hematological radiation protection has undergone a change which results from more recent patho-physiological findings and improved diagnostic differentiation. For illustrating this development, a detailed historic review is given, followed by a discussion of morphological blood changes which are presently known to occur after radiation exposure. For classification and evaluation, special emphasis is put on functional tests which can be used as criteria for determining the extent of existing bone marrow reserve. A further diagnostic improvement can be obtained by using autoradiographic cytochemical procedures. Electromicroscopy is also important. The electronic registration of volume changes in leukocytes is, presently, the most sensitive method for detecting an effective radiation damage in the peripheral blood; it is based on the induction effect produced by the giant cells. This method allows an early morphological diagnosis, which cannot be obtained with the conventional counting procedures commonly used. These results open up new viewpoints for radiation protection, especially in regard to longitudinal sections and to an individual classification of radiation effect. Additional investigations are being done.

CONARD, R. A.
Hematological effects of space radiation.
BNL-10221
STAR (NASA) 4:4301, No. N66-37342 (Nov. 23, 1966)

Available data on the hematological effects of space radiation on man are reviewed. The data indicate that the bone marrow is, under most circumstances, the most critical organ for damage from radiation. The blood forming tissues possibly do not have the regenerative or renewal capacity that the gastrointestinal epithelium has, and will, in most cases, be the limiting factor for survival. Neutrophil and platelet levels will be of primary importance in regard to the fitness and survival of the astronaut from the hematological point of view. Peripheral blood counts, both preflight and in-flight, for total white cell count (with neutrophil and lymphocyte levels) offer the best index of prognosis from the point of view of hematopoietic damage. Lymphopenia must be interpreted with caution, since dose distribution patterns and abscopal effects from partial body irradiation may give lower values than indicative of general bone marrow damage. The development of fever, infection, bleeding are signs of severe bone marrow damage. Abortion of a mission is indicated if any accumulated whole body dose of radiation of greater than 150 rads in a 48 hour period occurs; white blood counts drop below 2000 cells per cubic mm and neutrophils below 1000 cells per cubic mm; or if associated fever, infections, or bleeding occur. Very large doses of partial body radiation may be tolerated without lethal depression of circulating blood cells. Shielding part of the bone marrow may be an important factor in preventing serious hematological depression. It is recommended that serious consideration be given to providing shielding of part of the bone marrow of the astronaut. A lead apron over the pelvic region would shield about 40% of his bone marrow, and he could then withstand considerably larger doses of radiation to the remaind-

er of his body. The dose rate and depth-dose distribution patterns of space radiation are the most important physical considerations in determining total bone marrow damage. High proton flux irradiation associated with solar flares presents the most serious radiation hazard. Based on limited data, the quality of radiation delivered to the bone marrow does not appear to present any special hazards, since the RBE appears to be about 1 or only slightly above for most space radiations that penetrate to the depth of the bone marrow.

CONGDON, C.
Destructive effect of radiation on lymphatic tissue.
Cancer Res., 26:1211-20 (June 1966)
Source of abstract: NSA 20:4684, No. 38612 (Nov. 15, 1966)

The destructive effect of x radiation on lymphatic tissues is influenced in variable ways and to different extents depending on the physical factors concerned with the radiation itself and on biologic factors concerning the exposed organism. In this context the major physical factor is radiation dose and the major biologic factor is local versus whole-body exposure. Presence of non-neoplastic pathologic changes in lymphatic tissue could conceivably also alter radiation effects as well as the subsequent ability of the lymphatic tissues to regenerate. Regeneration in the exposed tissue is interesting from the normal physiology point of view, and the observation that granulopoiesis usually precedes reaccumulation of lymphocytes requires further consideration. Potentiation of radiation effects by graft-versus-host and graft-versus-tumor reactions is of great interest because clinical trials utilizing immunotherapy of cancer as a supplement to standard therapeutic measures are now worth serious consideration. The idea that tumor cells of lymphatic tissue orgin might cause graft-versus-host reactions could form the basis for additional experiments.

DALRYMPLE, G. V., I. R. LINDSAY, J. J. GHIDONI, J. D. HALL, J. C. MITCHELL, H. L. KUNDEL and I. L. MORGAN
Some effects of 138-Mev protons on primates.
Rad. Res., 28:471-88 (June 1966)
Source of abstract: NSA 20:3794, No.31101 (Sept. 15, 1966)

A total of 102 primates (Macaca mulatta) were irradiated with spaced doses of 138-Mev protons ranging from 105 to 1220 rads, an $LD_{50(30)}$ of 516 ± 0.09 (S.E.) for the mortality RBE. Adjusting the 2-Mev x ray $LD_{50(30)}$ to correspond to the 138-Mev proton dose rate gives an RBE of 1.0. Changes in total leukocyte count, lymphocyte count, neutrophil count, platelet count, hemoglobin concentration, hematocrits, LDH concentrations, and SGOT concentrations indicate an RBE of 1 for 138-Mev protons as compared to 2-Mev x rays. The only findings that were significantly different between these qualities of radiation were clinical. Considerably more pronounced signs of gastrointestinal injury and hemorrhage were produced by 138-Mev protons as compared to equivalent doses of 2-Mev x rays.

DZHAPARIDZE, T. N.
Protective and regenerative reactions of the organism at various doses.
Soobshch. Akad. Nauk Gruz. SSR, 43:221-5 (July 1966) (In Russian)
Source of abstract: NSA 21:532 No.4875 (Feb. 28, 1967)

Artificial hypothermia is one of the chief methods to reduce the reactivity of the organism, as it depresses the metabolic processes. The problem was studied by exposing 50 dogs to lethal and sublethal x-radiations, including single exposures of 400 to 600 r and repeated doses of 20 to 50 r up to a total dose of 400 r. The effects were observed clinically by hemorrhaging, changes in weight and temperature, and by studying the peripheral blood composition, the phagocytic activity of leukocytes and the overall activity of the blood coagulating system. The results indicated that the protective action of the organism is enhanced if repeated small doses are allowed to act on it, instead of a single large dose. While lethal doses caused deep degenerative necrobiotic changes, cooling the animals to 22 to 23°C resulted in only relatively mild radiation sickness and a favorable clinical picture.

DZHIKIDZE, E. K. and S. M. PEKERMAN
Immunological reactivity of monkeys following acute radiation sickness.
Byulleten Eksperimental Biologii i Meditsiny 59:73-7 (1965)
(English Trans. UDC 616-001. 28-092:612.017.1)

(See section A for abstract)

FILATOV, P. P. and E. S. GAIDOVA
Immunopathology in a chronic exposure to ^{65}Zn.
Vestn. Akad. Med. Nauk (USSR) 20:65-70 (No. 9, 1965) (In Russian)
Source of abstract: NSA 20:3796, No. 31112 (Sept. 15, 1966)

$^{65}ZnCl_2$ was administered orally to rabbits daily for 18 months in a daily dose of 10 μc/kg body weight. After 12 to 16 months of treatment autoantibodies against tissues were detected by immunodiffusion. After 9 months the protein content of the blood serum showed changes; the albumin decreased by 29% and the β- and γ-globulin levels increased by 45 to 48%. After 16 to 18 months there was evidence of reticular tissue hyperplasia in the hemopoietic organs, extramedullary hemopoietic foci in the spleen and lymph nodes, and the presence of plasma cells and amyloid in the spleen and kidneys. The data suggest that an autoimmune mechanism plays an important role in the pathogenesis of chronic radiation injury by ^{65}Zn.

GAL'CHIKOV, V. I., I. S. SLIZKIY, A. V. TUZIKOV and O. V. SHNYRENKOVA
Tissue acceptance of foreign bodies in radiation sickness.
Voyenno-Meditsinskiy Zhurnal, No. 7, P.94-100 (1960)
JPRS:7432, CSO:1374-N/32

(See section T for abstract)

GIURGIU, T., P. IONESCU, T. SAFTA, O. MACARIE and A. NICULESU
Experimental study on humoral and functional changes in the syndrome caused from combined action of burns and whole body irradiation.
Rev. Sanit. Mil., 16: Special No.,466-73 (1965) (In Rumanian)
Source of abstract: NSA 21:532, No. 4874 (Feb. 28, 1967

Second and third-degree burns were applied to dogs 1, 2 or 24 hours or 5 days after x-irradiation (500 r). Mortality was 55% in unirradiated, burned controls; 100% in animals burned and irradiated; and 100% in irradiated controls. The latter group survived 1 to 7 days longer than the group administered both stresses. Hematologic data are discussed in detail.

GONCHARENKO, I.M. and A.Ya. FRIDENSHTEIN
Morphologic changes in the thymus and spleen of newborn mice exposed to local irradiation with x rays in a massive dose.
Byull. Eksp. Biol. Med.61: No. 6,103-7 (June 1966) (In Russian)
Source of abstract: NSA 20:5236, No. 42887 (Dec. 15, 1966)

Mice of strain C57Bl were exposed to x rays in a dose of 3,000 R on the first day after birth. This was accompanied by a practically complete destruction of mature forms of thymus lymphocytes (thymocytes), which made it possible to produce a model of an organ devoid of thymocytes but with a fully retained structure of the elements of its stroma for a period up to three weeks. The restoration of the thymus structure took place by the 22nd day after irradiation; simultaneously, there occurred complete development of the spleen structure, which was retarded until this moment. It is supposed that restoration of the thymocytes is due to repopulation by lymphocytes from other organs.

GOVORUN, R. D. and S. V. VOROZHTSOVA
Study of the effect of protons of 126 MeV and gamma rays of cobalt-60 on the processes of cell division in the bone marrow of white rats.
Problems in Aerospace Med. (Oct. 21, 1966)
Source of abstract: STAR (NASA) 5:189, No.N67-11482 (Jan. 23, 1967)

Mitotic activity, destructive processes in brain cell nuclei, and disturbances in the cell division processes were investigated in white rats that were subjected to various doses of whole-body irradiation with 126 MeV protons and gamma rays from Cobalt 60. A distinct change in mitotic index of the bone marrow was found with increasing doses; and there was an increase in the number of metaphases for 6 to 48 hours following irradiation, as well as a decrease in number of prophases and anaphases during the first day. A considerable increase in the number of degenerated nuclei is observed during the first day; and there was less damaging action from the protons than the gamma rays. Magnitude of relative effectiveness of the two types of irradiation varied according to when the tests were performed, and chromosome aberrations were related to dosage. To carry on these studies, the rats were decapitated at 1, 3, 6, 12, and 24 hours; as well as 2, 4, 7, 20, and 30 days after exposure.

GROSS, U.M. and H. GERMS
The activated lymph node of mice after x-ray irradiation.
Beitr. Pathol. Anat. Allg. Pathol. 131:200-19 (1965)
Source of abstract: NSA 20:850, No. 6809 (Mar. 15, 1966)

In the mouse, subcutaneous injection of heterologous serum leads to a characteristic modification of the regional lymph nodes accompanied by an accidental cytopoiesis. This phenomenon is examined in the present study by the utilization of x-irradiation. Whole-body irradiation of mice (200 and 300 r) causes first a marked dimunution of the lymphocytes in the lymph nodes. Subsequent repopulation and restitution of the lymph nodes originates from the small, apparently radioresistant, parenchymal reticulum cells. After serum treatment preceded by irradiation, the radiation reaction in the lymphoreticular parenchyma was unchanged. It was noted however that regeneration occurred earlier, was accompanied by a more marked proliferation of the small and large reticulum cells and that there was also a cellular regeneration in the entire nodal parenchyma analogous to the above-mentioned cytopoiesis. The radiation reaction was markedly diminished when the nodes, which were stimulated by daily serum injection, were irradiated on the fifth day. The cytopoiesis induced by daily injections of serum was not compromised except for a radiation-dependent suppression of mitosis with a corresponding increase in amitotic forms in the stimulated reticular cells. The results obtained under these various conditions are discussed in the light of the known structure of lymphoreticular tissue.

GRUZDEV, G. P., L. M. ROZHDESTVENSKII, M. I. FEDOTOVA and E. N. SHCHERBOVA
Mechanism of injury of the hematogenic tissue under the action of ionizing radiation.
Radiobiologiya, 6:483-5 (1966) (In Russian)
Source of abstract: NSA 21:715, No.6669 (March 15, 1967)

Rats and bone marrow cultures were gamma irradiated using a cobalt-60 source. Unirradiated rats and bone marrow cultures served as controls. The mitotic index and the number of cells with chromosome abberations were used as indicators of the hematopoietic capacity of the tissue. In the control rats the mitotic index remained constant, and in the control cultures dividing cells appeared one hour after the beginning of the culture. In irradiated cultures and in bone marrow cultures from irradiated animals a delay in division at the metaphase was noted. Chromosome aberrations were much more numerous in irradiated cultures and in cultures from irradiated rats than in controls. The change in hematopoietic capacity of cells in irradiated bone marrow cultures is analogous to the change following irradiation of the whole animal.

GUTTMAN, P. H.
The effect of thymectomy and splenectomy on the course of x-ray induced progressive intercapillary glomerulosclerosis in the mouse kidney.
(UCSF-34P41-13) June 1, 1966
Source of abstract NSA 21:3[illegible], No. 3435 (Feb. 15, 1967)

Whole body neonatal irradiation (450 rads) of Swiss-Webster mice resulted in progressive intercapillary glomerulosclerosis (IGS). Neonatal thymectomy

potentiated the effect of irradiation. Removal of the spleen at 18 days markedly reduced the effect of irradiation on the kidney when combined with thymectomy at birth. In the presence of an intact thymus, splenectomy had no effect on the course of radiation induced IGS. Germinal center formation and plasma cell infiltration were observed in the thymus of splenectomized-irradiated mice. The possible role of immunity in the pathogenesis of late effects of x-ray on the kidney is considered in the light of these findings.

HADNAGY, C., S. SZABO and F. OBAL
Phagocytosis by the re system and antibody formation.
Z. Immun. Forsch. 118:151-166 (1959) (In German)
Source of abstract: TID-3089, Book 2, 1160, No. 9628 (Sept. 1963)

(See section A for abstract)

HAMMOND, C. W.
Bactericidal activity of fixed phagocytes in irradiated and unirradiated mice treated with RNA.
Proc. Soc. Exptl. Biol. Med. 114, 213-15 (1963)

(See section T for abstract)

HELLMAN, S. and M. E. FINK
Granulocyte reserve following radiation therapy as studied by the response to a bacterial endotoxin.
Blood 25:310-24 (1965)

The granulocyte response to an intravenous injection of Pyrexal, a highly purified bacterial endotoxin was used as an assay of the marrow granulocyte reserve in patients who had received radiation therapy for various types of neoplasms. The response to the endotoxin was correlated with the amount of marrow irradiated. Only those patients with large volumes of marrow irradiated had abnormal responses to Pyrexal. No patient receiving radiation therapy to the head and neck, or thorax, or pelvis alone, regardless of dose, developed an abnormal response to Pyrexal. Early changes in the marrow granulocyte reserve were also studied in patients before, during and after radiation therapy.

HOEST, HERMAN
Regeneration of bone marrow cells in rats following cyclophosphamide or total body irradiation
Act. Radiol. Therapy, Phys., Biol. 4:337-52 (Oct. 1966)
Source of abstract: NSA 21:710, No.6625, (March 15, 1967)

Comparative studies of the effect of cyclophosphamide or whole-body irradiation on bone marrow cells were performed in rats. The recovery of erythropoiesis was the same after the two types of treatment, whereas differences were evident in the pattern of myeloid regeneration. It is suggested that the stem cells are less damaged by cyclophosphamide than is the dividing compartment, whereas the reproductive integrity of the stem cells is still reduced after cessation of the radiation-induced mitotic block.

ILLYUTOVICH, A. YU., B. N. RAIKIS and I. I. LABETSKII
Immunogenesis peculiarities in guinea pigs immunized with adsorbed tetanus toxoid in conditions of ionizing radiation injury.
Zh. Mikrobiol. 40:61-4 (1963) (In Russian)

(See section A for abstract)

JAROSLOW, B. N. and G. J. V. NOSSAL
Effects of x-irradiation on antigen localization in lymphoid follicles.
Aust. J. Exp. Biol. Med. Sci. 44:609-628 (1966)

(See section A for abstract)

KHOLIN, V. V. and T. F. IVANOVA
Peculiarities of injury to the blood in rats at an early age as a result of total x-ray irradiation.
Radiobiologiya, 6:399-402 (1966) (In Russian)
Source of abstract: NSA 21:715, No.6666 (March 15, 1966)

The presence of substantial peculiarities in the response of the peripheral blood of baby rats to x-irradiation was established, in contrast to sexually mature rats. These peculiarities were expressed, on the one hand, in a more severe injury of hematogenesis in the baby rats, and on the other, in the characteristic unique dynamics of development of the response of the blood to irradiation. Pronounced and stable anemia developed in the baby rats as a result of irradiation, with a weak manisfestation of anemia in the sexually mature animals.

KISELEV, P. N. and P. A. BUZINI
The influence of chronic continuous action of ionizing radiation on immunity.
Med. Radiol. 4, 36-44 (1959) Apr. (In Russian)

(See section B for abstract)

KLEYTMAN, YE. I.
Certain data on the influence of betaton rays on the natural immunity of white rats to tularemia.
Transactions of the Tomsk Scientific Research Institute of Vaccins and Serums. 11:1-327 (1960)
FTD-TT-63-1082 (Translation) P.400-406 (May 1, 1964)

(See section B for abstract)

KON'KOVA, L. G.
The radiation sensitivity of white rats under conditions of hypothermia.
Problems in Aerospace Med. (Oct. 21, 1966)
Source of abstract: STAR (NASA) 5:196, No.N67-11551 (Jan. 23, 1967)

A comparison of the radiation sensitivity of white rats irradiated in a state of hypothermia and at normal body temperature was made on the basis of genital system and fertility, peripheral blood, and change of weight. The following results were indicated: (1) The sexual cycle of rats irradiated in a state of hypothermia occurred without significant deviation from the norm; however, rats irradiated at normal body temperature exhibited serious disturbances during the course of the extra cycle appearing as a prolongation of the stage of diestrus and decrease in the number of normal cycles. (2) In respect to fertility, it was found that females subjected to irradiation in the state of hypothermia and mated with nonirradiated males produced vital progeny, which did not occur in females irradiated at normal body temperatures. (3) Changes in peripheral blood were more weakly expressed in animals irradiated in the state of hypothermia.

KONNOVA, N. I.
The combined action of acceleration and ionizing radiation on the organism or animals.
Problems in Aerospace-Med. (Oct. 21, 1966)
Source of abstract: STAR (NASA) 5:195, No.N67-11550 (Jan. 23, 1967)

The combined influence of acceleration and ionizing radiation on mice, rats, and dogs was evaluated on the basis of mortality, length of life of the test animals, body weight, and peripheral blood. In the tests on mice, it was found that contrifuging both before and after a 600 R gamma ray dose increases the survivability of the animals by 8% to 12%. In the experiments on rats there were no statistically reliable differences in tests of survival and average length of life between the test and control groups. Testing of the dogs established that in the animals subjected to the animals subjected to the combined action of acceleration and irradiation, leucopenia was more pronounced.

KORNFELD, L. and V. GREENMAN
Differential sensitivity of circulating and peritoneal mononuclear cells of mice to total-body x irradiation.
(USNRDL-TR-999) EUR 2634.d (1966)
Source of abstract: NSA 20:3250, No. 26651 (Aug. 15, 1966)

Dose-response curves obtained 1 and 3 days after exposure to total-body x irradiation indicate that the mononuclear cells in the circulating blood and in the peritoneal cavity of LAF_1 mice may be arranged in the following order of decreasing sensitivity: circulating lymphocytes, small peritoneal lymphocytes, medium peritoneal lymphocytes, and peritoneal macrophages. However, on the 3rd day post-irradiation, the curve of the small peritoneal lymphocytes closely approached that of the circulating lymphocytes. It is suggested that the greater sensitivity to irradiation of small rather than medium peritoneal lymphocytes is not due to environmental factors but to as yet unidentified differences in the cells. On the other hand, the greater loss of circulating lymphocytes rather than small peritoneal lymphocytes 1 day after x ray exposure may merely reflect more efficient removal of damaged cells from the circulation than from the peritoneal cavity.

KORNFELD, L. and V. GREENMAN
Effects of continuous low-level gamma irradiation on circulating and peritoneal mononuclear leucocytes of mice.
USNRDL (1966)

LAF1 mice were exposed continously to Co^{60} gamma radiations at a dose rate of 1.4 rads per hour. The number of lymphocytes in the circulating blood fell sharply during the first week of exposure (190 rads) and decreased thereafter at a very gradual but statistically significant rate for the duration of the experiment (15 weeks, 3450 rads). The disappearance of small lymphocytes (6 μ in diameter) from the peritoneal cavity was also more rapid during the first week of irradiation than during subsequent weeks. Medium peritoneal lymphocytes (8-10 μ in diameter) and peritoneal macrophages disappeared at constant rates over the entire observation period. After the first week of exposure, the disappearance rates of small and medium peritoneal lymphocytes were identical. This rate was greater than that for peritoneal macrophages and that for circulating lymphocytes. Based on the fraction of cells surviving any given exposure, the mononuclear leucocytes may be arranged in the following order of decreasing sensitivity to continuous low dose rate gamma irradiation: circulating lymphocytes, small peritoneal lymphocytes, medium peritoneal lymphocytes, peritoneal macrophages. This order is the same as that after acute exposure to X rays.

KUENKEL, H. A., H. MAUSS and K. MIHM
Radiobiological investigations with choromium-labeled erythrocytes. IV. Is there a relation between erythrocyte lifetime and radiosensitivity?
Strahlentherapie, 131:137-42 (Sept. 1966) (In German)
Source of abstract: NSA 21:390, No.3442 (Feb. 15, 1967)

Red cell survival was determined by the use of chronium-51 in two different strains of rats (Wistar and BD1). The mean survival time was 52 days in Wistar-rats and 68 days in BD1-rats. After whole-body x-irradiation with 900 r 77% of the Wistar-rats died within 30 days. BD1-rats, however, were extremely radioresistant (mortality after 900 r: 21% in 30 days). Red cell survival is not shortened by radiation of this dosage range. In two different strains of mice similar differences were observed. The life span of the erythrocytes of C57-mice was found to be 34 days, that of NMRI-mice 46 days. After irradiation with 550 r 78% of the C57-mice died within 30 days, whereas a mortality of only 34% was observed in NMRI-mice. In this case, too, animals with shorter red cell survival were much more radiosensitive. It is supposed that there exists a general connection between radiosensitivity of mammals and survival time of their erythrocytes. The increased radiosensitivity of animals with erythrocytes of shorter life span (compared with another strain of the same species) might be caused by a faster turnover and rapid production of new red cells in the bone marrow of those animals.

LANGEVOORT, H. L., F. J. KEUNING, J. v. d. MEER, P. NIEUWENHUIS and P. OUDENDIJK
Histogenesis of the plasmacellular reaction in the spleen during primary antibody response in normal and sublethally x-irradiated rabbits.
Koninkl. Nederl. Akademie Van Wetenschappen-Amsterdam, Proc. Series C. 64:397-404 (1961)

(See section A for abstract)

LEBEDEV, K. A.
Immunological response of rabbits irradiated with x-rays after repeated administration of antigen. 1. Study of the dynamics of appearance and meophology of antibody - containing cells by means of the "Indirect Method" of coons.
Radiobiologiia 5:132-41 (1965)

(See section A for abstract)

LEBEDEV, K. A.
The influence of immunization on the resistance of an organism to the radiation factor of space flight.
Problems in Aerospace Med. (Oct. 21, 1966)
Source of abstract: STAR (NASA) 5:198, No.N67-11575 (Jan. 23, 1967)

The lymphoid tissue of irradiated rabbits which were immunized before irradiation were studied to investigate the mechanisms involved in the protective action of various antigenic agents. After irradiation, it was shown that there was destruction in the multiplication centers of the secondary follicles in the lymph nodes. In studying the antibody-containing cells, it was found that after irradiation the number of these cells increased in the same manner as in nonirradiated immunized rabbits. The radiation resistance of the actively multiplying hemocytoblasts is thought to be the reason for the accelerated regeneration of lymphoid tissue.

LEBEDEVA, G. A.
Lesions of the gastrointestinal tract in chronic radiation sickness caused by multiple x irradiation.
Ark. Patol., 24:21-6 (Oct. 1962). (In Russian)
Source of abstract: NSA 20:4947, No.40645 (Nov. 30, 1966)

Studies were made in 12 dogs which had been subjected to x rays 1 to 5 times per week in doses of 5, 10, or 30 r per day at intervals from 1 to 2 months for a duration of 4 months to 7 yr. Total doses of 1540 to 6950 r were administered. Chronic radiation sickness developed in the animals. Postmortem investigation showed hemorrhages in the wall of the gastrointestinal tract, moderate atropy of the mucous membrane of the stomach and intestine, sclerotic changes, disturbances of the vascular, lymphatic, and nervous tissue, and a change in the cellular composition of the stroma. In one dog, which died 7 years after irradiation (total dose of 6950 r) malignant changes were discovered. The extent of injury to various segments of the gastrointestinal tract differed; the most pronounced changes occurred in the stomach. There appeared to be no strict relation between the severity of pathologic changes and the radiation dose.

LOEHR, E.
Early reactions of the peripheral blood and the bone marrow after lethal whole-body irradiation. Part I.
Strahlentherapie,130:245-64 (June 1966) (In German)
Source of abstract: NSA 20:5246-7, No. 42955 (Dec. 15, 1966)

(See section N for abstract)

LOSHAK, A. YA.
The question of the biological effect of combined x-ray and superhigh-frequency radiation.
Problems in Aerospace Med. (Oct. 21, 1966)
Source of abstract: STAR (NASA) 5:199, No.N67-11582 (Jan. 23, 1967)

The effect of decimetric radio waves of low intensity and the effect of total and local ionizing radiation on the survivability of rats after x-ray irradiation with a lethal dose of 100/30 was studied. The purpose of the study was to examine the degree of sensitivity of rats to the subsequent action of lethal doses of ionizing radiation, and to determine the possibility of increasing the radiation resistance of the organism. Results of the experiment did not show the presence of a protective effect of preliminary microwave irradiation, and it was not possible to establish differences in the survival of rats subjected to general or local (head) effects of superhigh frequency energy. Data indicated a considerable reduction in the resistance of rats to the combined effect of decimetric radio waves of low intensity and of ionizing radiation. This phenomenon is attributed to the single direction of the morphological and functional changes in the organs and tissues, particularly in the hemopoietic system, occurring under the influence of the electromagnetic fields of the decimetric range and of x-rays. The less expressed biological effect of the superhigh frequency irradiation of the head of the rats was connected with the absence of the direct effect of microwaves on the hemopoietic organs, especially on the bone marrow.

L'VOVA, T. S.
The influence of vibration on the course and outcome of radiation injury in animals.
Problems in Aerospace Med. (Oct. 21, 1966)
Source of abstract: STAR (NASA) 5:200, No.N67-11586 (Jan. 23, 1967)

Tests were conducted on mice and dogs to determine the realtionship between the frequency of vibration, radiation dose, and time between exposures on the occurrence and degree of radiation injury. In tests on mice it was established that the preliminary action of vibration with a frequency of 700 hertz at four hours and one day before irradiation reduced mortality rates by 10 to 20% and increased the average life span of the animals which subsequently died by 10 to 40%. The preliminary action of vibration five days before irradiation increased mortality rates and reduced the average life span of these animals. The application of vibration every four hours for one day and five days after irradiation reduced mortality rates by 15 to 38% and increased the average life span of the animals which eventually died. The preliminary action of vibration after one hour did not influence the course or outcome of radiation injury. Radiation sickness was intensified when a vibrational frequency of 700 hertz was applied after irradiation. Studies of hematological indices of dogs irradiated at two hours or one day after vibration showed that the quantity of leucocytes and erythrocytes was higher than that of control animals. No persistent and expressed shifts were observed with respect to leucocytic number.

MASTRYUKOVA, V. M. and A. D. STRZHIZHOVSKIY
Comparative study of the cytogenetic effect of protons with an energy of 630 MEV and of the gamma radiation of cobalt-60.
Problems In Aerospace Med. (Oct. 21, 1966)
Source of abstract: STAR (NASA) 5:201, No. N67-11591 (Jan. 23, 1967)

Corneal epithelium of mice was subjected to irradiation with 630 mev protons and gamma radiation of Co^{60} to determine the damaging effects of high energy protons on tissue regeneration. Irradiation with 630 mev protons in doses of 100, 200, 700 and 1000 rad caused reversible suppression of mitotic activity in corneal epithelium. The intensity of mitotic activity restoration decreased with an increase in radiation dosage. The quantity of cells with chromosomal aberrations increased exponentially with an increase in dosage. The average effective dose was 560 rad. Damage to cell genetic structure sharply suppressed cell reproduction and resulted in the formation of pathological mitoses shortly after irradiation. Classification of chromosomal aberrations by types aided in establishing a correlation between the degree of suppression of cell reproducibility and type of chromosomal abberation. Studies of the effects of Co^{60} yielded significant data on the nature of mitotic activity restoration and the distribution of chromosomal abberations related to intracellular reparation and radiation effects. The relative biological effectiveness of 630 mev protons, as compared with gamma radiation of Co^{60} was 0.7.

OGAWA, K.
The effects of x ray irradiation of the liver on the function of the reticulo-endothelial system.
Nagoya Med. Jr. 9:97-105 (Dec. 1963)

X-radiation doses of 30, 60, 90, 120, 250, 500 and 1000 r were delivered to a 2 x 2 cm area of surgically exposed livers of guinea pigs. The phagocytic capacity of histiocytes in subcutaneous tissues was tested with india ink particles 1, 3, 7, 14 and 21 days after local irradiation. Phagocytic power was enhanced with a dose of 90 r. With higher x-ray doses, less enhancement was observed, stimulation was still recognized at 500 r, and inhibition at 1000 r. The observed enhancement was evident on day 1 and persisted through day 21 post-irradiation.

PLURIEN, G., H. SENTENAC-ROUMANOU, R. JOLY and J. DROUET
Influence of electromagnetic radiation emitted by radar on the phagocytic function of cells in the reticulo-endothelial system of mice.
(Centre d'Etudes et de Recherches de Biologie Appliquees a la Marine, Toulon, France). Compt. Rend. Soc. Biol., 160:597-9 (1966) (In French)
Source of abstract: NSA 21:390, No.3446 (Feb. 15, 1967)

The effects of high frequency electromagnetic radiation emitted by radar on phagocytic activity of cells of the reticulo-endothelial system of mice were studied. Results indicated a period of excitation was followed by a depression of phagocytic activity during chronic exposure over a 20 day period.

POLYAK, A. I.
Changes in immunological reactivity and morpholgical construction of lymphoid tissue at various stages in radiation injury.
Meditsinskaya Radiologiya 7:51 (1962)

(See section A .or abstract)

PUKHAL'SKAYA, E. CH., S. N. GOLUBKOVA, M. M. NIVINSKAYA and A. S. LYUFACHUN
Changes in the myelogram of normal and irradiated rats after administration of serotonin.
Med. Radiol., 11:No.9, 60-5 (Sept. 1966). (In Russian)
Source of abstract: NSA 21:383, No.3420 (Feb. 15, 1967)

A repeated subcutaneous administration of serotonin in doses of 5 to 10 mg/kg caused a distinct rise of the percentage of cells in the reticular syncytium of rat bone marrow. A similar reaction of the bone marrow was observed in rats after serotonin administration in the stomach by means of a tube. Indices of maturation of granulocytes and erythroblasts in the bone marrow did not change. Serotonin caused a moderate leukocytosis in peripheral blood at the expense of augmented quantity of mature neutrophils and lymphocytes. Maturation of granulocytes in the bone marrow and their increased quantity in the blood was enhanced by repeated subcutaneous injections of serotonin in rats exposed to 650 R whole-body irradiation.

ROBINSON, E. and A. HOCHMAN
The effect of typhoid vaccine injection of partial body irradiated rats.
Acta Haematologica 34:301-304 (1965)

Male rats (Hebrew University local strain) received partial body exposure at a dose rate of 130 r/minute at 200 Kv. Total leukocyte counts were done immediately before and on the 5th day after irradiation. On the 5th day, one ml. of typhoid vaccine containing 1000 millions S. typhi, 500 millions S. para typhi A and 500 millions S. para typhi B was injected s.c. and leukocyte counts performed 1, 4 and 6 hours later. X-radiation doses of 250, 500, 750 and 1000 r were delivered. The present experiments show that the one hour leucocyte count was lower in the upper-body than in the lower-body irradiated groups. The 4 and 6 hour counts show that the release of leucocytes from the bone marrow was more depressed in the lower-body than in upper-body irradiated groups. The probable explanation of this is that irradiation damages both the intravascular leucocytes and the cells in the bone marrow. Typhoid vaccine injection augments the sequestration of damaged cells in the reticulo-endothelial system in the first hour. As the blood volume is larger in the upper than in the lower-body, a lower one hour white cell count is seen in the upper-body irradiated group. The active bone marrow is mostly concentrated in the lower body and so the 4 and 6 hour counts, which represent the release of cells from the bone marrow, are lower in the lower-body than in the upper-body irradiated group. The 1 hour count in the groups which received 1000r was similar to that in the controls. This was probably due to the fact that this dose destroyed most of the cells so that the typhoid vaccine could not augment the sequestration of intravascular cells. It is of interest that the 6 hour leucocyte count in the 250r lower-body irradiated group was higher than the control. It is possible that this dose stimulates the bone marrow to release more cells.

SAFIER, S., H. P. WAGNER, H. COTTIER, K. RAI, C. R. JANSEN and E. P. CRONKITE
Lymphoid cell lines in the thoracic duct of the calf with different generation times.
From Conference on Germinal Centers of Lymphatic Tissue, Bern, Switzerland. (1966)
Source of abstract: NSA 21:708, No.6610 (March 15, 1966)

Evidence is presented indicating that at least two populations of lymphoid cells with different tinctorial properties and unequal DNA synthesis and generation times exist in the thoracic duct of calves. A single intravenous injection of ^{3}H-thymidine was given after extracorporeal irradiation of circulating blood. The population having more-basophilic cells had a DNA-synthesis time of 3 1/2 hrs. and a generation time of 5 1/2 to 6 hrs., whereas the population(s) having less-basophilic cells were characterized by longer DNA-synthesis and generation times.

SAVITSKII, I. V., I. V. ZARETSKAYA and L. M. SHAFRAN
Glycogen and ribonucleic acid content and phagocytic acitvity of the leukocytes in x-ray irradiation of rabbits.
Radiobiology (USSR) (Engl. Transl.) 6:24-7 (No. 1, 1966) Orig.p.17-19.

In rabbits irradiated at a dose of 900 r, the phagocytic activity of the leukocytes is sharply reduced, there is an impoverishment of the cytoplasm of the neutrophils in glycogen, all the way to its complete disappearance on the seventh day after irradiation, and the amount of RNA changed. Qualitative changes in the cellular structures of the leukocytes are observed: Hypersegmentation of the nucleus, the appearance of unstained granules in the protoplasm, a decrease in granularity, and an inability of it to bond dyes. The weakening of the phagocytic acitvity of the leukocytes is evidently coupled with a decrease in their glycogen and RNA content.

SELVARAJ, R. J. and A. J. SBARRA
Effects of x-irradiation on the metabolic changes accompanying phagocytosis.
Nature 210:158-161 (1966)

Particle uptake by polymorphonuclear neutrophils (PMN) is known to be accompanied by a number of metabolic changes in the phagocytes. For example, an increase in the rate of oxygen consumption and glycolysis and a large stimulation of the oxidation of glucose-1-^{14}C and formate-^{14}C have been reported to accompany phagocytosis by guinea-pig exudate PMN. A variety of antimicrobial agents and hydrolytic enzymes are also known to be released from cytoplasmic granules of PMN during phagocytosis. *In vitro* irradiation of exudate guinea-pig PMN with x-ray doses up to 50,000 r had little or no measurable effect on the phagocytic and metabolic functions of these cells. Attempts to demonstrate an effect of x-rays by irradiating the cell suspension in 100 per cent oxygen atmosphere and/or preincubating the cells in order to deplete endogenous substrates were also not successful. The effects of high dose (1,500 r) whole-body x-irradiation on the phagocytic and the related abilities of the casein-induced exudate PMN to oxidize glucose-1-^{14}C and formate-^{14}C were studied. Two different experimental conditions were set up: In one, six animals were injected with casein and, 18 h later, all

were irradiated. The cells were collected and examined 1 h after irradiation. In another, six different animals were exposed to x-irradiation and 6 h later casein was injected. The resulting exudates were collected 18 h later for investigation. Exudate PMN obtained from non-irradiated animals were included and acted as our controls. The PMN induced after the high dose of x-irradiation phagocytized poorly and also exhibited a lowered phagocytic-metabolic rate. Experiments conducted with low doses of whole-body x-irradiation revealed that a decreased phagocytic ability and metabolic activities of the PMN could be demonstrated on the ninth and third post-irradiation day, with 50 r and 100 r respectively. Some decrease in metabolic activity was evident in the groups exposed to 100 r as early as 2 days after irradiation. All the metabolic parameters investigated are affected by doses of irradiation as low as 100 r, and these parameters do not completely return to the normal state as late as 30 days after irradiation. However, the phagocytic ability of the cell appears normal as early as 21 days after irradiation. These results suggest that the PMN, despite altered metabolism, is able to "phagocytize normally" only because the cell has now lost its selective membrane permeability and that is now possible for it to take up particles indiscriminately.

SERAYA, V. M., N. I. RYZHOV, N. N. DERVENEVA, T. YE. MASHINSKAYA, D. YA. OPARINA
Changes in the hematopoietic systems of rats irradiated with protons with an energy of 126 Mev and gamma rays of cobalt-60.
Prob. Aerospace Med. 442-3 (Oct. 21, 1966)
Source of abstract: STAR (NASA) 5:206, No.N-67-11637 (Jan. 23. 1967)

Hematological changes caused by proton irradiation from a synchrocyclotron and by Co^{60} gamma-radiation were compared. A phase character was noted in the changes in quantity of leucocytes and the nucleus-bearing cells in bone marrow. Details are given on these phases. It was found that the processes of the disturbance of hematopoiesis are identical but that the degree of their manifestation and the times of their occurrence are somewhat different.

SHMAKOVA, N. L. and S. P. YARMONENKO
The mechanisms of injury and defense of the bone marrow of animals in the case of proton and x-ray radiation.
Problems In Aerospace Med. (Oct. 21, 1966)
Source of abstract: STAR (NASA) 5:209, No. N67-11671 (Jan. 23, 1967)

Experimental data on radiation effects on the bone marrow of mice are reviewed. Cytologic analysis showed that the leading component of radiation damage during the first day is the delay of cellular division and the discharge of regular elements into the bloodstream. It was found that chromosome damage of the cells do not affect the rate of bone marrow exhaustion, but do determine the outcome of radiation injury.

SKLYANSKAYA, Ye. I. and O. P. PETERSON
Cellular shifts in lymph nodes of normal and irradiated animals vaccinated against influenza.
Voprosy Virusologii 9:83-90 (1964)

The authors studied the effect of vaccination with "influenza antitoxin" (sic) type A on the cellular response in lymph nodes of sub-lethally x-irradiated mice and rats. The response was followed in four groups of animals 1) irradiated and vaccinated; 2) vaccinated only; 3) irradiated only; 4) untreated controls. Animals were sacrificed 1, 2, 4 and 7 days after vaccination. Irradiation decreased lymph node weight and plasmocytic responses (in terms of immature cells) in all groups, although vaccination with adjuvant lessened these effects and increased the extent and duration of the response and maintained lymph node weight at normal levels. No increase in titer of circulating antibody was noted in adjuvant treated animals but authors attribute the latter to insensitivity of their technique (details of which are not given). The authors speculate on the analogy of the findings observed here and those observed with cortisone treatment and proposed the possibility that increased resistance to radiation following vaccination is due to hormone inbalance.

SMITH, W. W., I. M. ALDERMAN and R. E. GILLESPIE
Hematopoietic recovery induced by bacterial lipopolysaccharide in irradiated animals.
Rad. Res., 7:451, No.119 (1957)

(See section T for abstract)

STEPANYAN, E.D. and T.H. MARUKYAN
Phagocytic activity of the leukocytes in immunized rabbits due to ionizing radiation effect.
Vopr. Radiobiol. 2:131-42 (1961) (In Russian)
Source of abstract: NSA 18:2659, No. 19736 (June 30, 1964)

It was shown that intravenous immunization of rabbits with killed bacteria or sheep erythrocytes stimulated phagocytosis. X-irradiation (300 r) of the animals changes phagocytosis variably, as does its administration before and after immunization. A double vaccination of rabbits with homogenous antigen (bacteria or erythrocytes) rendered phagocytosis more active. Irradiation between vaccinations suppressed or normalized phagocytosis. Immunization of the rabbits with heterogenic antigens increased phagocytosis. Phagocytosis and the formation of antibodies in immunized and irradiated-immunized animals often takes place in parallel.

TENOSO, H.J.
Effect of irradiation and brucella infection on the malic dehydrogenase activity of rabbit peritoneal macrophages.
University of Calif., Los Angeles Thesis (1966)
Source of abstract: NSA 20:4681, No. 33586 (Nov. 15, 1966)

A metabolic approach was used to study the host-parasite relation between B. abortus and rabbit peritoneal mononuclear cells. The malate dehydrogenase activities of mononuclear cells from normal, Brucella-infected, and

irradiated rabbits were examined and an attempt was made to correlate these differences with ability of the cells to survive Brucella infection. Findings showed that by using inhibitory concentrations of malate specific differences in malate dehydrogenase activity could be found among mononuclear cells from normal, immune, and irradiated rabbits. Mononuclear cells from rabbits infected with Brucella had an increase (relative to cells from normal rabbits) in MDH activity from the third post-infection day onward. Agglutinating antibody was demonstrable in the circulation of these rabbits on the fifth day. In the irradiated rabbits a reduction in MDH acitivty could be detected on the fourth through the sixth day. When rabbits were both irradiated and infected with Brucella it was possible to detect increases in MDH activity in the absence of agglutinating antibody. The evidence suggests that the malate dehydrogenase activity was specific for Brucella and that there was no direct correlation between agglutinating antibody and changes in MDH activity. There are two possible explanations for the change in MDH activity. One is that some part of the bacterial cell remains for long periods of time exerting a constant effect on the enzyme directly (on an allosteric site) or through some intermediate. The other explanation is that some part of the bacterial cell induces a precursor cell to start producing an isomer of malate dehydrogenase with different activity. The suggestion is implicit that a heightened enzymatic response in peritoneal macrophages of an infected animal may be of some significance in assessing the animal's ability to survive specific bacterial invaders.

THOMSON, R. A., S. M. MICHAELSON and J. W. HOWLAND
Leukocyte response following simultaneous ionizing and microwave (radar) irradiation.
Blood, 28:157-62 (Aug. 1966)
Source of abstract: NSA 20:4948, No.40650 (Nov. 30, 1966)

Simultaneous microwave and x-irradiation at a sublethal x-ray dose level modify the hematologic response to x-irradiation. Earlier neutrophil recovery and delayed lymphocyte and hematocrit recovery resulted following simultaneous microwave and x-ray exposure.

TROITSKII, V.L., M.A. TUMANIAN and A. Ia. FRIDENSHTEIN
Investigations on the effect of ionizing radiations on natural immunity.
J. Microbiol. Epidemiol. Immunobiol.(USSR) (English Translation) 29,839-46 (1958)
Source of abstract: TID-3089, Book 2, 1136, No. 9466 (Sept. 1963)

The course and outcome of radiation sickness are affected to a considerable extent by auto-infective processes caused either by commensal bacteria or by pathogenic bacteria in the case of latent forms of infection. Radiation bacteriemia is the result of inhibition of the body's auto-sterilization mechanism which is normally functioning in the gut wall. This mechanism is based upon the phagocytic activity of macrophages in the gut wall.

TSUKAMURA, M. and S. TSUKAMURA
Modification of distribution of ^{35}S-labelled mycobacterial vaccine in mouse organs by x-ray irradiation.
Japan. J. Tuberc. 12:41-5 (1964)

CF1 mice were immunized i.a. with heat-killed Mycobacterium smegmatis (Jucho strain) and challenged 3 weeks later with an i.v. injection of M. tuberculosis H37 Rv. An x-radiation dose of 4080 r was delivered at 83 kv at a dose rate of 17 r/minute immediately after vaccination. The effect of vaccination was decreased significantly by x-ray irradiation. In control animals, a majority of the vaccine labeled with ^{35}S or its degradation products were found in the lungs, liver and spleen as early as on the first day after vaccination. The total amount of radioactivity, derived from the labeled vaccine, was maintained in these organs even after seven days, but the specific radioactivity in the organs was decreased by the swelling of the organs after seven days. On the other hand, the organs of x-ray-irradiated animals, especially the lungs and spleen, took up much less vaccine and released some of it after seven days. The organs of prednisolone-treated animals took up the vaccine to the same extent as those of control animals after one day, but they released a considerable amount of it after seven days. It is suggested that x-ray irradiation of the animals inhibits the fixation of the vaccine by the organs and the organs of the irradiated animals can combine only loosely the vaccine or its degradation products.

TSUKAMURA, M. and S. TSUKAMURA
Further observations on the effect of x-ray irradiation on the fate of ^{35}S-labeled vaccine in mouse body.
Japan. J. Tuberc. 13:1-5 (1965)

Mice (CF1 strain) were vaccinated with an ^{35}S-labeled heat-killed vaccine of Mycobacterium smegmatis (Jucho strain). X-radiation (2640 r) was delivered immediately after vaccination at 83 kv at a dose rate of 11 r/minute. One, 7 and 14 days later control and irradiated mice were sacrificed and livers and spleens were homogenized for mitochondrial and microsomal fractions. It was noted that the uptake of the radioactivity by the liver and spleen was decreased in irradiated animals one day after vaccination. At this stage the specific radioactivity also decreased in these organs. Furthermore, the specific radioactivity of the mitchondrial and microsome fractions of the spleen was significantly low. This early change in the spleen may be related to the decrease of protection power observed previously. Fourteen days after vaccination, the uptake of the radioactivity by the organs and specific radioactivity in all the subcellular fractions became very low in the irradiated animals. On the other hand, the quantity of the radioactivity and the specific radioactivity were maintained at high levels in the control animals. It was suggested that in the irradiated animals the organs could not fix the vaccine as firmly as in the control animals.

VANČURÍK, J.
Effect of x-irradiation on the course of experimental vaccine anthrax.
Folia Microbiologica 9:164-172 (1964)

(See section B for abstract)

VODYANNIKOVA, A.A.
The effect of ionizing radiation on the micro-flora and the course of the wound process in experimentally induced infected wounds.
Byull. Eksptl'. Biol. Med. 48, No. 7, 34-8 (July 1959) (In Russian)
Source of abstract: TID-3089, Book 2, 1137, No. 9475 (Sept. 1963)

Experiments conducted on white rats and mice demonstrated that x-ray irradiation of the animals with local purulent focus caused an acute depression of phagocytosis and pronounced increase of the number of microbes in the wound with increase of their pathogenic properties. This promotes the generalization of the process(bacteremia) and causes the death of the animals.

WOLF, J. S. and D. M. HUME
Transplant immunity in animals with lymphocytopenia induced by indwelling beta irradiation.
Surg. Forum 16:202-4 (1965)
Source of abstract: NSA 21:228, No.1817 (Jan. 31, 1967)

Intra-arterial irradiation of circulating blood with beta emitting ^{90}Y silica coated pellets produced lymphocytopenia in dogs, which persisted after the acute radiation period. The radiation-induced lymphopenia caused immune responses to be weakened with respect both to foreign protein and organ homografts.

YANUSHEVSKAYA, M. I. and N. F. BARAKINA
Investigation of local and remote irradiation influences on proliferative activity of marrow cells.
Radiobiologiya, 6:237-40 (1966) (In Russian)
Source of abstract: NSA 21:530 No.4855 (Feb. 28, 1967)

The mitotic activity of bone marrow cells was studied in mice administered 200, 400, 700, or 1000 r whole-body doses of x-rays, in animals in which a hind limb was shielded during x-ray exposure (700 r), and in animals in which the excised small intestine was irradiated (700 and 3000 r). Inhibition of the mitotic activity of the marrow cells exhibited a direct dependence upon the radiation dose (within the dose range 200 to 1000 r). Long-term effects of irradiation upon the proliferative activity of the marrow cells were transitory, depending upon the radiation dose and the dimensions of the exposed portion of the body. No tissue specificity was evident. The mitotic activity of irradiated marrow cells was rapidly restored when nonirradiated hematogenic tissue was present in the organism, which is explained by migration of undamaged cellular elements and by the influence of humoral factors penetrating from intact tissue.

ZHABINA, M. I. and R. V. PETROV
Radioprotective action of marrow transplanted before irradiation.
Radiobiologiya 6:329-30 (1966) (In Russian)
Source of abstract: NSA 21:528 No. 4834 (Feb. 28, 1967)

(See section T for abstract)

ZUKHBAYA, M. P., B. A. KALANDOROVA, N. A. MARKELOV, N. A. POPOVA and YE P. SIZAN
The biological effect of a 12-time repeated gamma radiation treatment of white mice.
Prob. Aerospace Med. 231-2 (Oct. 21, 1966)
Source of abstract: STAR (NASA) 5:193, No. N67-11523 (Jan. 23, 1967)

Results are presented from an investigation in which white mice were subjected to repeated once-a-month gamma radiation with a dose of 12.5 roentgens to a total dose of 150 roentgens/year. Consideration is given briefly to the hemopoietic system, mitotic activity in cornea epithelium, chain motor conditioned reflexes, and radiation injury compensation in the central nervous system.

NONSPECIFIC SERUM FACTORS

BYKHOVSKII, A.V., G.S. KOMOVNIKOV and B.V.POLUSHKIN
Effect of zymozan on the macrophage response of the lungs and phagocytosis in acute radiation sickness.
Vest. Akad. Med. Nauk SSSR, No. 9, 83-6 (1965) (In Russian)
Source of abstract: NSA 20:4277, No. 35341 (Oct. 15, 1966)

(See section C for abstract)

EREDE, P., F. DURST and A. M. PODESTA
Effects of irradiation with ^{60}Co on the amino acid content of the liver and kidney of the rat.
(Univ., Genoa). Pathologica, 56:245-8 (Sept.-Oct. 1964). (In Italian)
Source of abstract: NSA 21:390, No.3448 (Feb. 15, 1967)

Rats 2 1/2 months old were exposed to various doses of ^{60}Co γradiation: 300 r in three 100-r doses, 450 r in two 225-r doses, 450 r in a single dose, and 600 r in a single dose. Eight days after the last radiation exposure, liver and kidney were removed and hydrolyzed in 6N HCl. Amino acids in these organs were then studied by two-dimensional chromatography. The liver of irradiated rats showed lower levels of glycine and threonine than normal liver. The nitrogen content of liver also decreased as a result of irradiation, from a control level of 27.8 mg N/g to 25.9 in the 600-R group. In irriated kidney, lower than normal contents of glutamic acid, glycine, threonine, leucine, and basic amino acids (lysine, arginne, and histidine) were noted. In kidney also, N content decreased, from 28.9 mg N/g in controls to 2[illegible].9 in the 600-r group. Levels of cystine, serine, alanine, tyrosine, valine, and phenylanine were relatively unaffected in both organs by irradiation. In general, the decline in the other amino acids and in N content was proportional to the radiation dose.

HAWRYLEWICZ, E. J. and W. H. BLAIR
Effect of gamma and proton irradiation on lactic dehydrogenase isoenzymes.
Rad. Res., 28:538-47 (June 1966)
Source of abstract: NSA 20:3795, No.31105 (Sept. 15, 1966)

Exposure of monkeys (Macaca mulatta) to γ and proton radiation causes marked alterations in the serum and the tissue LDH enzyme activity. The increase of serum activity is a reflection of an immediate increase in the M-LDH isoenzymes, and subsequently an inversion and crossover point are observed. At this point the H-LDH isoenzyme acitivity predominates. The extent of the increase, the rate of the increase, and the extent of alteration of the isoenzyme ratios are functions of dose, energy level, and type of radiation. Gamma radiation produces the most rapid and severest response.

KASHKIN, K. P. and S. V. ALEKSANDROVA
Changes in the composition of the serum proteins of animals injured by irradiation.
Vestn. Akad. Med. Nauk SSSR, 20: No. 9, 193-6 (1965) (In Russian)
Source of abstract: NSA 20:3250, No. 26650 (Aug. 15, 1966)

Serum proteins of mice irradiated with x rays and of rats and monkeys irradiated with γ rays of ^{60}CO, were changed, as was demonstrated by immunoelectrophoresis utilizing high resolution rabbit antiserums in intact and irradiated animals. Antiserums to the serum of irradiated animals were not completely neutralized by adsorption with the corresponding serums of the intact animals. These antiserums were distinguished by increasing heterogeneity. Reduction of γ globulin content was a result of cell and of lymphoid tissue destruction. Albumin decrease followed a redistribution between the inner and outer vessel channels. Some α- and β-globulin fractions were increased, others were decreased. There were fractions with varying electrophoretic mobilities in the areas of transferrin and α_2-globulin.

KUNDEL, H. L.
Effect of high-energy proton irradiation on the cardiovascular system of the rhesus monkey.
Rad. Res., 28:529-37 (June 1966)
Source of abstract: NSA 20:3795, No.31104 (Sept. 15, 1966)

During the first 24 hours after total-body irradiation of the rhesus monkey (Macaca mulatta) with 3680 rads of 138-or 400-Mev protons, there is a decrease in mean arterial pressure similar to that observed in monkeys irradiated with an equivalent dose of ^{60}Co γ-radiation. Irradiation of monkeys with the same dose of 55-Mev protons also causes a decrease in mean arterial pressure, but of much lesser magnitude than at the higher energies. After irradiation with 32-Mev protons, although there is an immediate decrease of mean arterial pressure, recovery occurs by 6 hours postirradiation. The response of the mean arterial pressure to small intravenous doses of norepinephrine is diminished immediately after irradiation with 55-, 138-, or 400-Mev protons. The animals in the 138-Mev and 400-Mev proton-irradiated groups showed recovery by 24 hours, a pattern similar to that seen in the ^{60}Co γ-irradiated animals. The abnormality persisted in the 55-Mev proton-irradiated animals. The 32-Mev proton-irradiated animals showed only a minimal decrease in responsiveness to norepinephrine immediately after irradiation. The differences in response of the rhesus monkeys to the same surface dose of different proton energies is attributed to differences in depth-dose distribution of the protons. At energies of 138 and 400 Mev, where deposition of energy is relatively uniform, the effects are similar to those of ^{60}Co γ-irradiation, and it is suggested that the RBE for these effects approximates 1. At lower energies, where only the outer portion of the body is irradiated, the effect on the blood pressure is not as great. Because of difference in depth-dose distribution, an RBE cannot be validly calculated.

LINDSAY, I. R., G. V. DALRYMPLE, J. J. GHIDONI, J. C. MITCHELL and I. L. MORGAN
Some effects of 55-Mev protons on primates.
Rad. Res., 28:446-64 (June 1966)
Source of abstract: NSA 20:3794, No.31099 (Sept. 15, 1966)

Seventy-four primates (Macaca mulatta) were given spaced doses of 55-Mev protons to the whole-body surface. The mortality data, hematological measurements, and LDH and SGOT concentrations demonstrate an effect intermediate between that of poorly penetrating 32-Mev protons and that of radiation that completely penetrates the primate. In addition, 12 animals received partial-body exposures of 55-Mev protons in single spaced doses to the abdominal area. These exposures produced the gastrointestinal syndrome with no accompanying hematological injury, and a linear relationship between survival time and dose was demonstrated.

LOEHR, E.
Early reactions of the peripheral blood and the bone marrow after lethal whole-body irradiation. Part I.
Strahlentherapie, 130:245-64 (June 1966) (In German)
Source of abstract: NSA 20:5246-7, No. 42955 (Dec. 15, 1966)

The effects of an exchange transfusion made during whole-body irradiation of female rats on the cellular constituents of the peripheral blood and the hemoglobin content of erythrocytes was investigated for lethal radiation doses. Possibility of the extension of the life span by this treatment was also investigated. The exchange blood obtained during the irradiation was studied biochemically. The results showed that in the peripheral blood after a whole-body x irradiation of 780 r no radioinduced inhibition of the enzymatic activity was detected in the enzymes investigated: Hexokinase, glycerinaldehyde-3-phosphate-dehydrogenase, glucose-6-phosphate-dehydrogenase, and glutathion-reductase. The altered substrate concentrations of the investigated adenine-nucleotide must be interpreted as a probably reversable perturbation of the energy metabolism. in contrast to the studies of previous workers, no reduction of the ATP concentration was detected in the peripheral blood after whole-body irradiation when this concentration is related to an equal number of cells. The alterations of the redox buffer system GSSG/GSH were less traceable to the radioinduced oxidation processes than to the modifications of the total concentration on the bases of the radioinduced permeability disturbances of the erythrocytes. These investigations showed that after lethal whole-body irradiation in the dose range from 780 and 1500 r no incisive disturbance of the energy metabolism in erythrocytes is biochemically detectable.

PETROV, R.V.
Third part: Noninfectious immunology of radiation sickness.
JPRS 18620, OTS-63-21545 (April 9, 1964)
Source of abstract: STAR (NASA) 2:288, No. N64-11832 (Feb. 8, 1964)

(See section R for abstract)

SHCHEGOLEVA, R. A., NESTERENKO, A. I., CHERNOV, G. A.
Serotonin exchange in chronic radiation sickness.
Med. Radiol., 11:No.9,58-60 (Sept. 1966)
Source of abstract: NSA 21:383, No.3387 (Feb. 15, 1967)

The exchange of serotonin in chronic irradiation was studied in dogs. For the characterization of the serotonin exchange, a dynamic determination of the serotonin level in the blood, 5-oxyindolacetic acid in the urine, and the activity of ceruloplasmin in the blood serum were determined at different times post-irradiation. The results demonstrate that the exchange of serotonin is disturbed by chronic irradiation, phasic changes of the serotonin level appearing at early periods after the beginning of irradiation. Changes in the level of 5-oxyindolacetic acid in the urine and ceruloplasmin activity are correlated with alterations of the serotonin level in the blood.

SHILOV, V.M.
The epidemiological significance of a disturbance of immunity during affection by ionizing radiations.
Veonno-Med. ZH. 11:29-33 (1962)
Source of abstract: NSA 17:4266, No. 31977 (Oct. 15, 1963)

(See section R for abstract)

STEPANOV, E. P.
Sorption properties of internal organs under the combined influence of total gamma irradiation and burns.
Radiobiologiya, 6:349-52 (1966) (In Russian)
Source of abstract: NSA 21:715, No.6671 (March 15, 1966)

The sorption of an intravital dye, neutral red, by various tissues of the rat was studied after administration of gamma radiation, burns, and a combination of radiation and burns. Results are tabulated. Under the combined influence of total gamma radiation at a dose of 400 r and thermal burn, the effect of the injurious action is intensified, which is expressed in an increase in the sorption properties of most of the investigated tissues and a slower return to normal. The increase in the sorption properties of radiosensitive tissues under the combined influence gives a basis for assuming that burn, while itself inducing no significant changes in the sorption levels of the investigated organs, in conjunction with radiation intensifies the injurious effect of ionizing radiations.

THUERIGEN, G., N. JANSSEN and H. STENDFR
Influencing properdin and agglutinin formation by whole-body irradiation.
Strahlentherapie 130:131-8 (May 1966) (In German)
Source of abstract: NSA 20:4697, No. 38695 (Nov. 15, 1966)

The changes in properdin and in Brucella agglutinins in serum were investigated in rats after whole-body irradiation with ^{60}Co (500, 800, 900 rad, and 3 X 300 rad, respectively). The properdin level was decreased for about 3 weeks after 500 rad. A greater decrease was observed after fractionated

irradiation with 3 X 300 rad than with a single dose of 500 or 900 rad. Administration of Brucella antigen 3 and 5 days prior to irradiation decreases the fall of the serum properdin. The rise of the properdin level was observed at the same time at which production of agglutinin could also be found. Properdin, a system of heterologous effective and polyvalent antibodies, showed the same behavior as Blucella agglutinin after whole-body irradiation

VATTERONI, M.
Action of ionizing radiation on the nonspecific immunity level of subjects with malignant uterine neoplasms.
Quad. Clin. Obstet. Ginecol., 19:216-24 (April 1964) (In Italian)
Source of abstract: NSA 21:530, No.4853 (Feb.28, 1967)

The effect of ionizing radiation on nonspecific components of the body defense system, such as properdin and lysozyme, is reviewed. Clinical studies were made on women undergoing radiotherapy for uterine cancer. Five cases of adenocarcinoma of the body of the uterus and 15 cases of cervical carcinoma in stages II and III were studied. Serum properdin levels were determined in these patients before, immediately after, and one month after radiotherapy which entailed tumor doses averaging 6000 r. In general, the initial values of properdin varied in accordance with the severity of the malignancy and degree of metastases. In all 20 cases serum properdin levels were lower immediately after than before irradiation. A partial return toward initial values was noted one month post-irradiation. Higher initial and final levels were found in the five patients with corpus uteri carcinoma than in those with cervical cancer. The depletion of this nonspecific defense factor in blood after irradiation is further evidence of the impairment of immunity caused by ionizing radiation.

ZSEBOEK, Z. B., G. JANOSSY, G. PETRANYI JR., and L. KOVACS
In-vitro investigations of the absorption capacity of the small intestine after super-lethal x-irradiation.
Strahlentherapie, 131:122-36 (Sept. 1966) (In German)
Source of abstract: NSA 21:390 No.3441 (Feb.15, 1967)

Functional disturbances in the absorption of water, sodium, chloride, and glucose occurring in the small intestine of rats were investigated in vitro 24, 48, and 72 hours after whole body x irradiation with 1,500 r. The absorption of all substances was increased 24 hours after irradiation; the absorption was decreased 48 hours and considerably decreased 72 hours after irradiation and reached the low level of the irradiated intestine which was perfused without glucose. The ion concentration of the absorbed liquid was proportional to the extent of the damage to the epithelium and the decrease in water transport, and approaches the concentration values of the perfusion solution (Krebs-Ringer-solution). Histological and histochemical studies showed that there was no significant funtional difference between the intestine which had been perfused in vitro for 1 hour and the intestinal regions which had been fixed before the perfusion. Therefore, this method can be considered to be suitable for investigating this problem.

TREATMENT AND PREVENTION

AINSWORTH, E.J. and F.A. MITCHELL
Decreased radiation mortality in dogs treated with typhoid-paratyphoid vaccine.
US Naval Radiological Defense Lab. USNRDL-TR-880 (July 26, 1965)

An injection of Typhoid-Paratyphoid vaccine (TAB) given 24 hours before exposure of dogs to 360 R of 1 Mvp X rays reduced mortality to 13% as compared with 60% mortality among saline-injected controls. TAB given 1 hour after 360 R did not significantly reduce mortality. When given either before or after irradiation, TAB produced marked changes in the granulocyte levels during the second week after irradiation. In animals given TAB before irradiation a transient rise occurred in the number of circulating granulocytes between day 8 and 13. No distinct rise in granulocyte numbers was observed in animals given TAB after irradiation, but the counts in the treated animals were higher than in the controls. Platelets were also enumerated in dogs given TAB 24 hours before 195 R, a sublethal exposure. During the second post-irradiation week the platelet counts in the TAB treated animals were higher than in the controls.

ALEKSEEVA, O. G., E. I. LAVRENCHIK and S. P. YARMONENKO
Effects of antiradiation agents under conditions of fractionated irradiation. III. Evaluation of the effectiveness of vaccine prophylaxis in the case of prolonged radiation influence.
Radiobiology (USSR) (Engl. Transl.) 6:176-80 (No.1, 1966) Orig.p.112-14.

Immunization of mice with BCG vaccine two weeks before irradiation at doses of 650--680 r exerts a weak protective effect, consisting of some increase in the survival of the animals in individual experiments, in comparison with the control. Under conditions of four external irradiations at a summary dose of 1200 r (300 r each time at 48-hour intervals) or under the influence of radioactive phosphorus (10--20 mC/kg), preliminary vaccination is ineffective. On this model of fractionated irradiation, four administrations of AET or sodium aminoethylthiophosphate (cystaphos) caused 63 and 56% survival, respectively, as opposed to 5% survival in the control. When the indicated protectors were administered to vaccinated animals, 68 and 63% of the mice survived, respectively.

BENES, S. , M. MIHAESCU-NIGRIM, V. DOBRESCU and M. CIOBANESCU
Formation of antibodies rats receiving injections of vitamin K3 and exposed to x-irradiation.
Rev. Sanit. Mil., 16: Special No., 474-81 (1965) (In Rumanian)
Source of abstract: NSA 21:528 No.4829 (Feb. 28, 1967)

Preliminary studies on rats administered vitamin K_3 15 minutes before x-irradiation with 250 r showed that mortality was 55% in comparison with 19% in irradiated rats not having received the vitamin. However, in a later more comprehensive study results on the effect of K_3 on mortality and immunogenicity in irradiated rats were relatively uncertain despite statistical treatment.

BENES, S., M. MIHAIESCO-NIGRIM, AL. G. TURCANU and S. CIORANESCO
Attempts to protect the process of immunogenesis in irradiated mice by means of acellular preparation. (Essais de proteger, au moyen de preparations acellulaires, le processus d'immunogenese chez la souris iradiée).
Arch. Roumanian Path. Exper. Microbiol. 23:701-714 (1964)

Whole-body exposure to a single x-ray dose of 500 r strongly inhibited the appearance and development of sheep red cell agglutinins in animals inoculated 24 hours after irradiation. As compared with non-irradiated inoculated animals, the irradiated group displayed an obviously increased induction period and constantly and significantly lower mean titres. The mean total titre difference between the two groups was significant and total significant titre difference was considerable, both being in favour of the non-irradiated group. The protecting action of cell-free mouse liver homogenate and extract, administered to irradiated animals in amounts of 0.5 and 1.43 spleen equivalents respectively, was expressed by a significant increase in mean titres, as compared with those in untreated irradiated animals and by a decreased total significant titre difference and mean total titre difference (still significant) between the irradiated and the normal groups. In the group treated with 1.43 spleen equivalents of the extract the course of the curve became similar to that of the curve in the non-irradiated group and the peak mean titres were statistically similar. The action of irradiation on the group treated with 1.43 spleen equivalents of the extract was expressed only by a lower rate of antibody production. The shape of the titre curve in non-irradiated animals inoculated with antigen and with 1.43 spleen equivalents of the extract suggests that the preparation exerted an adjuvant action. However, definite conclusions connot be drawn from these experiments. Some criteria (statistical parameters) of immunological efficiency are discussed and comments are made on current hypotheses concerning protection and therapy by means of tissue preparations in irradiation disease.

BERGHEAU, S., N. GHEORGHE, O. CAVULEA and I. PLESCA
Experimental procedure for elimination of radioactive isotope in animals contaminated orally.
Rev. Sanit. Mil, 16: Special No., 418 (1965) (In Rumanian)
Source of abstract: NSA 21:525 No.4803 (Feb. 28, 1967)

Activated charcoal in gum tragacanth administered by gavage had little effect on chromium-51, iodine-131, phosphorus-32, and calcium-45 uptake by lungs, liver, spleen bone, kidneys and intestines. However, the same treatment followed by a drastic purgative agent had pronounced favorable effects.

BROWN, P. E.
Investigations of the mechanism of radioprotection by aminothiols.
(UCRL-16806, pp 39-41)
Source of abstract: NSA 21:387, No.3416 (Feb. 15, 1967)

Cystamine, one of the compounds most effective in protecting living material against ionizing radiation, has been shown to bind reversibly to DNA. The binding results in stabilization of the DNA helix, as indicated by the large increase in the melting temperature of the DNA. The dose of x or β rays at which destruction of he helix occurs is about 20 times as great for DNA bound with cystamine as for DNA alone. This protective effect is not due to scaveng-

ing by the excess cystamine in solution, but is associated with the bound cystamine. This in vitro protection may be due to removal of free radicals generated on the DNA, but it is suspected that a biological mechanism is more important for in vivo protection.

CAVULEA,O., N. GHEORGHE, A. GASPAR, I. PLESCA, S. BERGHEAU, GH. POPUSCU and T. MILEA
Effect of some subcellular thymus tissue fractions in radiation sickness in mice.
Rev. Sanit. Mil., 16: Special No., 414-17 (1965 (In Rumanian)
Source of abstract: NSA 21:527, No.4824 (Feb.28, 1967)

Mitigation of radiation sickness in mice was studied in animals given injections of mitochondria and nuclei. A single administration of mitochondria was more effective than repetitive treatments but administration of nuclei only was superior.

CORRENI, E., M. MIHAESCU-NIGRIM, S. BENES, G. BUZARNESCU
Effect of administration of immune hologous antitissular serum in irradiated mice.
Rev. Sanit. Mil., 16: Special No., 481-7 (1965) (In Rumanian)
Source of abstract: NSA 21:527 No.4822 (Feb. 28, 1967)

In mice, injection of homologous immune sera of spleen or liver homologous tissue antibodies tended to exert a protective effect against injuries from subsequent radiation as to onset of radiation sickness and total mortality.

COSTACHEL, O., I. CORNECI and T. ANDRIAN
Recent advances in biological protection against radiation lesions.
Rev. Sanit. Mil., 16: Special No., 339-64 (1965) (In Rumanian)
Source of abstract: NSA 21:524, No.4799 (Feb. 28, 1967)

Parameters of biological protection against radiation injuries reviewed include: mode of action; macromolecular protection with cell-free homogenates, plasma or serum components, and nucleic acids; and protection with viable cells emphasizing numbers of cells required. Data on radiation protection studies in rats, mice, guinea pigs, dogs and monkeys are tabulated. Immunological problems in transplanation of bone marrow are discussed.

DUPLISHCHEVA, A. P., K. K. IVANOV and N. G. SINILOVA
Influence of specific polysaccharides from typhoid fever bacteria and proteus with a structure partially modified by acid hydrolysis, acetylation, or oxidation upon the radioresistance of mice.
Radiobiology (USSR) (Engl. Transl.) 6, 225-9 (No. 2, 1966) Orig.p.318-21.

The protective properties of corpuscular vaccines, total antigens, and lipopolysaccharides, administered before irradiation, are evidently associated with stimulation of the protective forces of the organism, its cellular and humoral immunity, and are probably due to the presence of specific polysaccharides. It was of interest to determine whether fractiona-

tion of the polysaccharides will lead to the isolation of fractions exhibiting a stronger protective effect, as well as to study how changes in the basic chemical structure of the polysaccharides influence their protective properties. The specific polysaccharides from typhoid fever bacteria and Proteus, when administered i.a. 24 hours before irradiation (750 r) protect about 31% of the mice. Alcohol fractionation of the specific polysaccharides does not lead to the isolation of fractions more active in protective properties. Hydrolysis of the specific polysaccharides with 1N acetic acid sharply reduces the radioprotective properties. Oxidation of the specific polysaccharides with iodic acid does not cause any changes in their protective properties. Acetylation of the specific polysaccharides leads to a sharp reduction of their radioprotective properties.

FLEMMING, K.
Radiation protective effect and pharmacologically changed activity of the reticulo-endothelial system.
Nature 200:1117-18 (1963)

Olive oil, triolein, 2-oleodistearin and tricaprin stimulated the phagocytic activity of reticulo-endothelial cells 24 hours after injection and ethyl palmitate, ethyl stearate, ethyl oleate, and cholesterol oleate depressed it at this time. All these lipids exerted a protective effect against 610 r whole-body x-radiation in mice. The concept of enhanced activity of the reticulo-endothelial system as a factor in the survival of irradiated mice is discussed.

FLEMMING, K. and C. FLEMMING
Investigations on biological radiation protection. Part 73. The effects of pyrexal (lipopolysaccharide from Salm. abortus equi) on survival rate after x-irradiation.
Strahlentherapie, 131:150-9 (Sept. 1966) (In German)
Source of abstract: NSA 21:383, No. 3430 (Feb. 15, 1967)

Pyrexal (lipopolysaccharide from S. abortus equi) shows protective as well as a therapeutic effect in x-irradiated rats, mice and guinea pigs. In mice, pyrexal is effective in a broad dose range from 0.001 to 100 µg/animal (0.05 to 500 µg/kg body weight). A maximum effect was obtained with 500 µg/kg body weight and sublethal radiation doses. The pyrexal effect depended greatly on the time of injection: an injection done 96 hours prior to irradiation resulted in an increased radiation sensitivity. The time dependency of the pyrexal protection in rats and guinea pigs was different from that in mice.

GAL'CHIKOV, V. I., I. S. SLIZKIY, A. V. TUZIKOV and O. V. SHNYRENKOVA
Tissue acceptance of foreign bodies in radiation sickness.
Voyenno-Meditsinskiy Zhurnal, No. 7, p.94-100 (1960)
JPRS: 7432, CSO:1374-N/32

The purpose of this study by the Military Medical Service (USSR) was to determine the effect of x-radiation-induced injury on tissue acceptance of foreign bodies (fragments and bullets). A series of experiments were carried

out on 30 x-irradiated (800 r) involving many experimental conditions of radiation, trauma, surgical embedment of sterile and contaminated foreign bodies. Foreign bodies and the injuries produced by them in tissues and organs of irradiated animals do not exert any notable influence on the course of radiation sickness with the exception of cases in which the tissue is considerably destroyed at the time of infliction of the trauma as well as where there is a purulent-necrotic complication of the wound process. Radiation sickness of mild and moderate degrees of severity, developing as the result of irradiation with X-rays, does not delay the process of encapsulation of foreign bodies in the tissues and organs of experimental animals. In the case of a severe degree of radiation sickness the encapsulation of the foreign body is markedly retarded. Radiation sickness caused by radioactive substances injected directly into the tissues delays the plastic process. The use of penicillin contributes to a reduction in the number of post-traumatic complications. In addition to penicillin the use of streptomycin and other antibiotics, which can exert a beneficial effect in mixed infection, is possible. Surgical tactics for foreign bodies deeply situated in tissues and organs and not removed in the primary debridement from those affected by ionizing radiation should be performed in accordance with the clinical signs of the wound and with consideration of the possible functional-morphologic disturbances and late complications.

GONSHERY, L., R. Q. MARSTON and W. W. SMITH
Naturally occurring infections in untreated and streptomycin-treated x-irradiated mice.
Am. J. Physiol. 172:359-364 (1953)

A total of 935 mice were subdivided into groups and x-irradiated with doses of 550, 625, 700, 800, 1100 and 1400 r. One group irradiated with 625 r was given daily s.c. injections of streptomycin sulfate from the 3rd through the 28th day after irradiation. Heart, blood and spleens were cultured for bacteriological studies. In the four experiments where autopsy blood was cultured there was a marked reduction in the incidence of bacteremia whether mortality was reduced or not. The concomitant increase in the number that died showing no bacteremia indicates that death resulted either from other radiation sequelae or from a transient infection superimposed upon radiation damage. Additional evidence of the influence of infection on lethality following radiation is demonstrated in the shortening of the survival time of animals showing certain types of infection at death. Deleting the animals that showed positive cultures at death resulted in an essentially linear relationship between dose and time to death in the dose range 800 to 550 r. Infections were rarely observed in mice that died about 3.5 days after irradiation (1400 and 1100 r) and were most frequently observed in animals that died after 6 to 9 days, with the incidence reduced in those that died in the 3rd week after irradiation. With streptomycin treatment, although there was not always a significant reduction in mortality, there was always a reduction in the number that showed positive blood cultures and an increase in those showing negative cultures at death. Streptomycin treatment resulted in a prolongation of survival time which was independent of the presence of organisms in the blood at death.

HAMMOND, C. W.
Bactericidal activity of fixed phagocytes in irradiated an unirradiated mice treated with RNA.
Proc. Soc. Exptl. Biol. Med. 114, 213-15 (1963)

CF1 female mice 9-10 weeks old were injected intravenously with RNA 30 minutes before or on the 4th day after exposure to a sublethal dose of x-irradiation (550 r). Simultaneously an equal number of irradiated mice were injected intravenously with buffered saline to serve as controls. On the 5th day post-irradiation all mice were injected intravenously with Pseudomonas aeruginosa followed one minute later by intravenous polymyxin or colymycin. The next day all mice were killed and heart's blood cultured. Livers and spleens were removed, ground separately in tissue grinders and appropriate dilutions plated. The results of the bacterial counts indicated that the mean number of pseudomonads in livers and spleens of mice injected with RNA were slightly lower than the mean number in livers and spleens of controls but the difference was not significant. Similar results were obtained among unirradiated mice injected with RNA 4 days before challenge with P. aeruginosa.

KISELEV, P.N., V.N. SILVERSEVA and P.A. BUZIN
Auto-infection in radiation sickness and its treatment. (Russian Text).
Trud. Pervoi Zakavk. Konferentsii Po Med. Radiol., 67-74 (1956)
Source of abstract: TID-3098, Book 2, 1119, No. 9346

Experiments were conducted on a large number of white mice which were exposed to x-rays in varying doses. It was demonstrated that if the dose is greater than 300 r bacteraemia always occurs and disappears as a rule on the 16th or 17th day. If the dose is less than 300 r bacteraemia is not observed. It was found that under certain conditions and with the help of antibiotics, especially streptomycin, the mortality of the animals can be lowered to 40-45%. If the dose of radiation is greater than the absolute lethal dose by 30-50% antibiotics are of no avail. Other useful measures are: administration of substances which lower the permeability of the tissues (vit. P, rutin, hyaluronic acid, etc.), transfusion of packed white cells to counteract the marked leucopenia accompanying radiation sickness and, finally, the administration of properdin, which according to foreign authors is effective in combating infective and auto-infective processes.

KOVALEVSKII, K. L.
Auto-infection (intestinal) in radiation sickness and its prevention in Wistar white rats.
Tr. Inst. Genetics (Moskova) 30:315-320 (1963)

The tests have shown that autoinfection can be prevented during radiation sickness by changing the intestinal microflora through an introduction of Lactobacillus acidolphilus. The rats were given acidophilic milk orally with lactose daily for 10 days before irradiation and during the course of the experiment. This played a decisive role in the maintenance and increase of weight of the rats after irradiation. The first group of rats was 1 1/2 months old; the second group was 3 months old. The effectiveness of treatment with L. acidolphilus and lactose is confirmed by a decrease in mortality

of the experimental rats. Their diet consisted of grains, white bread, yeast, oatmeal, meat and carrots. The total irradiation dose was 700 r, and the dose rate was 31.6 r/min. An autopsy of the irradiated rats revealed an acute hyperemia, multiple hemorrhages in the internal organs, enlargement of the heart and an inflammatory infiltration in the cardiac muscle; the liver showed effects of serous edema. There were no signs of pathological changes in the intestines. The following bacteria were isolated as a result of a bacteriological study of the blood taken from the heart: Staphylococcus albus, Staphylococcus citreus, and L. acidolphilus.

LANGENDORFF, H. and M. LANGENDORFF
Investigations on biological radiation protection. Part 72. The effectiveness of various radioprotective substances in fractionated x-irradiation of mice.
Strahlentherapie, 131:37-50 (Sept.1966) (In German)
Source of abstract: NSA 21:383, No.3417 (Feb. 15, 1967)

The influence of 5-hydroxytryptamine (serotonin), homocysteine thiolactone HCl (HCT), and of Chlorotrianisen (Tace) on mice which had received a fractionated x-irradiation with 100 r daily is reported. The results obtained show that the protective substances investigated are less effective in the case of fractionated irradiation than in the case of a single irradiation with a higher dose rate. Compared with untreated control animals, a repeated administration of HCT causes an increase in radiation sensitivity in mice which had received fractionated irradiation. Due to the long lasting effect of Tace, a protective effect is obtained even with a single administration; with higher total radiation doses a sensitization is observed. The effect of Tace is believed to be due to a toxic factor, which increases with increasing radiation dose.

LANGENDORFF, H., H. MELCHING, O. MESSERSCHMIDT and C. STREFFER
Investigations on combined injuries, Part 3. On the efficiency of radioprotective substances for a combination of radiation burden and skin wound.
Strahlentherapie, 2:264-72(Oct.1965) (In German)
Source of abstract: NSA 20:861, No. 6878 (Mar.15, 1966)

(See section B for abstract)

LIVIKOVA, N. I.
Influence of cystamine and s, β-aminoethylisothiuronium on desoxyribonuclease-LL activity in radiosensitive organs or rats irradiated with the doses of 350 and 100 r.
Radiobiologiya, 6:166-9 (1966) (In Russian)
Source of abstract: NSA 21:527 No.4825 (Feb. 28, 1967)

The effects of cystamine and AET on the acitvity of DNA-ase II were studied in the spleen and thymus of rats given x-ray doses of 100 and 350 r. In irradiated controls DNA-ase II activity rose sharply one day post-irradiation after which it declined until the seventh day at which time activity

was again normal. Both AET and cystamine depressed the radioinduced increase in DNA-ase II activity in spleen and thymus. The enzyme activity was not affected in unirradiated controls administered the radioprotective preparations.

MANDEL, P., J. M. MANTZ, M. DELEMEN, P. MICHAELIDIS, J. RODESCH
Experimental study of the treatment of radiation injuries by padutin (kallicreine) [etude experimentale du traitement des radio-lesions par la padutin-depot (kallicreine)]
Euratom (July, 1966) (In French)
Source of abstract: STAR (NASA) 5:11, No. N67-10032 (Jan. 8, 1967)

Further experiments carried out on the rat show that following a treatment with kallicreine the cicatrization period for cutaneous radiolesions is considerably lower in the treated animals than in the controls (60,000 r). The same phenomenon has been demonstrated with the guinea-pig and the rabbit (80,000 r). Experiments are at present in progress to corroborate these findings. Study of the optimum treatment conditions led to the following therapeutic doses: 5 BU for the rat, 10 BU for the guinea-pig and 20 BU for the rabbit. The best time to begin the treatment is the clear ulceration stage, i.e. 3rd week after irradiation for the rat and the guinea-pig, and 4th or 5th week for the rabbit. Kallicreine administered as a preventive injection after whole-body irradiation (800 r) appears to have no effect on the survival rate of the animals. However, quantitative determinations of nucleic acids and a cytological study of the marrow of a bone system show a protective effect which is particularly marked at about the 7th day after irradiation. From the recovery angle (treatment after whole-body irradiation at 800 r) it is observed that the life of the animals is considerably prolonged, particularly by the repeated intraperitoneal administration of kallicreine. Quantitative determinations of bone-marrow nucleic acids permit the inference of a regeneration of the medullary cells which is especially active from the 4th day after irradiation.

RUSSELL, W. J. and W. LITSKY
Restoration of agglutinin production against Shigella paradysenteriae in irradiated rats.
Rad. Res. 20:541-8 (1963)

Wistar albino rats were exposed to ^{60}Cobalt γ-radiation at a dose rate of 31.46 r/minute. The experimental group was irradiated with 500 r, while the control group received no irradiation. The animals of both groups were inoculated subcutaneously with 0.2 ml of the heat-inactivated suspension of Shigella paradysenteriae. Agglutinin titers were determined by applying a constant amount of agglutinating antigen to serial doubling-dilutions of antisera and recording the highest dilution of antisera showing agglutination. The antibody titers of the irradiated animals always were significantly lower than those of the control animals. The titers became progressively lower and appeared to be dependent on the time of injection with respect to time of 500 r, of irradiation. For example, the agglutinin titer decreased as the post-irradiation time of antigen injection increased. The agglutinin production was found to be nil in irradiated animals when the bacterin injection was administered 48 hours after irradiation. In addition,

irradiated animals exhibiting no agglutinin titer 11 days after antigen injection were further tested at 14, 21, and 28 days. No agglutinin production could be demonstrated at these times. Three isothiuronium compounds, S,β-aminoethylisothiuronium bromide hydrobromide (AET), 2-mercaptoethylguanidine (MEG), and bis-(2-guanidoethyl) disulfide (GED), were tested for their ability to protect the antibody-forming mechanism against irradiation. AET, MEG and GED were administered 20 minutes before irradiation. All animals received 0.2 ml of the antigen 48 hours after irradiation. Irradiated control animals receiving the sham solution did not develop agglutinin titers significantly different from those receiving only 500 r. Even though the irradiated animals receiving AET, MEG, or GED demonstrated agglutinin titers were significantly lower than those of the untreated nonirradiated controls.

SMITH, W. W., I. M. ALDERMAN and R. E. GILLESPIE
Hematopoietic recovery induced by bacterial lipopolysaccharide in irradiated animals.
Rad. Res., 7:451, No.119 (1957)

Survival was increased by a single i.p. injection of lipopolysaccharide from S. typhosa immediately after irradiation (24 ± 3 mice/100)or the day before irradiation (42 ± 3 mice/100). Pseudomonas infection was reduced, and to a greater extent Proteus and α-streptococcus infections. Increased survival is attributable to early recovery of the hematopoietic system. One week after 900 r (LD_{90}) counts of granulocytes mobilized by 5μg of endotoxin 18 hours beforehand averaged 5000 per cubic millimeter in mice given endotoxin the day before irradiation, compared to 500 in irradiated controls. Lymphocytes averaged 300, compared to 800. Hemoglobin averaged 9 gm at 15 days after irradiation, compared to 6 gm and at that time platelet counts were also higher in endotoxin-treated mice. Survival was not increased, and hematopoietic recovery was not advanced in mice given three injections of endotoxin prior to irradiation (days 7, 4, and 1), although the immediate granulocytic response to the endotoxin was still intact. A week after sublethal irradiation (700 r) their mobilized granulocytes averaged only 1600, compared to 3800 in irradiated controls and 14,500 in mice given a single injection one day before irradiation.

SUDNOV, A. M.
The effect of preliminary immunization with live vaccines on the course and outcome of radiation sickness in rabbits.
Med. Radiobiol. (Moskva) 8:55-59 (1963) (In Russian)

Rabbits were injected i. a. with a live vaccine of B. anthracis (strain STI) immediately before irradiation and several times after irradiation. Whole-body x-ray doses of 500-600 r were delivered at 180 kvp at a dose rate of 25 r/minute. Doses of 15-20 billion organisms did not alter mortality, whereas doses of 25 million to 10 billion organisms resulted in increased survival. When the live vaccine was given prior to irradiation, the number of circulating leukocytes greatly increased. This finding was directly related by the author to the observed increase in survival. The author suggested that live vaccines be used to prevent radiation sickness in patients subjected to x-rays for therapeutic purposes.

TALIAFERRO, W. H. and B. N. JAROSLOW
The restoration of hemolysin formation in x-rayed rabbits by nucleic acid derivatives and antagonists of nucleic acid synthesis.
J. Infect. Dis. 107:341-350 (1960)

Adult female New Zealand rabbits were x-irradiated (400 r) at 250 Kv at a dose rate of 29 r/minute. X-radiation was delivered 1 day prior to i.v. injection of sheep red cells. A variety of substances were tested for their restorative capacity upon antibody formation. The materials tested were injected intravenously either mixed with the antigen or injected separately at the same time except for colchicine and croton oil. The last two materials were given subcutaneously immediately after injecting the antigen intravenously. Among the chemically defined substances tested, colchicine completely restored and 3-indoleacetic acid and kinetin partically restored the hemolysin-producing capacity in irradiated rabbits with respect to peak titer and the rate of rise. In accord with our previous work, yeast was also completely restorative. Preparations of DNA and RNA enzmatically degraded in vitro by their specific nucleases were partically restorative, but the two polymerized nucleic acids, adenine, the nucleosides and the nucleotides were not restorative. Croton oil used as a control for colchicine was without a significant restorative action. Colchicine and, to a lesser extent, yeast increased the hemolysin response in normal nonirradiated rabbits. None of the restorative agents significantly counteracted the lengthened induction period resulting from x-radiation.

TIUNOV, L. A.
Prophylaxis of radiation injury by means of combinations of therapeutic agents.
Voyenno-Meditsinskiy Zhurnal, No. 7, p.55-60 (1960)
JPRS:7432, CSO:1374-N/32

(See section R for abstract)

TRASKUNOVA, N. V.
Hematopoiesis in irradiated animals during treatment with diphacyl.
Med. Radiol., 11:No. 9, 53-8 (Sept. 1966) (In Russian).
Source of abstract: NSA 21:383, No.3419 (Feb. 15, 1967)

The radioprotective effects of the diphenylacetic ether of diethylaminoethanol (diphacyl) was studied in rabbits given 600 R x-ray doses. Radiation effects on megakaryocytopoiesis were inhibited and thrombocytopenia was markedly reduced in most animals during the course of radiation sickness. Bone marrow from rabbits treated with diphacyl was richer in cullular elements of the granulocytic series in comparison with controls. Survival was not enhanced by diphacyl.

TROITSKI, V. L.
Disruptions of natural immunity in irradiated animals and methods of stimulating it.
Herald of the Academy of Medical Science of the USSR. 5:13-28 (1962)

Repeated daily administration of homologous marrow to lethally x-irradiated rats decreased mortality by 30%. A single injection of marrow was not effec-

tive unless cortisone was also given. Resistance to infection with Salmonella typhosa and to diphtheria toxin was restored almost to normal levels by this treatment. In irradiated mice (Balb/c) receiving homologous marrow (C57 Blk), antibodies to donor cells were found by passive anaphylaxis from 3-4 days to about 60 days after injection. The peak intensity occurred around 40 days. Antibody to the recipient's tissue was found in the second month following injection. The authors concluded that both host versus graft and graft versus host reactions are operative in secondary disease and that anaphylaxis may be one of the mechanisms involved in secondary disease.

TUMANYAN, M. A.
Further investigation of the chemotherapy of radiation sickness in experiments on monkeys.
J. Microbiol. Epidemiol. Immunobiol. (In Russian) 29:3-9 (1958)

The use of antibiotics in the treatment of radiation sickness prevented the development of post-radiation bacteremia and a transition of latent chronic dysentery in monkeys to a clinical, acute form of dysentery. Chemotherapy proved to be effective in the treatment of radiation sickness in monkeys; it prevented the death of an appreciable number of monkeys when lethal doses of x-rays had been administered to them. Streptomycin can be substituted by other antibiotics, namely, albomycin and colimycin or sulfamide preparation of phthalylsulfothiazole in the chemotherapeutic treatment of radiation sickness.

TUMANYAN, M. A. and Z. V. SHEVSOVA
Chemotherapy of the radiation sickness in experiments with monkeys.
Med. Radiol. 1, 2:41-45 (1956)

Six monkeys were given whole-body x-ray doses of 600-750 r at 190 kv at a dose rate of 9 r/minute. The animals were treated with a combination of vitamins B_1, B_2, B_{12}, ascorbic acid and antibiotics. Extensive treatment over a period of 10 weeks with penicillin, streptomycin, Levomycetin (chloramphenicol) prevented the death of lethally irradiated monkeys. The authors proposed that the irradiated animal has the capacity to restore radiation-damaged tissue if infections are effectively dealt with.

VISEK, W. J. and HUNG CHEN DANG
Protection against lethal doses of gamma irradiation with urease immunity.
Cornell Univ. Agricultural Exp. Station (April 1966)

Male CF-1 mice were immunized actively with injections of crystalline jackbean urease or passively by injection of urease antisera from rabbits. Actively immunized animals showed a higher percentage of survivors 30 days after acute Co^{60} irradiation in one experiment testing this approach. In repeated experiments, the LD_{50} at 30 days for untreated animals was 600 r while for mice injected intraperitoneally with antisera it was 860 r. The greatest number of observations were recorded at 800 r of exposure. Twenty-one percent of control animals survived 800 r while 72.8% survived if given urease antisera before irradiation. Antisera was protective if given in a volume of 0.4 ml 10 minutes before exposure or in volumes of 0.3 ml thrice

weekly for two weeks with the last injection 6 days before irradiation. Protective effects were compared with S, beta-aminoethylisothiuronium Br HBr(AET) and β mercaptoethylamine HCl (MEA) which also inhibit urease as parent compounds or metabolites. The evidence strongly suggests that ammonia is an important toxin in irradiation death.

WASSERSTROM, V. and H. HERSOVICI
Experience of the nuclear medicine laboratory at the M.F.A. (acronym not explained) polyclinic in the problem of protection from the damaging effect of ionizing radiation.
Rev. Sanit. Mil., 16: Special No., 398-403 (1965) (In Rumanian)
Source of abstract: NSA 21:524 No.4801 (Feb. 28, 1967)

(See section R-P for abstract)

WEBSTER, J. B.
The effect of oral neomycin therapy following whole-body x-irradiation of rats.
AFRRI SR66-5 (Oct. 1966)

This study was designed to examine the beneficial effects of oral antibiotic treatment with neomycin following total-body x-irradiation of Sprague-Dawley rats. Survival times of irradiated, neomycin treated male rats were compared with those of irradiated, untreated controls. Eleven selected radiation exposures, beginning at 700 r and extending in increments to 2500 r, were used. Thirty-day lethality was also evaluated at and below exposures of 1100 r. Neomycin treatment resulted in a significant prolongation of the mean survival times of irradiated animals at exposures between 800 r and 1500 r. At exposures between 1500 r and 2500 r, a small but consistent prolongation of mean survival time resulted. For exposures between 700 r and 1100 r, the 30-day lethality was consistently lower for the neomycin treated rats. It is suggested that postradiation treatment with oral neomycin, administered every 13 hours, can effect an increase in the mean survival time of whole-body x-irradiated rats.

WOLF, H., W. STENBACK, P, TAYLOR, J. PINERO, C. GRABER and J. J. TRENTIN
Protection of irradiated mice against Pseudomonas aeruginosa and its control in a convential colony.
Lab. Animal Care 14 332-3 (1964)
Source of abstract: NSA 19:30, No. 197 (Jan 15, 1965)

(See section B for abstract)

ZEBRO, T.
Chemical protection from ionizing radiation. V. Comparative histopathologic observations on some organs of mice irradiated after prior protection with sodium cysteinethiosulfonate (CTS) and without protection.
Acta Med. Poland 7:83-95 (1966)
Source of abstract: NSA 21:383, No.3431 (Feb. 15, 1967)

To ascertain whether CTS administered in nontoxic doses protects the internal organs from postradiation damage, the gastrointestinal tract and kidneys of irradiated and unirradiated mice were studied histologically. Whole-body x-irradiation of mice with a dose of 500 r caused marked damage to the internal mucosa and kidneys, seen mainly as degeneration and necrosis of the epithelia. The lesions in the mucous membrane of the small intestine had a biphasic course; the most severe changes appeared on the 3rd to 5th and about the 15th day after irradiation. The most severe damage to the kidneys appeared between the 3rd and 8th day. These changes may explain the mechanism of later complications in the course of radiation sickness such as bacteremia and late focal fibrosis in the kidneys. CTS administered intraperitoneally exerted a protective action as manifested by less extensive postradiation lesions in the intestinal mucosa and epithelia of the renal tubules and by quicker repair of the damage brought about in these organs by irradiation.

ZHABINA, M. I. and R. V. PETROV
Radioprotective action of marrow transplanted before irradiation.
Radiobiologiya 6:329-30 (1966) (In Russian)
Source of abstract: NSA 21:528 No. 4834 (Feb. 28, 1967)

Isogenic bone marrow was transplanted into mice one to three hrs. before exposure to 650 or 700 r doses of γ rays. Sixty-one percent of the irradiated controls survived the 650 r dose compared to 5% survival at the 700 r dose. Bone marrow transplantations prior to irradiation increased survival to 82% in the 600 r group and 32% in the 700 r group. The radioprotective effect is explained by the fact that transplanted cells, found in the blood stream or at injection sites, are less radiosensitive immediately following injection and are therefore more likely to recover from radiation injury. In essence transplantation produces a lower index of radiosensitive cells.

RADIATION AND PRIMATES

ABDULLAEV, V. M.
Morphological changes and some histochemical alterations in the eyes or monkeys affected with radiation sickness.
Ark. Patol., 27:45-52 (1965). (In Russian)
Source of abstract: NSA 20:4947-8, No. 40646 (Nov. 30, 1966)

A study was made of the eyes of 30 monkeys 1.5 to 2.5 years old, affected with radiation sickness, while 5 monkeys served as controls. The monkeys were subjected to 620 r v irradiation from a ^{60}Co source. Changes in various characteristics appeared in all membranes and cell layers of the eyes of the irradiated monkeys. After the monkeys died (10 to 36 days after irradiation), the eyes were sectioned for histologic study. The earliest development of a radiation reaction in the eye was seen in the concentrations of glycogen and ascorbic acid as well as degenerative changes of the interstitial substances, usually preceded by alterations in cell structure. In most cases, marked vascular changes were noted, which were accompanied by hemorrhages in the vitreous and retina. The rod and cone layer, and also cells of the pigment epithelium, underwent degenerative changes. In interpreting the pathogenesis of radiation manisfestations in the eye it is necessary to consider the complexity of morphological and histochemical changes of all its membranes and cell layers; some were also present in healthy monkey eye tissue.

ALLEN, J.R., A.S. HALL and C.F. CHESNEY
Pathologic alterations observed in rhesus monkeys given total-body x-irradiation and bone marrow transplants.
Amer. J. Vet. Res.27:1103-12 (July 1966)
Source of abstract: NSA 20:4026-7, No. 33071 (Sept. 30, 1966)

(See section B for abstract)

ANDREWS, G. A., B. W. SITTERSON and B. M. NELSON
Infections in patients exposed to total-body irradiation.
Oak Ridge Inst. of Nucl. Studies. Med. Div. Res. Rept. (Dec.31, 1964)
Source of abstract: STAR (NASA) 3:2478, No.N65-25658 (Aug. 8, 1965)

(See section B for abstract)

BENDER, M. L.
Synergistic effect of zero-G and radiation on white blood cells. An experiment for the Gemini III manned space flight.
Annual Report, Period Ending 30 June 1965
(NASA-CR-80821; ORNL-TM-1550)
Source of abstract: STAR 5:493-4, No. N67-14035 (Feb. 23, 1967)

(See section C for abstract)

BRANCADORO, P. and A. SICILIANO
Chromosomal aberration types in the leukocytes of periferal blood of patients exposed to radiotherapy.
Nunt. Radiol., 31:1403-18 (Dec. 1965) (In Italian)
Source of abstract: NSA 21:532 No.4786, (Feb. 28, 1967)

(See section C for abstract)

CAVENESS, F., L. ROIZIN, A. CARSTEN and J. P. SCHADE
Early and late effects of x irradiation on the cerebral cortex of the monkey.
Trans. Amer. Neurol. Assoc., 89:126-7 (1964)
Source of abstract: NSA 20:4438, No. 36656 (Oct, 1966)

The effects from the exposure of a portion of the head to 3500 r (x-radiation) were determined in 14 Macaca mulatta, irradiated at 12 months of age. A single exposure, at a rate of 350 r/min, was delivered to the right portion of the head to provide comparison with the left. It was limited to the cerebral cortex, its coverings, and the immediately subjacent white matter, to a total depth of 1 cm (to avoid secondary influences from alteration of large vascular beds and midline nuclear masses). Following irradiation there were intermittent functional alterations, as expressed by electroencephalography (EEG), that began as early as 24 hr. Structural changes of questionable significance in the irradiated cortex, i.e., glial alteration or proliferation, were noted as early as the third day. Inflammatory reactions, circumscribed or perivascular, were seen as early as the first week. Degenerative, chromatolytic, or pyknotic cellular alterations were seen as early as the fourth week. Necrobiotic changes were noted in none of the animals sacrificed up to 16 weeks.

CONARD, R. A.
Medical survey of the people of Rongelap and Utirik Islands nine and ten years after exposure to fallout radiation (March 1963 and March 1964)
(BNL-908-T-271, May 1965)
Source of abstract: STAR (NASA) 3:2485-5, No. N65-26295 (Aug. 8, 1965)

The results of a follow-up medical survey conducted 9 to 10 years after exposure to radiation fallout are presented. Initial examinations showed low levels of leukocytes and platelets of the peripheral blood in the 64 people who received 175 rads; this condition was less marked in the groups receiving less exposure. Annual hematological follow-up studies have revealed that the levels of white cells and platelets of the peripheral blood in the exposed group never reached the levels of the unexposed comparison population. Beta burns of the skin and epilation appeared about 2 weeks after exposure, mainly on parts of the body not covered by clothing. During the past several years, increased numbers of pigmented nevus-like lesions were noted in previously irradiated areas of the skin but appeared to be benign. Comparative radiochemical analyses of urine samples of the exposed and unexposed population are tabulated. A full-term still birth with congenital anomalies was born to exposed parents in 1962. A case of congenital heart defect was noted

in a child born to exposed parents several years ago. Except for one ectopic pregnancy, no miscarriages were reported during this two year period. Statistics on mean blood counts, hematological findings, anthropometric studies, serum folic acid levels, and bone marrow differential counts are also included.

CONARD, R. A.
Hematological effects of space radiation.
BNL-10221
STAR (NASA) 4:4301, No. N66-37342 (Nov. 23, 1966)

(See section C for abstract)

CONARD, R. A., A. LOWREY, M. EICHER, K. THOMPSON and W. A. SCOTT
Aging studies in a Marshallese population exposed to radioactive fallout in 1954.
Contract AT (30-2)-Gen-16. (CONF-66063541)
Source of abstract: NSA 21:225, No.1794 (Jan. 31, 1967)

Late effects of radiation observed in March, 1966 in a Marshall Island population accidentally exposed to radioactive fallout in 1954 are reviewed. The most significant findings are the development of thyroid abnormalities which have occurred largely in children exposed at less than 10 years of age, and presumably caused by γ-rays and irradiation of the thyroid gland from internal absorption of radioiodines in the fallout. Possible radiation induced aging effects were studied in 90 adults, 36 exposed and 55 unexposed by measurement of 14 criteria usually associated with aging (skin elasticity and looseness; hair greyness; accommodation, visual acuity, and arcus senilis of the eyes; hearing loss; nervous and neuromuscular function and vibration sense; light extinction test; rapid movement test; hand grip strength; systolic blood pressure; blood cholesterol level; and body potassium (^{40}K)). Analysis of variance was used to determine correlation with age and the data for each criterion were weighted according to this correlation factor. Combined scores for all criteria give a measure of physiological age as compared with chronological age on an individual and group basis. Most of the criteria showed good correlation with age on a group basis, less so on an individual basis. Between 20 and 40 years of age the criteria showed less change than after that age. No significant differences were noted between the exposed and unexposed groups. It was postulated that if there were aging effects from the dose of radiation received by this population more sensitive tests would be necessary to show them.

DALYMPLE, G. V., J. J. GHIDONI, H. L. KUNDEL, T. L. WOLFLE and I. R. LINDSAY
Edema: A delayed complication of total-body 32-Mev proton irradiation.
Rad. Res., 28:434-45 (June 1966)
Source of abstract: NSA 20:3794, No.31098 (Sept. 15, 1966)

(See section B for abstract)

DALRYMPLE, V. and R. LINDSAY
Protons and space travel: an introduction.
Rad. Res., 28:365-71 (June 1966)
Source of abstract: NSA 20:3793-4, No.31095 (Sept. 15, 1966)

The radiations found in space can be grouped into four major categories: (1) electromagnetic radiations, (2) electrons, (3) protons, and (4) nuclei of elements with atomic number (Z number) greater than 1. The electrons and electromagnetic radiations have sufficiently low energy (and subsequently low penetration power) that they do not represent a great hazard to the occupant of a space vehicle as long as he remains inside, because the shielding provided by the vehicle walls would be thick enough to absorb these radiations. The protons and heavier nuclei, however, do represent a very real danger because a large number of them have sufficient energy to penetrate the thickest shielding, either available now or planned for years to come. Of these particles, the protons are by far the most hazardous to the space traveler because of the weight of their numbers. Of all the charged particles (excluding electrons) found in space, the protons make up well over 90% of the total. Available data on the origin of protons in space and the reactions of protons in tissue are reviewed. The biological effects of the complex space proton spectrum are discussed.

DALRYMPLE, G. V., I. R. LINDSAY, J. J. GHIDONI, J. D. HALL, J. C. MITCHELL, H. L. KUNDEL and I. L. MORGAN
Some effects of 138-Mev protons on primates.
Rad. Res., 28:471-88 (June 1966)
Source of abstract: NSA 20:3794, No.31101 (Sept. 15, 1966)

(See section C for abstract)

DALRYMPLE, G. V., I. R. LINDSAY, J. J. GHIDONI, L. KUNDEL, E. T. STILL, R. JACOBS and I. L. MORGAN
Some effects of whole-body 32-Mev proton irradiations on primates.
Rad. Res., 28:406-33 (June 1966)
Source of abstract: NSA 20:3794, No.31097 (Sept. 15, 1966)

(See section B for abstract)

DALRYMPLE, G. V., I. R. LINDSAY, J. J. GHIDONI, J. C. MITCHELL and I. L. MORGAN
Some effects of 400-Mev protons on primates.
Rad. Res., 28:507-28 (June 1966)
Source of abstract: NSA 20:3795, No.31103 (Sept. 15, 1966)

Primates (*Macaca mulatta*) were given spaced doses of 400-Mev protons. From the mortality data an $LD_{50(30)}$ of 585 ± 33 (S.E.) rads was calculated. Hematological measurements, LDH, and SGOT concentrations, ^{59}Fe ferrokinetics, and histopathological findings indicate that the effects produced by the protons are virtually identical to those produced by equivalent doses of 2-Mev x-rays. The only differences in response were clinical; relatively more intense gastrointestinal and hemorrhagic signs occurred after proton irradiation than after similar doses of x-rays.

DALRYMPLE, G. V., I. R. LINDSAY, J. J. GHIDONI, J. C. MITCHELL and I. L. MORGAN
Estimate of the biological effects of the space proton environment.
Rad. Res., 28:548-66 (June 1966)
Source of abstract: NSA 20:3795, No.31106 (Sept. 15, 1966)

Small primates (Macaca mulatta) were irradiated with relatively low doses (25 to 400 rads) of either 55- or 250-Mev protons. The biological changes which were demonstrated were directly related to the depth of penetration of the protons as well as to the size of the doses. A summary of the results of the present and prior studies is presented, together with some published physical measurements of the space proton spectrum. Predictions of the biological effects of the protons on man as a space traveler are given. In general, the effects produced by protons are very similar to those produced by supervoltage electromagnetic radiations, when allowance is made for depth-dose distribution.

DIERCKX, R. and W. HORN
Neutron dose determination in case of critical accidents by gamma counting of the fillings in patients' teeth.
(Euratom, Ispra, Italy) Vienna, International Atomic Energy Agency, 1966,
Source of abstract: NSA 21:383, No.3410 (Feb. 15, 1967)

After the accident, mercury silver amalgam fillings are removed from teeth and counted by means of a calibrated gamma scintillator. Conclusions are as follows: The silver activity due to the reaction $^{109}Ag(n,\gamma)^{110m}Ag$ (half-life: 250 days) gives only indications for thermal neutron doses above 500 rad. The mercury activity due to the reaction $^{202}Hg(n,\gamma)^{203}Hg$ (half-life: 47 days) gives information for thermal neutron doses above 50 rad. The counting of the 511 keV annihilation peak from the reaction $^{63}Cu(n,\gamma)^{64}Cu$ (half-life: 12.9h) can also be used to estimate the thermal neutron dose. Three hours after the accident a first estimation of the thermal neutron dose can be made by counting the 279 keV gamma-peak of the mercury-203 activity. After some days, accurate results can be obtained from this 279 gamma-peak counting.

DZHIKIDZE, E. K. and A. S. AKSENOVA
The efficacy of preventive tetanus vaccination in experiments on monkeys following prolonged irradiation with low doses.
Zh. Mikrobiol., Epidemiol. i Immunobiol. 29-31 (Nov. 12, 1964) Engl.Abst.

(See section A for abstract)

DZHIKIDZE, E. K. and S. M. PEKERMAN
Immunological reactivity of monkeys following acute radiation sickness.
Byulleten Eksperimental Biologii i Meditsiny 59:73-7 (1965)
(English Trans. UDC 616-001. 28-092:612.017.1)

(See section A for abstract)

EUGSTER, J.
Cell changes caused by cosmic radiation.
(Univ., Bern) Bull. Schweiz. Akad. Med. Wiss., 21:425-6 (1965) (In German)
Source of abstract: NSA 21:713, No.6652 (March 15, 1967)

Effect of cosmic radiation on human skin samples was studied by means of gold foils that produced intense radiation stars upon impact with cosmic particles. Ion density amounted to $\sim 10^4$ ion pairs/μm^3. Localization of the stars was ascertained by use of nuclear film. The skin tissue studied could be considered as senile or showing evidence of Bowen's disease. The average exposure time of the 33 human subjects used was 3 to 4 weeks. The exposure was performed on the Jungfraujoch. Histological changes in the skin were compared to the recorded tracts of the irradiation. In one study 9 impacts could be correlated with evidence of back mutation within the central zones of the foci observed.

HAWRYLEWICZ, E. J. and W. H. BLAIR
Effect of gamma and proton irradiation on lactic dehydrogenase isoenzymes.
Rad. Res., 28:538-47 (June 1966)
Source of abstract: NSA 20:3795, No.31105 (Sept. 15, 1966)

(See section N for abstract)

HELLER, G.
Effects of ionizing radiation radiation on testicular function of man.
(RLO-1780-8)
Source of abstract: STAR (NASA) 4:4301, No. N66-37341 (Nov. 23, 1966)

Progress is reported on: design and use of X-ray apparatus for uniform irradiation of human testes; hormonal evaluations; seminal fluid counts; quantitation of the germinal epithelium; assessing Leydig cell function; chromosomal studies; and tritium labeling in X-ray studies. Hormonal evaluations were made on subjects that received 5, 15, 20, 25, 50, 100, 300, 400, or 600 R. Estrogen, ICSH, and 17 ketosteroid data revealed no apparent changes after radiation compared to that of the control period. There was, however, a highly significant rise in gonadotropins following irradiation for every dose level and every subject. Of the subjects undergoing testicular biopsy, only 39% experienced a drop in sperm count, and this decrease always occurred within the first ten weeks. A technique was devised for evaluating the structural changes in Leydig cells and relating these to observed hormonal changes, or lack of changes. Problems inherent in the study of pachytene bivalents are discussed. Preliminary studies were conducted on two individuals to determine if labeled sperm could be detected through the depletion period following irradiation, and therefore, to prove that the preleptotene spermatocyte is not as radiosensitive as the spermatogonia. The two individuals were injected with ^{3}H-thymidine just prior to irradiation, and smears of their seminal fluid were followed by radioautography. Labeled sperm appeared after 46 days and continued until the tubules were empty and the subjects zoospermic as determined by routine seminal fluid counts.

HELLMAN, S. and M. E. FINK
Granulocyte reserve following radiation therapy as studied by the response to a bacterial endotoxin.
Blood 25:310-24 (1965)

(See section C for abstract)

KOZNOVA, L. B.
Olfactory disturbances in man following exposure to radiation (obonyatel'nyye narusheniya u lyudey pri luchevom vozdeystvii)
Med. Radiol. (Moscow) 2:26-30 (1957)
Source of abstract: STAR (NASA) 5:14, No.N67-10227 (Jan 8, 1967)

Disruptions in olfaction have been studied based on the observation of the of the general reaction of the human organism subjected to x-ray radiation in connection with mammary gland tumors. Changes in the olfactory analyzer were recorded by means of an olfactometer. Additional experiments were conducted with patients who were given caffeine to accentuate the sensitivity of their olfactory analyzer. The results of the investigations correlated with the complaints of patients subjected to radiation who experienced olfactory disturbances have convinced the author that such disturbances involve changes in the central nervous system and do not represent true hyperosmia since the subjective accentuation of olfaction during radiation treatment is not accompanied by a decrease in the thresholds of olfaction.

KULINSKII, V. I.
Time distribution of the death rate of irradiated macaques.
Radiobiologiva, 6:337-42 (1966) (In Russian)
Source of abstract: NSA 21:715, No.6670 (March 15, 1967)

In concentric γ irradiation doses of 570-930 r, the death of macaques occurred on the fifth to 22nd days, especially often on the 11th to 19th days. MLD_{100} was equal to approximately 700-720 r. No significant deviations of the empirical distributions of the death rate of irradiated macaques with time from those calculated according to a normal law of the curves were detected; a small negative asymmetry was possible. A logarithmic transformation of the periods of death does not bring them any closer to a normal distribution. At doses of 608-750 r, five to six peaks of the death rate were detected in the periods 5-7, 8-10, 11-13, 14-16, 17-19, and 20-22 days after irradiation, using three mathematical methods, which give good coincidence of the results. A circadian rhythm of the death of the irradiated macaques with a maximum in the daytime hours (8:00 AM to 4:00 PM) and a minimum in the evening hours (4:00 PM to Midnight) was established.

KUNDEL, H. L.
Effect of high-energy proton irradiation on the cardiovascular system of the rhesus monkey.
Rad. Res., 28:529-37 (June 1966)
Source of abstract: NSA 20:3795, No.31104 (Sept 15, 1966)

(See section N for abstract)

LAWRENCE, J. H., C. A. TOBIAS, J. L. BORN, L. A. LINFOOT and G. J. D'ANGIO
Heavy particles in experimental medicine and therapy.
J. Amer. Med. Assn.,196:166-70 (April 11, 1966)
Source of abstract: NSA 21:383, No.3429 (Feb. 15, 1967)

Experimental and clinical studies using heavy particles are described after a consideration of some of the differences and advantages of radiotherapy with these particles as compared with electromagnetic radiations. Studies on the proliferative capacity of mouse ascitic tumor cells in vivo demonstrated the advantageous properties of the high-LET heavy particles. Studies on the skin of rabbit ears of the acute reactions from varying LET radiations have also demonstrated the greater RBE of the higher LET radiations. Heavy-particle beams for medical use require energies in excess of 100 MeV, and there are seven institutions in the United States, and seven others throughout the world, which have cyclotrons with energies high enough to be useful in therapy. Use of heavy particles to treat acromegaly, diabetic retinopathy, and Cushing's disease is outlined. Work is being directed toward obtaining pion and muon sources for therapeutic use.

LINDSAY, I. R., G. V. DALRYMPLE, J. J. GHIDONI, J. C. MITCHELL and I. L. MORGAN
Some effects of 55-Mev protons on primates.
Rad. Res., 28:446-64 (June 1966)
Source of abstract: NSA 20:3794, No.31099 (Sept. 15, 1966)

(See section N for abstract)

LUSHBAUGH, C. C., and R. HOFSTRA
Radiosensitivity in man: a study based on therapeutic and accidental exposure.
Oak Ridge Inst. of Nucl. Studies Med. Div. Res. Rept.
Source of abstract: STAR (NASA) 3:2480, No. N65-25667 (Aug. 8, 1965)

The case histories of 94 patients who had received total-body irradiation in the course of therapy, or as a result of a criticality accident, were encoded and processed to determine the incidence of anorexia, nausea, and vomiting. The patients were divided into five dosage groups for which geometric mean doses of 49.6, 105.2, 300, 370.3 and 540.5 were determined. The percentage of cases in each group that showed anorexia, nausea, and vomiting are shown. Probability analyses were then done with these data to estimate the total body irradiation dose required to produce the particular response in 50% of the patients. The results are presented in tabulated form. The values are expressed as common logarithm to define the standard deviations of the estimates, and the midline air dose (roentgens), and the absorbed dose (rads) to the gastrointestinal tract. These results appear to indicate that, if it is true that the chance of an astronaut in space receiving 10 rads to the abdomen is less than one in 1000, the chance that radiation-induced severe nausea and vomiting will occur is less than 1:1000,000.

OBATUROV, G. M.,E. I. ZEINALOV, A. V. KOSENKOV and V. A. SHALIN
Methods of assessing absorbed neutron and gamma-ray dose in accidents with a graphite critical assembly.
Vienna, International Atomic Energy Agency, 1966, Preprint No.SM-76/56,22p. (In Russian) (Conf-660807-28). ORAU.
Source of abstract: NSA 21:383, No.3412 (Feb. 15, 1967)

Methods of dose determination and personnel dosimetry for use in accidents experienced with a graphite critical assembly are discussed. This involved measuring neutron doses and gamma-ray doses in air, at the surface of and inside phantoms representing the human trunk and also the measurement of ^{24}Na radioactivity in a liquid phantom. Standard dosimetric equipment was used for the measurements including an IDN apparatus, an IFKNG personnel dosimeter and activation detectors such as indium, manganese, sodium, copper, phosphor and sulphur. The results of the measurements are given in tables and graphs. The experimental results show that to determine the exposure of a worker involved in an accident with graphite critical assembly it is sufficient to determine the absorbed gamma-radiation dose averaged over the whole body, the absorbed gamma-radiation dose and the dose to the crystalline lens and gonads, due to charged particles formed by neutrons. Since the distribution of neutron fluxes in the vicinity of the critical assembly is uniform in the vertical direction, the absorbed dose to the crystalline lens and gonads can be determined using a personnel dosimeter, affixed to the chest, regardless of the position of the wearer relative to the direction of the incident flux. The average gamma-ray dose to the body can be assessed from the data provided by these personnel dosimeters and from measurements of sodium activity in the blood, using the formulas given. A table is presented that summarizes the methods of determining gamma-ray dose, and dose due to charged particles from neutrons at the surface, and the average dose over the entire body for a person exposed to an accident.

OKUNEWICK, J. P.
The relationship between post-irradiation recovery and equivalent residual dose.
Contract AT(C4-3)-414 Oct. 1966
Source of abstract: NSA 21:383, No.3403 (Feb. 15, 1967)

The problem of estimating the equivalent residual dose (ERD) of radiation retained by a man or an animal at any particular time following exposure to ing radiation is reviewed to determine whether the principal existing model used for estimating ERD fits the most recent experimental data and would therefore be applicable to studies related to thermonuclear war. It has been noted that the most commonly utilized model was drawn from data which used as an end point life-shortening after prolonged exposure to low doses of irradiation. However, in view of the significant body of experimental data which does not fit the model, reason was found to question the applicability of this model except in certain limited cases. The relationship between the establishment of an ERD for men and animals at any specified time and the physiological mechanisms underlying radiosensitivity at that time is therefore examined in detail. It is shown that recovery of men and animals from doses between approximately 100 R and the $LD_{100/60}$ could be correlated with the effects on certain critical tissues, in particular, the blood-forming tissue. Recovery of this tissue was found to differ from that shown by the commonly accepted models for radiation recovery in that it was oscillatory and not exponential

in nature. Estimates of radiation sensitivity of the whole animal that are obtained from splitdose experiments carried out over several days parallel the recovery of this tissue. This fact is extremely important in that predictions of ERD values have been made using only one or two data points obtained from split-dose studies and assuming exponential recovery. The finding that recovery may be oscillatory rather than exponential means that estimates of the ERD made in this manner may be subject to significant errors. The evidence for and possible mechanisms involved in this oscillatory recovery are therefore reviewed in this memorandum. The applicability of the present models is discussed, and some factors which must be considered in developing a generally applicable model for the representation of post-irradiationrecovery in man and animals are listed.

ROZIN, V. V.
Effects of small doses of ionizing radiation on human organism.
Voenna-Med. Zh., No. 8, 22-8, (1962)
Source of abstract: NSA 19:831, No.7162 (In Russian) (March 15, 1965)

Literature data characterizing the biological action of ionizing radiation in long- and short-term exposures are reviewed. Background irradiation both external and internal, is from natural radioactive elements (U, Th, Ra, ^{14}C, and ^{40}K) and cosmic rays. Occupational exposure of radiologists, fallout, atomic bomb, and experimental data are mentioned. The effects are broken down into categories: aging and length of life; gonads, including genetic changes; and blood and blood-forming agents.

RUGH, R., L. DUHAMEL, L. SKAREDOFF and C. SOMOGYI
Gross sequelae of fetal x-irradiation of the monkey (Macaca mulatta).
1. Effect on body and organ weights at 23 months.
Atompraxis, 12:468-73 (Sept. 1966)
Source of abstract: NSA 21:531, No.4861 (Feb. 28, 1967)

Two fetally x-irradiated male monkeys were studied for 23 months, simultaneously with a male control, to determine the morphological and phyiological effects. One experimental monkey received 200 r at 80 days and the other 300 r at 60 days gestation. All three were delivered normally, nursed by their mothers, and weaned at the proper time. The two x-irradiated monkeys showed consistent weight deficit when compared with the control, and organ weights at autopsy (at 23 months) showed the greatest deficit for the spleen, liver, lungs and intestines. Skeletal deficiencies were shown by means radiographs and, as with the soft tissues, the monkey receiving the higher exposure at the earlier stage showed the greater permanent damage. The brain showed gross damage, particularly in the occipital and cerebellar regions.

STIPCIC, N.
The experimental determination of the neutron radiation dose distribution in the human phantom.
(Institut Ruder Boskovic, Zagreb). Vienna, 1 ternational Atomic Energy Agency, 1966, Preprint No.SM-76/2
Source of abstract: NSA 21:383, No.3411 (Feb. 15, 1967)

The quality of radiation delivered to the human phantom is quite different from that of the incident neutron beam. The present communication is concerned with the experimental investigation of the variation of neutron dose in relation to the variation of neutron fluence with depth into the human phantom. The distribution of neutron radiation was determined in the human phantom, a cube of dimensions 25 X 25 X 50 cm, made of paratfin wax, the density of which was 0.92 g cm^{-3}. As neutron sources, Po-Be and Ra-Be point-sources were used. Neutron fluences were measured using different types of detector: scintillation detector, BF_3 counter, simi-conductor detector and nuclear track emulsions. Since the measurements of fluences with these four types of detectors were carried out under the same experimental conditions, it was possible to separate and analyze each part of radiation dose in paraffin. As the result of investigations, the distribution of the total radiation dose, as a function of the paraffin depth, was obtained. The maximum value of this dose distribution is constant with respect to the distance between the source and the paraifin phantom.

TABUCHI, A.
Congenital anomalies among children born of irradiated women.
Nippon Sanka Fujinka Gakkai Zasshi,9:210-21 (July 1962)
Source of abstract: NSA 21:389, No.3438 (Feb. 15, 1967)

Incidence of defective children of mothers exposed before or during pregnancy to radiation from atomic bombing or medical radiologic procedures is reported. A survey conducted in Hiroshima from 1 January 1950 to 3 June 1959 revealed that the number of still births (66.62) and artificial interruptions of pregnancy (55.20 per 1000 was larger than the national average. The number of still births in irradiated women (69.00) and artificial interruptions of pregnancy (57.18) was larger than that in unirradiated women (66.24) and (54.93) and the spontaneous still birth rate was highest in those exposed at short distances from the hypocenter. However, another survey on children born at 7 hospitals in Hiroshima Prefecture from January 1961 to 1962 revealed no increase in congenital anomalies, even in children born of parents both of whom were exposed to the atomic bomb. Biometry of 61 children whose mothers became pregnant after atomic bomb exposure showed no significant difference from controls but 6 of them showed maldevelopment. A survey of the body weight at birth of children (1480) born of irradiated women from 1 January 1951 to 31 August 1955 revealed that the body weight at birth of boys was 3024 g and that of girls was 2999 g, while that of control boys was 3054.35 g and that of control girls was 3007.05 g, indicating a slight decrease in the irradiated group as compared with the control group. A survey of children born of 45 mothers irradiated for medical reasons during pregnancy revealed no difference in the incidence of still birth, immature children, and perinatal death before irradiation as compared with after irradiation but one case of deformity was noted (a 26-yr-old mother had received abdominal roentgenography in the 5th month of pregnancy and gave birth to a girl with congenital hip joint dislocation). At present, the only clinical findings attributable to the effects of radiation on children born of irradiated women are microcephalia and mental retardation.

TURUSOV, V. S.
Relation between radiation affections of the skin and the cycle of hair growth.
Med. Radiol., 11:No. 9, 70-3 (Sept. 1966). (In Russian)
Source of abstract: NSA 21:383, No.3422 (Feb. 15, 1967)

Cyclic changes associated with the hair cycles of the skin exert an essential influence on the diverse effects of radiation action on the skin. Epilation occurs significently more rapidly during irradiation at the period of hair growth. Only after irradiation at the period of hair growth is there seen a dark pigmentation of the skin associated with the elimination of the pigment from the destroyed bulbs. Graying hair is markedly more apparent in the persons irradiated during the period of rest. The normally existing cyclic alteration of the pigmentation of the skin disappears after irradiation; the skin irradiated during the period of growth becomes dark, whereas that irradiated at rest acquires a constant mild pink pigmentation.

WARREN, S. and O. M. LOMBARD
New data on the effects of ionizing radiation on radiologists.
Arch. Envior. Health. 13:415-21 (Oct. 1966)
Source of abstract: NSA 21:229, No.1323 (Jan. 31, 1967)

The average age at death of U.S. radiologists in the past has been younger than that of other physicians or U.S. adult white males. Since 1935 this evidence of life shortening has lessened, most strikingly since 1945, and disappeared by 1960. Leukemia, though excessive among radiologists, occurs rarely and apparently only after a number of years of occupational exposure. The age pattern of the incidence of leukemia is quite different in radiologists and U. S. white males over age 25. In recent years the excessive incidence of leukemias in radiologists has decreased. From these findings one may conclude that current occupational maximal permissible dose levels provide adequate protection.

WASSERSTROM, V. and HERSOVICI
Experience of the nuclear medicine laboratory at the M.F.A. (acronym not explained) polyclinic in the problem of protection from the damaging effect of ionizing radiation.
Rev. Sanit. Mil., 16: Special No., 398-403 (1965) (In Rumanian)
Source of abstract: NSA 21:524 No.4801 (Feb. 28, 1967)

Ideal dosimeter indictors (e.g. lithium floride), optional methods for protection in radiation diagnosis, and treatment with various radioisotopes such as ^{131}I, ^{198}Au, ^{203}Hg, ^{51}Cr, and ^{60}Co are discussed. External decontamination using detergent and internal decontamination employing chelates are considered.

WENDT, F., and A. PREUSSLER
Zur diagnose von strahlenspaetschaeden der haemopoetischen organe infolge beruflich bedingter chronischer strahlenbelastung. (The diagnosis of delayed radiation damage to the hematopoietic organs following chronic occupational radiation exposure).
EUR-2634.d (1966)
Source of abstract: NSA 20:3250, No.26653 (Aug. 15, 1966)

The effects of radiation on 13 occupationally exposed persons were investigated by means of information from the occupational hazard insurance companies and other sources. The cases were divided into 4 groups according to degree of damage, namely: Minor reversible damage with temporarily lowered bone marrow cellularity and blood cell reductions (7 cases); medium reversible damage with longer term history of bone marrow hypoplasia and pathological blood cell values (1 case); severe irreversible damage with persistent bone marrow hypoplasia and pathological blood cell values (1 case); and malignant hemoblastosis or other forms of neoplastic bone marrow disease. The probability was established that the effect of radiation was an essential pathogenetic factor in 4 cases: a reticulosarcomatosis, a subacute myeloblastic leukemia, a sub-acute lymphatic leukemia, and a lymphatic leukemia with transition to a reticulosarcomatosis. No unequivocally radiation-specific alterations were found. The diagnosis of radiation-induced damage to the hematopoietic organs from small radiation doses such as occur in occupational exposure, can be made with adequate probability only after detailed and comprehensive investigation, and only from the totality of all unspecific symptoms. In this context a special significance is attached to exposure anamnesis, the subjective data of which must be supplemented by as accurate an individual dosimetry as possible.

WHITCOME, H., R. YOUNG, S. MELVILLE, JR., A. J. PITCOCK and R. D. ANDERSON
Chemical protection of irradiated monkeys in combination with autologous and homologous marrow transfusion.
Rad. Res., 29:339-53 (Nov. 1966)
Source of abstract: NSA 21:710, No.6628 (March 15, 1967)

Thirty-two rhesus monkeys were x-irradiated (900 r, total body) and given autologous and homologous marrow transfusions with and without prior administration of a chemical protection mixture (AET-cysteine-Nembutal). Survival times were greatest among the animals that received chemical protection plus autologous cells. No difference was observed for those animals receiving protection plus homologous cells when compared to those receiving homologous cells only. When the former group is compared to animals receiving chemical protection only, survival time is found to be shortened as a result of secondary disease. No difference in leukocyte regeneration was observed between autologous marrow recipients with or without protection. No effect of the protective mixture on the time of recovery of mononuclear cells was observed in autologous marrow recipients. Anemia was most severe in the hemologous marrow recipients showing donor RBC proliferation and is presumed to be due to hemolysis associated with the secondary disease. Serum glutamic transaminase was found to be elevated in all animals receiving homologous cells and surviving to the fifteenth day with and without chemical protection.

WILLIAMS, H., D. HALL and L. MORGAN
Whole-body irradiation of primates with protons of energies to 400 Mev.
Rad. Res., 28:372-89 (June 1966)
Source of abstract: NSA 20:3794, No. 31096 (Sept. 15, 1966)

The physical and dosimetric aspects of the whole-body irradiation of small primates (Macaca mulatta) with 400-, 250-, 138-, 55-, and 32 Mev protons are described. Doses varying from 25 to 7000 rads were given, about 100 animals being exposed at each energy. Details of the experimental procedures are given and the dosimetry problems are discussed. Biological results of these exposures are described in the references.