Ground Rules for Space Research

The newly formed National Aeronautics and Space Administration is now seeking in its organizational set-up the way of wisdom between two extremes. On the one side is the extreme of no central organization, which could mean that all participating laboratories find themselves conducting variants of the same experiment; on the other side is the extreme of complete organization, which could mean that the effort to discover the best way to conduct a given experiment results in very few experiments getting underway. Where lies the golden mean?

The new agency was established by Congress as part of the answer to criticisms of research and development as previously conducted by the armed services. According to critics, the armed services together with the Department of Defense produced a set-up that managed the singular feat of erring in both directions at once. Competition among the Army, Navy, and Air Force resulted in wasteful duplication, while the Defense Department's efforts to control duplication resulted in costly delays.

To avoid some of the shortcomings of earlier programs, the Space Administration appears to be planning to conduct a strong research program within its own facilities—this in addition to directing through outside contracts a broad range of efforts by research groups in universities and industry. Besides giving it the advantage of being able to initiate its own projects, a strong house program will enable the agency to give more effective direction to its outside research. To direct outside research, the Space Administration should have a staff of talented scientists upon whom, in conjunction with its special advisory committees, it can call for advice. Scientists being what they are, the opportunity for creative work that a house program affords would bring to the agency men of a higher caliber than it would otherwise be able to obtain.

Since the major strength of the earlier efforts in space research lay in the armed service programs, the new agency will look to this source both for individual scientists and for working groups. Opposition by the armed services is strong, and the services feel the most justified in those areas in which they have been the most farsighted. So far the new agency has had mixed success. One large transfer of personnel to the Space Administration was a group of approximately 150 scientists who had been engaged in the Vanguard program of the Naval Research Laboratory. A second transfer was the Army's Jet Propulsion Laboratory at Pasadena, California, which is operated by California Institute of Technology. However, the Space Administration also wanted to acquire the Army Ballistic Missile Agency at Huntsville, Alabama, with its staff of 2000 scientists under Wernher von Braun, but President Eisenhower has permitted the Army to keep control.

Detailed plans for the organization of research in the Space Administration have yet to be completed, and it would seem that the form they finally take will depend in part upon further developments outside the agency. The over-all problem is whether the earlier dispute over what properly belongs to the Army, Navy, and Air Force will now be replaced by the dispute over what is properly military and what civilian. The hope is that in place of rivalry we shall, with these new protagonists, now find cooperation.—J.T.
A mechanized "oracle" is helping Bell Telephone Laboratories predict the future in communications devices and systems.

The oracle is "Sibyl," a computer-like machine developed by Bell Laboratories engineers and psychologists. It can simulate the action of many kinds of communications devices. Through Sibyl, new kinds of telephone service can be evaluated without the considerable expense of building actual equipment. Observing and recording users' reactions to the simulated equipment, Sibyl provides indications of how users would react to proposed new systems features and equipment.

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Bell engineers expect that Sibyl will provide a better understanding of the relationship between telephone equipment and the people who use it. Sibyl's rapid and economical technique for evaluating new types of telephone sets is an important contribution to the art of telephony.
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If you want a copy, check with your Kodak dealer. If, as we suspect, he doesn’t remember anything about it, send 35¢ to Eastman Kodak Company, General Sales Service Division, Rochester 4, N. Y. Don’t neglect to mention the title.

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Our fastest kind used to be Kodak Industrial X-ray Film, Type K. Now we call it Type KK. The speed has gone up 50%. A 72-hour exposure becomes a 48-hour exposure. Time is money. So they say. Same principle applies to uranium fuel elements. (To Cs137 gamma rays, ½" of uranium looks like 4" of steel.) Type KK is a bit grainier than Type K. But it has higher contrast. The gain outweighs the loss. Up goes "radiographic sensitivity." Radiographers can spot smaller voids.

Kodak Industrial X-ray Film, Type AA beats KK seven ways to Sunday for “radiographic sensitivity.” It’s some slower, though. As Type A, it used to be a lot slower. That was a little over a year ago. It was then the most widely used x-ray film in industry. Now it’s more so. That sounds like tautology. Nevertheless, it makes us happy. With the higher speed, inherent contrast has gone up, not down. Grain’s the same. This is remarkable.

They can just reduce exposure time. Even for thinner specimens, time is money. So it is said. Or they can cover more area at a single exposure. That’s another way to save time.

Or they can take the same time and get more film density. Contrast doesn’t trip. "Sensitivity" doesn’t mean "speed" here.

Don’t worry. You’d get the hang of it if you had to. Yes, even the radiography of plutonium hardware, where you’re recording both endogenous and exogenous radiation. We’d give you what advice we could (but very little about plutonium). You’d write Eastman Kodak Company, X-ray Division, Rochester 4, N. Y.

We also have some freshly minted advice on silver-sensitized goods for dosimetry, including a bibliography. If that’s all you want, write Eastman Kodak Company, Special Sensitized Products Division, Rochester 4, N. Y. Ask for the new pamphlet, "Radiation Monitoring with Kodak Personal Monitoring Films." It’s useful for processing techniques, if nothing else.

The isonitroso that wasn’t expected

Dimethylglyoxime (Eastman 98), a rip-roaring success as a nickel reagent. Precipitate so beautiful that it’s used in the lipstick trade.

Reported recently by some fellows as an improvement. We want to make it, but we hate to mess around with selenium dioxide the way they did.

This is another advertisement where Eastman Kodak Company probes at random for mutual interests and occasionally a little revenue from those whose work has something to do with science and therefore "radiographic sensitivity" improve at higher density. Or they can get through the specimen with less penetrating radiation. Softer radiation emphasizes density differences along ray paths of slightly different absorption. You want those differences.

Kodak Industrial X-ray Film, Type M is for maximum detail and no rush, or else light specimens. Kodak Industrial X-ray Film, Type F goes with calcium tungstate screens. Their fluorescence in the visible intensifies the exposure. In a pinch that’s sometimes all right.

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Ketonic carbonyl oximated, by hydroxylamine. This part of the plan worked. We have put this in stock as S-Methyl-1,2,3-cyclohexanetrione Trioxime (Eastman 7478). We hope somebody will discover what it is a reagent for.

One of these we are going to have to consider smaller print for our catalog, “Eastman Organic Chemicals, List No. 41.” Even now there are some 3700 highly purified organics under its covers and in our stockroom. If you don’t have a copy, write Distillation Products Industries, Eastman Organic Chemicals Department, Rochester 3, N. Y. (Division of Eastman Kodak Company).
without cancer at the time of reexploration—21 percent eventually died of cancer. The salvage rate of 5.5 percent for the whole group was offset by an equal mortality rate for the "second look" operations; however there were no deaths in cases declared negative on the first reexploration. Wangensteen concluded that the program has shown clearly how extensive the primary operation should be.

For carcinoma of the corpus uteri, W. Hawksworth (Oxford, England) reported an operability rate of 88 percent and a five-year survival rate of 64 percent; the nodes of the lateral pelvic walls are a common site for recurrence. R. M. Fawzy (Cairo, Egypt) noted that bladder cancer comprises 40 percent of cancer in Egypt, possibly because of predisposition to infestation by Bilharzia; the operability rate is under 10 percent, with a five-year survival rate of 30 percent. R. Schade (Newcastle-upon-Tyne, England) thought that carcinoma of the stomach develops nearly always in a diseased gastric mucosa and especially in association with chronic atrophic gastritis.

Radiation therapy of cancer, according to F. Baclesse (Paris) has been improved to deliver an increased dose of radiation to the tumor. This is achieved by physical means, such as rotation, convergence, or grill therapy, and by biological means such as dose fractionation, and high voltage sources are valuable. For conventional x-ray therapy of lung-cancer patients with tumor doses up to 5000 r, S. Mustakallio (Helsinki) reported a five-year survival rate of 2 percent in patients with advanced disease and of 26 percent in a small proportion (3 percent) selected for surgery and postoperative x-ray treatment. L. Larsson et al. (Stockholm) found that colloidal Au198 is taken up by bone marrow only in places of active hematopoesis. Use of an automatic scanning scintillation counter to obtain bone marrow scintigrams gave valuable information in treatment of chronic leukemia, bone marrow carcinosis, and polycythemia vera.

Endocrine management of cancer of the thyroid has shown spectacular progress, as summarized in exhibits by E. E. Pochin and K. E. Halnan (London, England), L. G. Larsson (Stockholm), and J. C. McClintock (Albany). The therapist has now at his command the surgical techniques of lobectomy, total thyroidectomy, and radical neck dissection, which can be followed by external irradiation. In metastatic thyroid carcinoma, radiiodine often greatly prolongs life; temporary administration of antithyroid drug may revive the functional activity of the tumor and thereby renew its uptake of radiiodine; thyroid hormone sometimes causes regression of hormone-dependent tumors; and external radiation helps to relieve pain.

For disseminated cancer of the breast, R. A. Huseby (Denver, Colo.) reported that adrenalectomy or hypophysectomy benefited one-third of the cases. He stressed the need for a method to predict the results of these operations and noted that for women who are menstruating regularly, failure to respond to castration often heralds failure to respond to androgens, to adrenalectomy, or to hypophysectomy. X-ray treatment and intracavitary colloidal Au198 are valuable, even for patients already on hormone therapy. Sir C. Dodds (London, England) reported that 30 percent of patients with disseminated breast cancer responded to ovariec- tomy; he questioned use of hypophysectomy because of high operative mortality. C. Huggins (Chicago) reported that 11 different procedures induce remission in hormone-dependent metastatic cancer of the breast. In two studies on hypophysectomy of patients with advanced lesions, the five-year survival rates were 0 and 4 percent, respect- ively. Huggins further developed the method of H. Shay et al. (Philadelphia) and induced hormone-dependent mammary tumors rapidly in a high percentage.
of female rats with a single dose of 5 mg of methylcholanthrene, given by stomach tube; both Shay and Huggins used such tumors to assay hormonal and therapeu-
tic agents.

Chemotherapy

Chemotherapy of cancer, according to T. Yoshida (Tokyo), is taking its place beside surgery and radiation as a unique weapon to prevent metastases and allevi-
ate disseminated cancers. The five main classes of active compounds dis-
cussed were alkylating agents, nucleic and folic acid antagonists, quinones, an-
tibiotics, and steroids. One rationale is to poison the cancer cell selectively, by
exploiting the very differences that give it a biological advantage.

Nitrogen mustard, with the formula \( \text{C}_7\text{H}_7\text{N}-(\text{C}_7\text{H}_5\text{CH}_2\text{Cl})_2 \), often ab-
breviated to HN2, inhibits cell division by reacting with nucleoprotein but pro-
duces violent nausea. The less toxic and more soluble phenylbutyric acid deriva-
tive Chlorambucil was found to be su-
uperior for treatment of lymphocytic leu-
kemias and lymphomas, in Europe and
in the United States. Another amino acid (phenylalanine) derivative of HN2
named Sarcolysin was synthesized later independentl

y in the Soviet Union and in England. N. Blokhin (Moscow) re-
ported that Sarcolysin is effective for metasta-
tic seminoma of the testicles but not for metastatic teratoma. Other HN2
derivatives mentioned include the HN2
mannitol compound Degranol, which
gives regressions in metastatic cancer (P.
Rubányi, Budapest); the N’O-propylene
phosphate ester diamide of HN2 named
"B-518," which has low toxicity and
gives good remissions in lymphosarcomas
(R. Gross and K. Lambers, Marburg,
Germany); and several others, including
drugs showing promise in animal experi-
ments, such as the three-stage drugs
formed by linking a two-stage HN2-
amino acid derivative like Sarcolysin
with another amino acid, vitamin, or
nucleic acid precursor (L. F. Larionov,
Moscow). Alkylating agents other than
HN2 and its derivatives include Myleran,
which is effective in treatment of gener-
ized myeloid leukemia or in the radia-
tion-resistant disease (D. A. G. Galton
and P. E. T. Hancock, London, England);
and di-diepoxybutane, which
shows promise in Hodgkin’s disease (J.
Bichel, Aarhus, Denmark).

C. P. Rhoads (New York) thought
that cancer is a somatic mutation which
causes changes in nucleic acid structure,
and that these changes are the key to the
peculiar properties of the cancer cell.
Many chemotherapeutic compounds act
by interfering with nucleic acid metabo-
lism. Thus, 8-azaguanine is rapidly in-
corporated into tumor to form a non-
functional ribonucleic acid molecule,
while, according to P. Feigelson and J.
E. Ulmann (New York), it also inter-

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fers with nucleic acid metabolism by in vivo inhibition of xanthine catabolism. Similarly, C. Heidelberger reported that 5-fluorouracil and related analogs form nonfunctional (or "fraudulent") nucleic acids and also inhibit nucleic acid biosynthesis. A. R. Curreri (Madison, Wis.) found that 5-fluorouracil is clinically effective against tumors but also affects rapidly growing normal tissues, while R. Duschenksy et al. (Nutley, N.J.) had synthesized its ribose and deoxyribose in the hope of reducing toxicity. J. R. Fountain (Leeds, England) found 6-mercaptopurine very useful for chronic myeloid leukemia, perhaps due to activation at a site other than tumor (E. J. Sarcione and L. Stutzman, Buffalo). E. Frei et al. (Bethesda, Md.) found 6-azauracil too toxicotropic, while A. D. Welch et al. (New Haven, Conn.) reported that its riboside is from 10 to 20 times as effective against mouse tumors. S. Farber (Boston) noted that antifolies act by inhibiting cofactors essential for biosynthesis of nucleic acid precursors and stressed the use of Aminopterin (4-aminopteroylglutamic acid) for acute leukemia in children and of the related Methotrexate for acute leukemia with lung metastases.

Among quinones, the ethyleniminoquinone "E-39" inhibits cell glycosylation (N. Gerlich and H. J. Wolf, Bielefeld, Germany) and often gives satisfactory remissions in metastatic cancer and chronic lymphomatous (Wolf and Gerlich; J. Bernard et al., Paris). Both Farber and C. T. C. Tan et al. (New York) reported favorably on use of ac tinomycin D with Wilms' tumors; Tan also had good results in children with neuroblastomas but not in adults with metastatic neoplasms. Steroid therapy in chronic lymphatic leukemia was stressed by J. L. Cade (Edmonton, Canada) and by J. G. Freymann and J. B. Vander (Boston); they noted especial benefit in the presence of severe and refractory anemia, but infections were a serious complication.

Ideally, all screening of compounds for cancer chemotherapy should be done in man (C. C. Stock, New York). Since this is impracticable, Stock thought that assay systems such as heterologous transplants of human tumors; spontaneous, induced, and transplanted animal tumors; and tissue cultures and cultures of microorganisms all have their place. With K. Sugihara, he used a new transplatable mouse-virus leukemia to screen 100 different compounds by the simple initial criterion of spleen weight in treated and control mice. R. Bather (Edinburgh) employed day-old chicks injected with Rous sarcoma virus to test antitoxicils, while A. Goldin et al. (Bethesda, Md.) used an advanced mouse leukemia as a rapid assay system.

For objective clinical evaluation of chemotherapeutic response, E. Paterson (Manchester, England) defined a remission as the time interval after treatment within which a clinical index had again risen to its pretreatment value. The index was calculated by assigning a score of 2 for improvement, 1 for unchanged condition, and 0 for advancing disease to each of ten clinical indications: superficial nodes, mediastinum, spleen, liver, effusions, hemoglobin, fever, well-being, weight, and ability to work. Using this method, Paterson showed precisely how the length of the remission decreased with each additional course of therapy in Hodgkin's disease.

Combination therapy of chemotherapeutic agents with x-rays was reported to give beneficial effects in Hodgkin's disease but not in leukemia (L. Heilmeyer, Freiburg, Germany). Several papers reported effective use of chemotherapy as an adjunct to surgery. L. F. Laronio thought that the antitumor effect of chemotherapeutic substances is inversely proportional to the mass of the tumor, hence that chemotherapy should be more effective when the tumor mass is small—a concept similar to that of Sherman and Moore. Laronio reported that 18 patients were given HIN2 or Novembachin at an early stage of Hodgkin's disease: 50 percent survived for 5 years; 22 percent, for over 8 years.

Conclusion

In summary, a brief glimpse at the world-wide problem of cancer in 1958 is frankly heartening, showing steady advances on a widening front. Many speakers held that a single cure for cancer is unlikely and studied each group of cancers almost as a separate disease. Some hoped that cancer can be eradicated without an understanding of its very nature; others felt that we must understand better the etiologia of the cancer even of life itself. If the somatic mutation theory of cancer is right, then development of cancer is an inherent property of life, and cancer research is but in its lusty infancy. There is every hope that there will be continuing advances in understanding, detection, and therapy.

Thanks are due the British Organizing Committee for its excellent conduct of the congress and for its selection of the pleasant Royal Festival Hall and London County Hall as meeting places. The daily round of entertainments served to make the meeting truly memorable; these included a performance of Aida at Covent Garden Opera House, a delightful garden party at Hurlingham after a boat trip up the Thames, and a performance of the resplendent Guards bands under floodlights at Hampton Court Palace.

At the closing session, V. R. Khanolkar (Bombay) was announced as president of the International Union Against Cancer, and A. Haddow (London, Eng-
land) as president-elect. The next International Cancer Congress will be held in the Soviet Union in 1962. In his closing speech the president of the present congress, Sir S. Cade, noted with pleasure the number of young scientists who had attended, saying he thought it augured well for the future.

Arnold E. Reif

Department of Surgery,
Tufts University School of Medicine,
Boston, Massachusetts

Notes

1. Application of Doll's findings of proportionality to Hammond's data suggests that smoking four cigarettes per day (about one-fourth the average cigarette consumption) will equal in effect the atmospheric pollution experienced in an average American city. It will therefore increase eightfold the low lung-cancer rate of rural non-smokers, while doubling the rate for urban non-smokers.

2. Checked by correspondence following the congress with authors of papers where any possible doubt of agreement existed.

Forthcoming Events

December


29-17. Bahamas Surgical Conf., 1st, Nassau, Bahamas. (B. L. Frank, 1290 Pine Ave., W., Montreal, Canada.)

January


18-31. Bahamas Serendipity Session, Nassau, Bahamas. (B. L. Frank, 1290 Pine Ave., W., Montreal, Canada.)


22-23. Mathematical Assoc. of America, 42nd annual, Philadelphia, Pa. (H. M. Gehman, MAA, Univ. of Buffalo, Buffalo 14, N.Y.)


26-29. Institute of the Aeronautical Sciences, 27th annual, New York, N.Y. (IAS, 2 E. 64 St., New York 21.)

26-30. Writing and Publication in Industry, conf. and workshops, Brooklyn 1, N.Y. (T. L. Donahue, Writing and Publication Conf., Polytechnic Inst. of Brooklyn, 333 Jay St., Brooklyn 1.)


29-31. Western Soc. for Clinical Research, 12th annual, Carmel-by-the-Sea, Calif. (W. N. Valentine, Office of the Secretary, Univ. of California Medical Center, Department of Medicine, Los Angeles 24.)

(See issue of 21 November for comprehensive list)
**Equipment**

The information reported here is obtained from manufacturers and from other sources considered to be reliable. Science does not assume responsibility for the accuracy of the information. A coupon for use in making inquiries concerning the items listed appears on page 1526.

- **Temperature-calibrating bath** is a double unit permitting calibration at two temperatures. Temperatures are adjustable from 6° to 260°C above room temperature and are maintained ± 0.2°C. The inner shell is 10 in. in diameter and 15 in. deep. (American Instrument Co., Dept. 518)

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- **Fume-hood sash control** frees the user’s hands entirely for handling reagents and instruments. Sash opening and closing is controlled by a tread. The hood closes automatically when the user walks away. An overriding manual push-button control permits the sash to be moved to any position, and a stop button can be used to halt automatic motion. A third mode of operation permits opening or shutting in case of power failure. (Laboratory Furniture Co., Inc., Dept. 525)

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Letters

Initial Modesty

Authors "who believe that the use of I or we is immodest" were gently chided for their false modesty in the lead editorial, "Passive voice," in Science for 22 March 1957 [125, 529 (1957)]. But authors who prefer not to write in the first person are much more honest than those, like the author of the editorial in question, who write in the first person without signing their names.

An editorial report, or article whose author is identified only by initials has an anomalous status. Does it represent the view or opinion of the editorial board, as competently expressed by one member? Or does the use of initials imply a disclaimer by the board as a whole, so that only the owner of the initials is to be held responsible?

If cryptic initials are used only for internal identification, they should be much less obtrusive—perhaps in 6-point type, or in the form of a code number or of initials run together without periods, even in reverse order. As used, full-size, in Science, initials usually can be matched up with one of the names in the masthead, so they offer little anonymity. The editorial in question was signed "R.V.O."—presumably Robert V. Ormes, a member of the editorial staff. Was Ormes so ashamed of his editorial that he did not wish his full name attached to it?

(Perhaps he should be ashamed. For an essay on grammatical purity, its own purity leaves something to be desired. I was particularly set on edge by the sentence: "In the editorial office we still see gerunds and participles used in this manner, and it is discouraging." Is the manner discouraging?)

In addition to making an unclaimed orphan out of an editorial or note, the use of initials, rather than an honest name, imposes an unwarranted burden on the poor bibliographer. Forever more, this editorial must be listed as: "R(obert?) V. O(rmes?): Passive Voice," or "R.V.O. (Robert V. Ormes?): Passive Voice." Bibliographers should not be forced to pay thus for an unsure author's false modesty.

Arnold Court

Radiation Hazards

In the article entitled, "Mice, men, and fallout" [Science 128, 637 (1958)], M. P. Finkel presents some interesting results regarding the effects of low doses of Sr$^{90}$ on mammalian life expectancy and incidence of certain tumors. However, in discussing these results, the author draws far-reaching conclusions relating to the danger to man (or rather lack of it) from present Sr$^{90}$ fallout. The concluding sentence states, "the present contamination with strontium-90 from fallout is... extremely unlikely to induce even one bone tumor or one case of leukemia." I would like to raise the following points with regard to this conclusion.

1) In the data presented, the uncertainty was such that a 7-percent shortening of life span in an experimental group did not represent a statistically significant deviation from the control, nor did a threelfold increase in the incidence of osteogenic sarcomas. Yet the above statement refers to effects on the world's population which would amount to a small fraction of 1 percent.

2) No statistically justifiable extrapolation for determination of "threshold doses," or even demonstration that there is a threshold different from zero, seems possible from the data as presented. In fact, these data appear to indicate that the experimental design used is inadequate for this purpose.

3) At the present time, sober and accurate evaluations of the effects of chronic low-level irradiation of human populations, from internal and external radiation, are essential for the formulation of safe and wise national and international policies regarding the testing of nuclear weapons and the development of nuclear power. It is unfortunate that at this time a statement such as that quoted above is published with the implication that it is based on experimental evidence, when actually it appears to be without objective, logical support. Unfounded statements minimizing radiation hazards can be especially harmful if they turn out later to have been false.

A more appropriate conclusion from the data would seem to be that drawn by Austin M. Brues from a discussion of other data relating to carcinogenesis [Science 128, 693 (1958)]—namely, that a linear dose-effect relation is less probable than a nonlinear relation, and that a threshold might occur.

Carl Moos

College of Medicine, University of Illinois, Chicago

I should like to comment on the article by Miriam P. Finkel. First of all, it is difficult to tell whether this article should be considered as an editorial or as a strictly scientific paper. If the latter is the case, I should like to strenuously object to the opening paragraph, which in a back-handed kind of way casts disrepute on some of the most eminent scientists of our time who have been concerned with the effects of fallout on human beings.

Aside from this, I particularly wish to criticize some of the scientific conclusions. The type of effect that one is looking for with respect to the action of fallout on man is such that it has been predicted that several tens of thousands
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of individuals may develop tumors or leukemia. If the entire population of the world is considered, then only one individual in a few hundred thousand might be expected to show this damage, if the magnitude of the effect is what has been predicted. I do not see, therefore, how the figures given in Table 1 of Finkel's article are adequate to enable one to draw the conclusion that there will be no effect of the above-mentioned magnitude. At the lowest level of radiation used (group number 12 of Table 1), it seems to me, the number of animals used should have been approximately 200,000 instead of 150 in order to establish an effect of the magnitude we are seeking. Even with 200,000 animals it might be expected that only one mouse would develop a tumor as the aftermath of the radiation, and therefore the number utilized should be many times greater than 200,000 to establish a statistical significance of the effect at the low levels. In view of this I think the final sentence in the conclusion is extremely unwarranted and is not in accord with an objective scientific appraisal of the data presented.

Although the author points out that there are considerable differences to be expected in the response to radiation of a mouse and of man, I think this point should have been further stressed, particularly in view of the conclusion in the final sentence. One very obvious great difference is the fact that the mouse cells are exposed to the radiation for a period of not more than approximately 2 years, whereas human cells may be exposed to the radiation for a period of 60 to 70 years, with much more far-reaching consequences possibly accruing in the latter case.

I feel that the great publicity given to the article in question in the newspapers has given perhaps an erroneous viewpoint to many laymen who are not familiar with some of the imponderables involved.

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The article by Miriam P. Finkel of Argonne National Laboratory propounds very sweeping conclusions on the lack of danger from small doses of ionizing radiation, and particularly from strontium-90 fallout. An examination of the assumptions upon which these conclusions rest is called for. The chief of these is that the main danger of radiations in man's environment lies in their effects on the individuals exposed. The author states (page 637): "At lower levels [of radiation], tumor induction and shortening of life are the major signs of damage." This leads her to restrict her discussion of the evidence as follows: "The most useful criteria of radiation damage to the mammalian organism as a whole are decrease in life span and increase in incidence of certain tumors." Although she states that "these studies are concerned with the effects upon the exposed generation only," the article shows no sign whatever that the author is aware of the fundamental distinction between somatic and germinal radiation damage.

The undoubted fact that high-energy radiations induce mutations in germ cells would seem to be sufficient reason for at least using caution in discussing a question of such importance as the radiation damage to human populations. The data presented have obviously no bearing on the problem of direct proportionality between the radiation exposure and the number of germinal mutations induced.

The question of linearity of response of somatic cells to radiation is treated in a paper by A. M. Brues, from the Argonne Laboratory, in the issue of Science following that in which Finkel's paper appeared [126, 693 (1958)]. The conclusion reached is that there is no evidence of linear relationship between carcinogenesis and the dosage of carcinogen, and that this makes a mutational origin of cancer doubtful. Whether or not this conclusion is accepted, the evidence for it is set forth clearly and examined critically. The same cannot be said for Finkel's presentation, which arbitrarily excludes from consideration the genetic radiation damage.

The neglect of elementary methods of critical examination of evidence leads us to doubt not only Finkel's main conclusion that "the present contamination with strontium-90 from fallout is so very much lower than any of these levels that it is extremely unlikely to induce even one bone tumor or one case of leukemia" but also the rationale on which the work was based. Surely understanding of the effects of radiation on populations of organisms, including man, is not likely to be advanced by willful neglect of one of the well-established effects of radiation.

L. C. DUNN
T. DOBZHANSKY
Department of Zoology, Columbia University, New York, New York

Moos' comments are most pertinent to the complicated problem of the potential danger from very low doses of radiation. Since the major assumptions upon which the usual estimations of the human hazard have been based are not supported by animal experimentation, there is no reason to believe that straight lines drawn from the effects of moderate doses to zero effect at zero dose have any meaning. My conclusions have been based upon alternative methods of assessing the human hazard.

The objection is raised by Moos in point 1 that, in spite of the statistical uncertainties of the values at low levels, statements referring to large populations (Continued on page 1508)