REPOSITORY PNL PNL-10621-001
COLLECTION Prisoner Study
BOX No. 3156
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April 21, 1967

Bill: Would ya take a look at this? Paulsen is wanting to know what it all means! Ken has more details. Walt.

Dr. C. Alvin Paulsen
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U.S.P.H.S. Hospital
Box 3145
Seattle, Washington 98114

Dr. Kenneth L. Swinth
Research Scientist
Battelle Memorial Institute
P.O. Box 999
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Dear Drs. Paulsen and Swinth:

I have received rather similar letters from both of you and should like to take the liberty of answering you collectively in this fashion.

Dr. Oakberg's remarks doubtlessly refer to studies which were carried out by Dr. V.P. Bond and Dr. J.L. Bateman of the Brookhaven Medical Department, in collaboration with us and which dealt with the induction of minimal opacities in the lens of the eye of the mouse. RBE's approaching 100 were indeed observed but it was necessary not only that the injury be slight, but also that it appear only a short time before the typical period observed in the controls. If the level of opacification is higher and, in particular, if this opacification level is to appear substantially more rapidly, the RBE values appear to be of the order of 20 or 30. The above numbers apply to 0.43 meV neutrons. For 14.7 meV neutrons the RBE appeared to be uniformly less by a factor of 10.

The above remarks would appear to make the hazards to your human volunteers to be perhaps less severe than one might at first assume. However, I would think that you should be able to protect the eyes with hydrogenous material to bring the dose down into the millirad range. This would seem highly advisable since the neutrons that otherwise reach the eyes are likely to be of low energy and hence high RBE. Incidentally, the lowest dose of 0.43 meV neutrons utilized in our experiments was 0.5 rads which in all instances resulted in shorter latent periods for opacification than that of the controls.

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There remains of course the important question as to whether there is greater sensitivity and particularly neutron sensitivity of the human lens. Dr. V.P. Bond of Brookhaven has recently considered this problem in some detail. Whilst I would think that his conclusions would be likely to lend you further encouragement, I would strongly suggest that you ask his opinion in this area.

I enclose a section of our forthcoming annual report which presents some of the data obtained. Please do not hesitate to let me know if you think that I can be of further help.

Yours sincerely,

HHR:krj
Enc.

Harald H. Rossi
Professor of Radiology (Physics)

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DF-1 MRS Studies with Monoenergetic Neutrons

R.H. Ramsey, J.L. Bateman, and D.J. Thomas (in collaboration with Dr. Victor Ward and Dr. H.H. Smith of the Brookhaven National Laboratory)*

a) Opacity studies

During the last year the major effort in studies of the effects of monoenergetic neutrons related to the induction of opacities in the lens of the mouse eye by low doses. It was found possible to reliably evaluate a level of effect which is approximately one quarter of the levels investigated previously and the data at such low levels appear to be even more reproducible than those at higher levels. As a result of the sensitivity of the method, it is possible to clearly establish the effect of as little as 0.5 rad of 0.40 Mev neutrons and one rad of 24.7 Mev neutrons. It is also possible to marginally detect the effect of sub rads of x-rays.

The results of these investigations are now being organized and will appear in the form of a detailed publication. The following summarizes some of the findings involved:-

Figure DF-1-1 shows the relation between latent period (the time required for half of the animals in a given group to develop the stated

*Work supported in part by a grant from the Division of Radiological Health, Bureau of State Services, Public Health Service, RH 99.

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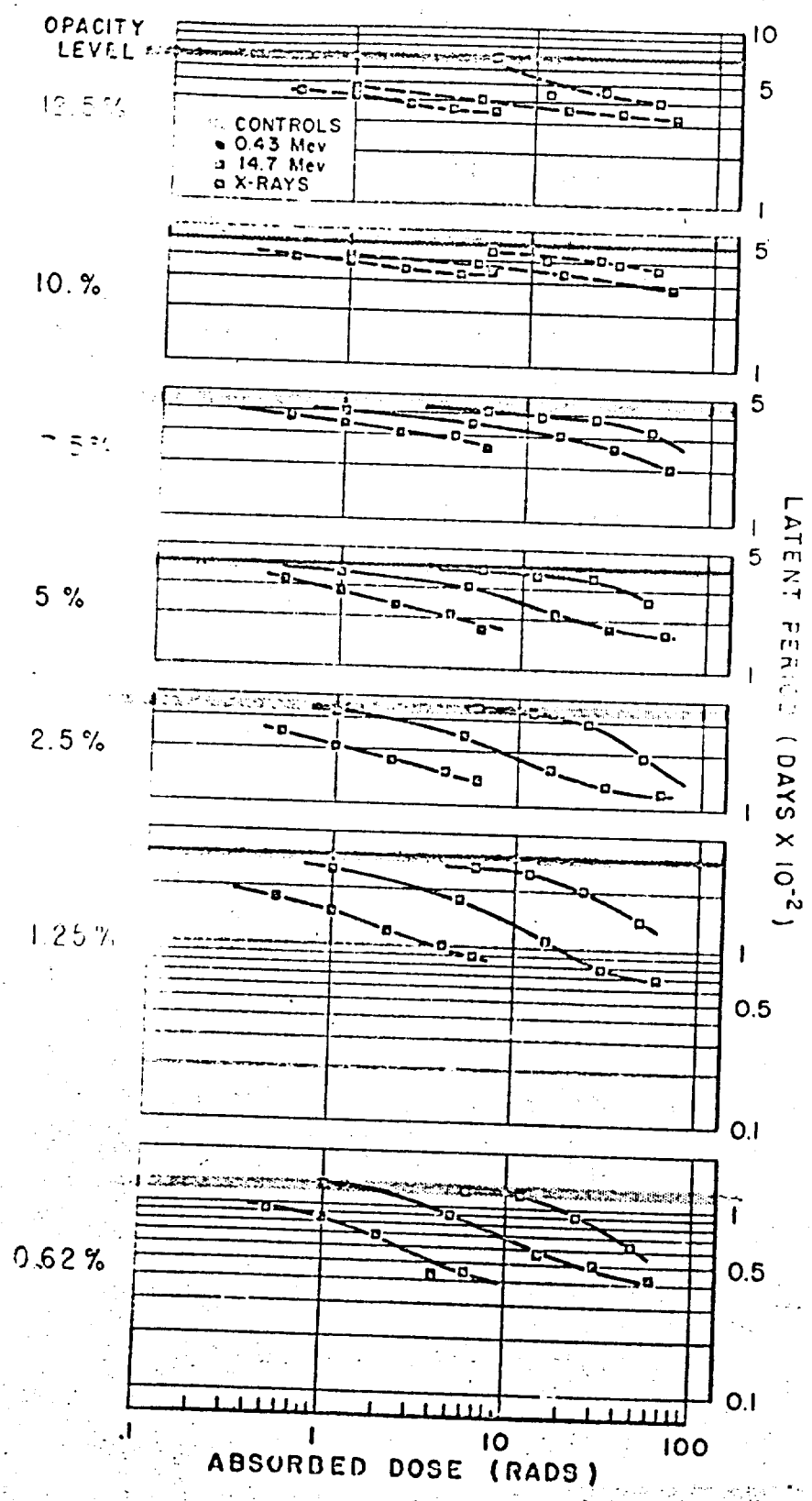
V OPACITIES, H SERIES



BP-1-1

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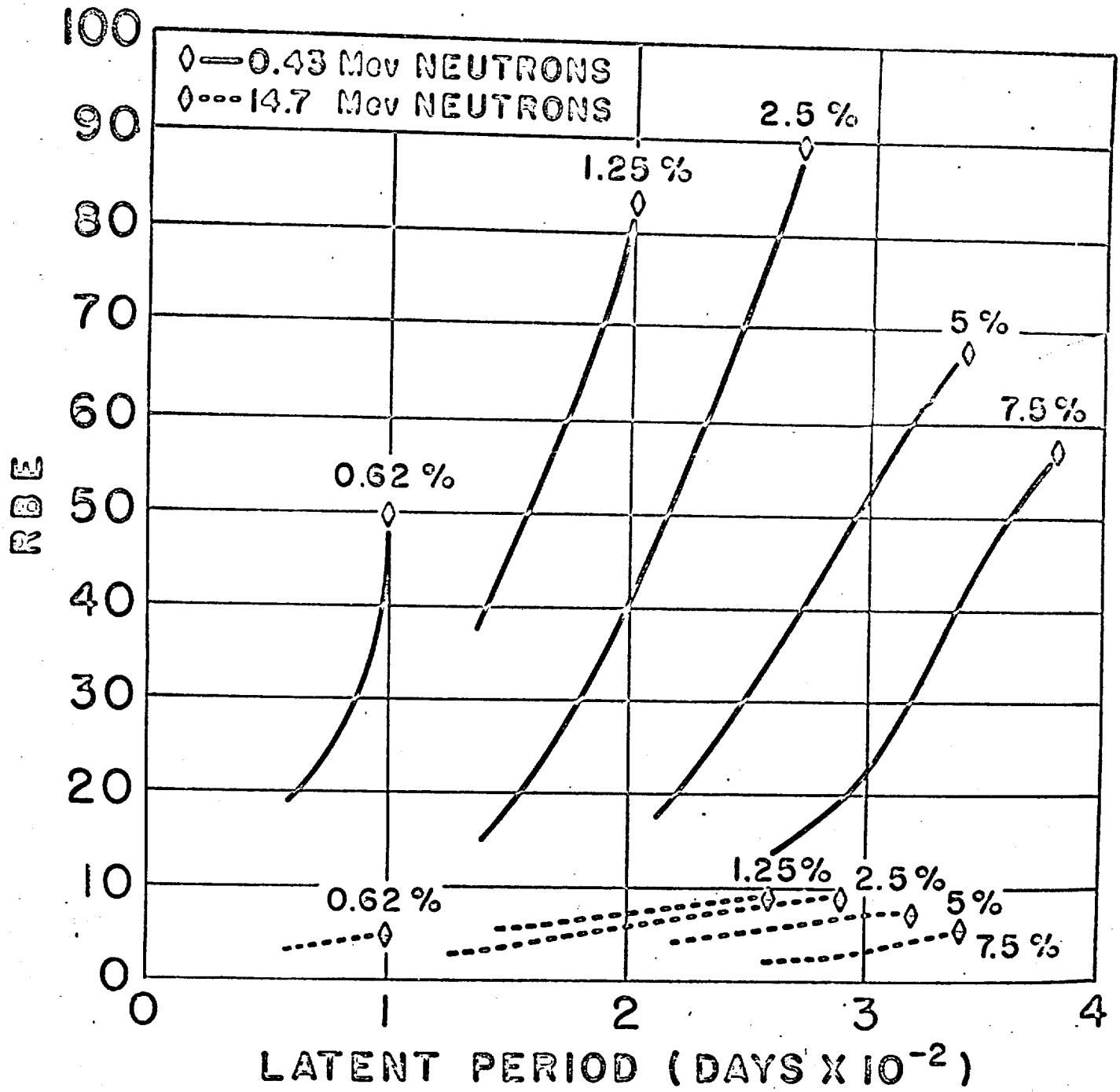
RBE FOR V OPACITIES



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level of opacification) versus absorbed dose. These data are for low opacification in the anterior portion of the lens. The stippled bands represent control values and indicate that such slight opacification occurs in most of the controls during their lifetime.

It will also be noted that with decreasing dose the control levels are approached in a different manner by the curves for x-irradiated animals than those for neutron irradiated animals. This results in increasingly high RBE values with decreasing dose, as indicated in Figure BP-1-2. This diagram also suggests that even higher RBE values might be attained at still lower doses.

An interesting correlation between radiation and aging may be found by organizing the data in the manner employed in Figure BP-1-3. Here the degree of opacification (on a more or less arbitrary scale) is plotted versus time after irradiation. It will be noted that the controls exhibit a rapidly increasing opacification with age as commonly found with most defects (and as often expressed by Gompertz curves). In the example chosen which concerns .43 Mev neutrons, irradiation results in an earlier occurrence of a given level of opacification with the time differential becoming more or less constant once the radiation induced "aging" is fully developed after 100-200 days. In the case of 0.5 rads the final differential is approximately 90 days. This might be interpreted to signify that this dose has aged the lens by 90 days.

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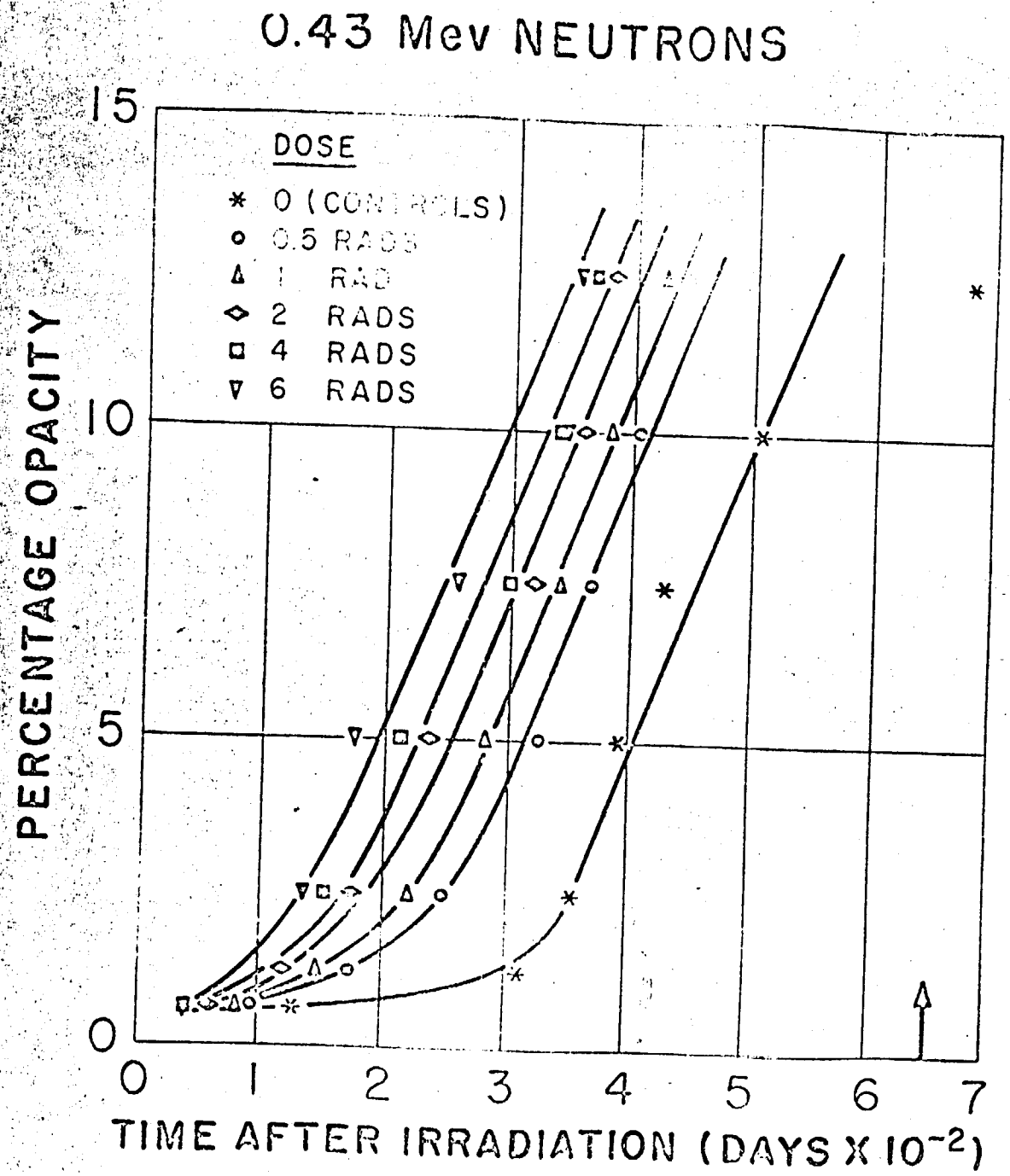
0.43 Mev NEUTRONS
DOSE
* 0 (CONTROLS)
o 0.5 RADS
Δ 1 RAD
◇ 2 RADS
□ 4 RADS
▽ 6 RADS
PERCENTAGE OPACITY
0
5
10
15
0
1
2
3
4
5
6
7
TIME AFTER IRRADIATION (DAYS X 10⁻²)

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It should be noted that an "aging" amounting to twice this period (that is to 180 days) requires much more than twice the dose since approximately 4 rads rather than 1 rad must be delivered.

A tentative explanation of this phenomenon is based on the general nature of the control curve which indicates that the detrimental changes occurring in the first 90 days are less than those occurring in the second 90 days. Whatever the explanation, the finding has evident implications to radiation protection.

b) Other studies planned

Previous experiments have established that the RBE values for mutations in plants are very high ranging up to values in excess of 100. It is generally known that in the case of animals RBE values for mutation are considerably lower. It is of interest to further investigate the magnitude of this difference and to evaluate in detail the dependence of mutation rate in animals on neutron energy. Drosophila was chosen in view of the extensive experience available with this insect. The planned experiments are to include gene mutations, as measured by sex-linked recessive lethals, and chromosome aberrations as measured by translocation between Chromosomes II and III. These studies are being planned in conjunction with an experienced radiation geneticist and initial research is scheduled to be carried out in col-

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Walt

SAN JERONIMO HOTEL

I am somewhat familiar with this work, but it is hard to judge it prior to their issuance of a good report.

I think he is saying two things: a) this low-opacity effect is not important for your problem, b) high-opacity effects may be, but write Vic Bond to find out for sure.

Bill.

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CAFE DEL MAR

LOS PALMAS

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