FAMILY COMMITTEE
Minutes of Eighth Meeting
May 6, 1950

A. Attendance.

The eithth meeting of the Family Committee was held Thursday, May 4, 1950 at 1:15 PM in Room B-117. Those present were

N. E. Bradbury	J. M. B. Kellogg
J. C. Clark	C. E. Leith
F. de Hoffmann	D. P. MacDougall
D. K. Froman	J. C. Mark
R. W. Goranson	B. R. Suydam
A. C. Graves	R. F. Taschek
D. B. Hall	E. Teller, Chairman
G. K. Hess	H. F. York
E. R. Jette	

B. Minutes of the Seventh Meeting.

[redacted]

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C. Scheduling.

The Chairman inquired whether the present gun schedule for the immediate future as outlined in Table III of the minutes of the fifth meeting has given rise to any difficulties. Both Holloway and Jette reported that work along the lines indicated in the schedule is proceeding satisfactorily.

[redacted]

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Graves remarked that while the present discussion would center on the general nature of the X-ray experiment, it was not too early to begin to tie down some of the details of the experiment (at least in a preliminary manner) as far as J Division is concerned. It was agreed that it would be advisable to have the Family Committee meeting of June 21, 1950 concern itself with the details of the X-ray experiment. York agreed that he could attend this meeting.

D. Philosophy of Spring '51 Tests.

Bradbury reminded the group that the basic purpose of the Spring '51 tests is to experiment with the relatively small quantity of tritium and to determine two pieces of information:

(a) whether the DT reacted
(b) as much detail as practicable concerning the conditions reached in the gadgets with respect to setting off the DT reaction and details how the DT reacted--if it did.

The diagnostic 14 mev neutron and X-ray experiments are designed to give information on point (b). If it should turn out that there is a serious chance of failure of one or both of these experiments, it is very questionable whether purpose (a) warrants the expenditure of tritium involved. Mark remarked that even (a) had never been demonstrated and it might still be worthwhile to expend the tritium. Teller suggested that even if only one of the two experiments (X-ray or 14 mev neutron) were successful, it would be worthwhile to perform the shots. The following two possibilities were considered:

(1) The diagnostic 14 mev neutron experiment is a failure and the X-ray experiment is performed successfully.

The worst possibility is that the detailed theoretical interpretation of the X-ray experiment turns out to give inconclusive results. In this case, there is still a minimum advantage to having performed the X-ray experiment which is the following:

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The intensity of X-rays and their time dependence will most likely enable one to tell whether the DT reaction took off.

(2) The X-ray experiment is a failure but the 14 mev neutron diagnostic experiment is successful.

This experiment is valuable even if the DT mixture would "not react". [redacted] Thus, a properly carried out experiment would indeed reveal at what time stage the DT reaction hesitated and fizzled.

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For the above reasons, it seems very important that every attempt be made that either or both of the above experiments perform successfully. This does not necessarily imply that the experiments should be made as complete as one might possibly dream up. In other words, it would be important that they perform as reliably as possible since their failure would seriously effect the usefulness of the tests. Moreover, Bradbury pointed out that the cost of these experiments was greater than the cost of the active material and tritium. This would tend to caution one against added costly refinements ad infinitum.

There follows below a detailed discussion of the two experiments:

E. X-Ray Experiment.

York described the present thoughts concerning this experiment. [redacted]

(1) [redacted]

(2) [redacted] DOE b(3)

(3) X-rays coming from the unperturbed outer surface of the tamper.

Since the X-ray experiment is a rather complicated one, it is possible that one will have to concentrate on only two of these spots. In that case, a measurement of spots 1 and 2 would be desirable. [redacted] DOE b(3)

[redacted] DOE b(3)

[redacted] DOE b(3) The second experiment may be performed sideways as indicated in detail below but the decision to do so will have to be based on more details and is to be made on June 2nd. [redacted] DOE b(3)

[redacted]

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Figure 1 shows an outline of the experimental setup. The details of the downward experiment are as follows: The X-rays travel down the evacuated tube and hit an array of detectors at the bottom. These detectors perform the spectral resolution and may be of the simple crystal type. Offhand, it is not believed that the heating and evaporation of the tube close to the gadget will give rise to troubles. It is hoped that the bomb material will push into the tube sufficiently rapidly so that the X-rays detected will be those emitted from the hot bomb material. However, there is the possibility that if the shock arrives before the radiation it will heat such air as may have gotten into the evacuated tube and this air may give rise to spurious X-rays. This problem should be looked into in detail and it may be advisable to put some such low Z substance as graphite into the upper end of the tube as a filler.

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There was comment that such a large number might lead to failure because of the complicated setup. All sweeps are to be triggered from a central point. This central point may be actuated by two methods (a) have the first of the 8 detectors which responds actuate this central point or (b) put an extra detector in the system which is not connected with any scope but serves merely to actuate the central point. In any case, a duplicate system will be provided so that the chance of failure is reduced.

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More positive predictions concerning the range of temperatures to be expected might cut the number of detectors by as much as one half.

A block house (or ground shelter) built at the bottom of the tower will house the detectors, thus providing a very convenient experimental setup. The signals are transmitted from this block house to the scopes in the recording shelter. In order to avoid spurious signals from the gamma rays emitted by the bomb, the transmission cables from the block house to the recording station need an attenuation of about 10^6. Air attenuation is pretty small and will be of importance only far away from the point of explosion. It is planned to bury the cables just below the surface since the water table on the Islands prevents them being put any deeper. On top of these cables a molehill of coral earth about 10' high is to go from the block house to the recording shelters.

Figure 2 shows the arrangement for the sideways experiment. The idea of turning the X-rays through 180° and having another downward setup similar to the one described above was discarded for intensity reasons. Figure 2 shows that the X-rays travel a distance of about 2 meters before they hit the first foil. This foil is made of aluminum and the incident X-rays give rise to fluorescent radiation. This fluorescent radiation is detected at the bottom of the corresponding evacuated tube. The foils are spaced about 4" apart and subsequent foils have higher Z values. Thus, the threshold for fluorescent radiation changes with each foil providing a certain amount of energy resolution. This energy resolution is not quite as favorable as in the case of the downward experiment. Actually, the intensity in the foils will be high enough to cause evaporation of these so that this angle will be somewhat ill-defined. [redacted] The suggestion was made that some absorbing material such as liquid hydrogen could be placed between the gadget and the foils in order to lower the intensity of X-rays striking the foils.

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The errors due to conversion of gamma rays were considered. It is believed that these can be held to a minimum because the relative gamma flux striking such points as the inside of the collimator is pretty small in the first place, the X-rays generated are only of the order of 1/2 kilovolt in energy, and lastly the conversion efficiency is rather small.

F. Diagnostic 14 mev Neutron Experiment.

Dave Hall presented the present ideas concerning the subject. As first conceived, there were two major objectives.

(1) [redacted]

(2) [redacted]

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[redacted]

[redacted] In addition to the reduced importance of objective (2) it can be achieved by a timing tie-in of this experiment with X-ray such that a successful performance of X-ray and only objective (1) of this experiment would yield the answer to objective (2). Hence, it was agreed that the experimentalists should devote less time to objective (2).

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Figure 3 shows the setup as now contemplated for the experiment. The neutrons are detected by means of proton recoils. It will be noted that the proton radiator is close to the gadget. This is necessary because it is found that the intensity falls off as about r^{-5}. The r^{-5} factor is due to the inverse square law, the fact that at a greater distance the same time interval gives a smaller energy band, and that a narrow energy band leads to a necessary decrease in the thickness of the radiator. The protons are curved in a magnetic field and recorded by an appropriate proton detector. This proton detector must have a good proton to gamma ray discrimination. Two schemes seem practicable. One is that of a particle multiplier of the type developed by J. Allen with a discrimination in favor of protons of 10^4. Another is the possibility of using a scintillation counter plus multiplier or photocell plus amplifier--that is schemes having a discrimination factor of 10^3. [redacted]

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TABLE 1

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Figure 3 shows how it is proposed to shield the detecting equipment. Allowance has been made in this design for n γ produced gamma rays and for the fact that gamma rays arriving from the right have necessarily lower energies because they must be multiply scattered gamma rays which have reversed their direction. The shielding material should be limonite concrete. Measurements at Oak Ridge for fission neutrons in equilibrium with fission gammas show that the 1/10th path for neutrons in this concrete is about 14 centimeters and that for gamma rays about 20 centimeters.

At present it is planned to place 6 magnets within the shielding. It is planned that the measurement be performed at 2 energies, namely about 7 million and 14 million volts. The extra factor of 3 is compounded of a safety factor and the necessary sensitivity range. This sensitivity range is covered in part by the scopes (factor 20) but in part it will have to be made up by having additional channels available.

Ideally, one would hope to adjust the range of sensitivity such that one would get a record such as that indicated in Figure 4.

[redacted]

Figure 4

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The accuracy before point A would not have to be very good since we are not intending to accomplish objective 2. However, it is very desirable to have a record of point A itself in order to know that the equipment was really working properly and is in fact recording the sudden burst due to the DT neutrons. The suggestion was made that it was somewhat of a luxury to measure point B accurately and that one might decrease the range by letting the equipment saturate. The disadvantage of such an arrangement is that the equipment may not recover sufficiently quickly to record point C and the subsequent events truthfully. It would indeed be interesting to record the latter. It may be possible to reduce the number of channels by placing less emphasis on the region below A. [redacted]

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Some discussion ensued about the most likely energy level at which point A [redacted]

An alternate scheme for detecting the recoil protons was also described by Hall. It involves placing a ring of scintillation counters around the proton radiator. Appropriate absorbers are placed between radiator and scintillation counters to discriminate against all neutrons lower than 14 mev. This method is less sensitive in terms of energy and time resolution. Its advantage is that it is simpler. However, the great weight of shielding required remains the same in either method and it would seem that the magnet method is to be preferred if it can be made to work successfully since it will yield more accurate information.

The total weight of equipment presently contemplated for this experiment which would have to be placed on the towers is of the order of 150 tons.

There is the problem of leading the signal from the detectors to the recording shelters. Thus, a means must be found of leading the signal from the tower cab to the ground without introducing spurious noise due to bomb radiation. Clark has suggested the following solution: Build a self-supporting limonite column of about 3' to 4' thickness right next to the tower and reaching as high as the cab itself. There will be a hollow space in the middle of this limonite column to take the coaxial cables. These will then go underground in the same or similar trench to the one described under E above. Teller suggested a possible alternate scheme for the experiment which would involve the following: Materials spaced at some distance from the tower would be caused to fluoresce and the resultant fluorescence would be observed by telescope from the ground. It was recognized that such a scheme might have intrinsically fewer difficulties than the complex scheme now considered. On the other hand, the difficulties which are likely to occur cannot be anticipated as well in Teller's scheme as in the one outlined above. Thus, it is believed to be safer with the short time schedule available to rely on the scheme outlined above and take the consequence of having to erect 200 ton towers.

G. Calibration Runs on How'.

Graves recalled that at present it is not planned to instrument How' for either of the experiments discussed under E and F. From the point of view of J Division it would be advantageous not to have to instrument How'. This would mean that How' could be shot on a 300' tower. It was hoped to obtain a comparison of photographic and radiochemical yields by this means. A heavy short tower with the resultant extra amount of iron may make the radiochemical determination of yield uncertain and would undoubtedly jeopardize the photographic determination of yield. Furthermore, the cost of instrumenting How' is of the order of $1,000,000 or slightly less. Against these points the group weighed the advantage of having a dry run on the 14 mev neutron experiment. Hall and Taschek strongly supported the argument that a dry run would be essential, especially to set up for the right sensitivity range.

H. Conclusions.

(1) The group agreed that the 14 mev diagnostic experiments would have to be performed as outlined by Hall.

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(2) It was agreed that the 14 mev diagnostic experiments should be carried out as a calibration on How'. This means that

(a) How' should be shot on a 200 ton tower and
(b) the How' site is to be instrumented.

Frederic de Hoffmann

Executive Secretary

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FIG. 1
EXPERIMENTAL SETUP FOR X-RAY EXPERIMENT

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[redacted]

FIG. 2
SIDEWAYS X-RAY EXPERIMENT

FIG. 3
14 MEV NEUTRON EXPERIMENT