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PROGRESS REPORT NUMBER ELEVEN OF THE GADGET PHYSICS DIVISION OF THE LOS ALAMOS PROJECT

JUNE 15, 1945

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Date:

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PROGRESS REPORT NUMBER ELEVEN OF THE GADGET PHYSICS DIVISION OF THE LOS ALAMOS PROJECT

JUNE 15, 1945

The G Division engineering section has continued with the design and production of the tamper assembly with plug. Difficulties have been encountered in the preparation of a suitable Tu casting for the tamper ring into which the plug is inserted. It became necessary to make this ring in two pieces which it is hoped can be sweated together for ease of handling. The assembly was also redesigned to accommodate the expected larger sphere of delta-phase material after it has been decided to make this change in the gadget about May 20.

At the request of the G Division engineers, further calculations were made on the predetonation problem, and it was found that reconsideration led to higher estimates of the probability of serious predetonation. This difficulty was further increased by the use of delta-phase material which increases spontaneous fission background and also, due to its greater size, increases the time of collapse.

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Several experiments on the safety of 49 have been carried out by Group G-1. 5.2 Kg of 49 metal with surface area of 450 cm^2 have been immersed in water with no measurable multiplication.

It is hoped to be able to carry this sphere to critical with the use of equatorial plates and thus obtain an operational check on the size of the critical sphere.

An assembly of 37.1 Kg of U containing 80 percent 25 was found not to be critical in a 6.25" iron tamper.

A test of 25 metal in water started to react before the system was completely surrounded, and the activity became quite strong before the water level had been lowered sufficiently. In this accident, the personnel involved received a rather severe irradiation from which, however, no ill effects seem to have been observed. The material was sufficiently active that it could not be handled for two days. Preliminary plans are now under way for the construction of a laboratory for critical assemblies. Since it is difficult to make critical assemblies in a manner which precludes accident. radiation shields will be built to surround such assemblies. These shields will also allow the operation of two or more assemblies at the same time without interference. Provision will also be made for heavy handling equipment which seems necessary in most of the assemblies.

Further experiments of the gun target have been made, and it has been found that 1.2 crits in a pseudo-target assembly made of cubes protected by .005" Cd are not critical when immersed in water in the target assembly. It is roughly estimated

[redacted]

[illegible] the critical mass in this condition would be 1.[illegible] [illegible] at the density used.

The work of Group G-8 during the past month has again been largely devoted to the study of initiators. The photographic x-ray equipment has been used to study the penetration of paraffin jets into paraffin. This has been done both with and without the use of white lead to aid in the detection. It has been possible to study in some detail the penetration of a paraffin jet into paraffin.

Experiments have been carried out at P Site with the cooperation of Group G-10 to study the alpha particles ejected from Po carried directly on jets a few μsecs. after the jet has been started by shock operation. Considerable help has also been given indirectly to the initiator work in the help of instrumentation for the new Po laboratory.

Considerable work has been carried out to perfect techniques for the observation of defects in Tu castings for the tamper. The new design has somewhat increased the difficulties of these observations as well as the exposure time.

Experiments with the same arrangement using Tu gave no pulse record. It is believed that part of the difficulty at least in the latter case is due to the non-conductor washer which is used and which probably does not watch the U shell very well. The method will be used to obtain a check on the shock transit time with the electric method. The records obtained with Tu appear to be unambiguous

Further preparations have been made at the Pajarito Canyon Site for full scale work.

Further improvements have been made in the elimination of background from the electric detonators by a more careful arrangement of the electrical leads along meridian planes.

The same increase is apparent in the rise time of the Tu shock. While it is not yet clear, it seems likely that the absolute time imperfection of the implosion increases as the scale is increased and that further efforts at a higher degree of perfection are probably warranted.

Numerous magnetic records have now been obtained in conjunction with the betatron experiments of Group G-5.

Some errors in the time base of the magnetic records have been made and provisions to prevent this in the future have been introduced. There are a few discrepancies in the time records obtained from the magnetic records and measured from the detonator firing times. It is interesting that some points showing relatively little compression at the time of the expected minimum are removed from this region of the curve if their relative time position is plotted backward from the time at which the shock is reflected from the center.

The work of the electronics group, G-4, has risen to a high pitch with completion being expected of considerable quantities of equipment for the Trinity and Alberta projects during June. The demands for these projects have been very great, but it now appears that unless unforeseen additional requirements are made present commitments can be satisfactorily met.

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The equipment built for Trinity includes alpha particle air samplers, recording gamma meters, piezo gauge equipment, geophone equipment, fast timer equipment, detonator informers, air blast wave informers, air blast wave informers and electronic equipment to be used in the measurement of the multiplication constant.

Equipment constructed for Alberta project is not nearly so varied, and the greater part of it has been devoted to electronic equipment for neutron measurements on the initiators and for various monitoring equipment both for Geiger counters and for contamination survey meters. Considerable equipment for the airborne blast measurements has also been designed and built.

The conclusions in this respect are not definite, but several reassuring facts have been found.

Observations made with mock assemblies in front of the cloud chamber and taken through explosive gases from a similar amount of charge give the same observed radius before and during the explosion to within 1.0 percent. Measurements made deliberately early in the implosion as a check give the setup radius in the few cases observed to within about 1.5 percent.

A close comparison is being made with the accompanying magnetic records and some time variations have been discovered. A comparison of high, low, and intermediate points in the neighborhood of the minimum shows that for the former the duration

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of the section of the magnetic record corresponding to the fall time for the central reflection is larger than for the other two and for those points showing the greatest compression is smallest of all. This observation may be fortuitous, but there seems to be some evidence not yet conclusive that the variations in the ratio R/R_o observed in the betatron experiments are due in parts to variations in the implosion.

During the past month, several RaLa experiments have been carried out by Group G-8.

These variations, when one considers the averaging already made by the 4 banks of ionization chambers, are probably somewhat larger than one would expect from the variations due to the observing equipment alone. There is probably, but not certainly, some evidence that the last of these was actually a better implosion.

The errors in these rise times are large, but the observed smallest rise time corresponds to the greatest compression.

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The fact that the compression is significantly lower than that previously expected experimentally is probably significant.

Further work has been done by Group G-7 in collaboration with Group X-7 on the preparation of PETN for the 1773 bridge wire detonators. The evidence for a more stable and more sensitive form of PETN precipitated from CCl_4 has been confirmed, but difficulties in pressing have been encountered. It has been decided after experimentation to continue the use of the water-precipitated PETN using more dilute solutions and reversing the procedure of pouring the PETN acetone solution into the water. The PETN thus prepared seems on preliminary tests to have a lower threshold and to have satisfactory temperature stability.

Work has been started on a double detonator to be used essentially for the Trinity test in case difficulties with the 1773 insulators cannot be corrected by that time. It is planned to make 3,000 of these assemblies using the bridge wire plug of the 1E-5 and accelerator tubes similar to the 1773. This program will be continued at high priority until the 1773 units seem satisfactory.

Considerable progress has been made on the azide program, but difficulty has been encountered in the extremely low capacity threshold of the azide spark gap detonators. It has been found possible to set off one of these detonators with the static charge obtained by a man. This makes them very dangerous to handle unless satisfactory shorting arrangements can be made or some other protection introduced.

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This rather large difference in the observed velocities is difficult to ascribe to the experimental methods used.

critical examination of the experimental method is being made, but it seems unlikely that errors exist which are nearly as large as the observed differences in the velocities obtained from supposedly identical assemblies. It seems more likely that there is a significant difference in velocity from one shot to another.

This shot was fired on June 21. The velocities observed under the polar lens and under an adjacent lens, as well as under an intersection of three lenses, appear to be identical.

The experiments are being continued.

Some further observations have been made on jet velocities, particularly on the assembly being used by G-10 in studying Po on a jet. Some observations have also been made on jets from small cracks, and jets from cracks as narrow as 2 mils have been observed.

Initiator work by <u>Group G-10</u> has been almost entirely devoted to the urchin. Priority has been given to those tests having to do with the preparation and test of a final initiator. The deposition of the inhibiting layer and of the Po coating has been intensively worked on in the CM Division.

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Considerable success has been achieved in the protective coating, and two initiators have been prepared whose backgrounds meet specifications.

The assembly was consequently not tight.

Since the first initiator was subjected to vibration and heat cycling tests with success, it seems likely that the second will be able to meet these tests as well.

Some further observations have been made on the detection of alpha particles from Po carried on jets, and evidence has been found for a Po cloud which seems to accompany the jets. The experiments are being continued.

There has been considerable progress in obtaining alpha particle pictures from hot test shots. The degree of definition is quite encouraging, and it is hoped that the technique can be successfully exploited in the future.

The main work of Group G-11 has been devoted to preparations for the Trinity test. Many of the pictures taken at the 100 Ton test on May 7 are now available, and a good series of photographic records has been obtained. Preparations for the Trinity test are nearly complete, and top priority is being given to photographic records of the shot.

R. F. Bacher

[redacted]

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GROUP G-1, O. R. Frisch, Group Leader June 20, 1945

2. Safety Tests at Omega

Safety Tests on 49 Metal - Feld, Osborn

A number of safety tests have been made by immersing lumps of 49 metal in a large tank of water. In the last test, 6.2 Kg of metal with a surface area of 450 cm^2 were employed. There was no measurable multiplication.

Safety Test on UF_6 - Feld, Osborn

At the request of E. Teller, an attempt was made to find the critical mass of Cd surrounded by 25 F_6 in an infinite water tamper. The 25 was in the form of vertical 1/2" x 1/2" rectangular columns of 78 percent 25 metal with a distance of 1.31" between centers of the columns. The remaining space was filled with CF_2 of density 2; the volume ratio of CF_2 to metal was 6. Approximately 35 Kg of metal were used in the measurements. The extrapolated critical mass of this lattice, completely surrounded by Cd, was 73 Kg. When the Cd was removed from the side and left only on the top and bottom of the 25 CF_2 system, the critical mass extrapolated to 65 Kg.

Safety Test on 25 Metal - Bistline, Hammel, Kupferberg

35.4 Kg of 25 surrounded by polythene and water were critical. The reaction started before the system was completely surrounded with water and became quite intense before the water level could be sufficiently lowered. No ill effects were felt by the persons who were close to the system (Bistline, Hammel, Kupferberg), but the 25 could not be handled for two days, which forced us to cancel some experiments on our program.

A table of all measured critical masses and safe amounts has been compiled (LA-309).

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8. Time Scale Measurements - Baker, Group R-1.

Group R-1 has made measurements, by the Rossi method, of da/dm of 25 metal in U tamper. The multiplication rate is about 1.4 times as great as for the WC tamper. This value for U is not in as serious disagreement with theory as that for WC. The theoretical interpretation is not yet entirely clear.

8A. Energy of Neutrons Escaping from Tamper - Daghlian, Baker, Frisch

Absorption in B^{10} of these neutrons was studied in collaboration with R-2. Results with "bad" geometry (Bailey, Baker and Hanson, LAMS-242 and 242A) and with "good" geometry (Baker, Bistline, Daghlian, Frisch, LAMS-258) show that the neutrons from a U tamper have higher energies than those from a WC tamper, which, furthermore, seem to contain some neutrons of quite low energy down to 1 Kev or lower.

12. Critical Mass Measurements - Baker, Bistline, Hammel

37.1 Kg of 80 percent material was not critical in a 6-1/4" iron tamper.

13. Neutron Distribution In Reaching 25 Metal Assembly - Camac, Feld, Frisch

Distributions with 25, 28, 37, Mn, W, Au detectors have been reported in LAMS-248. Intercalibration of these detectors is in progress. Measurements of fission rate in steps of 1/8" show no anomaly near the WC boundary such as would have been expected if more than 5 percent of all the fission were caused by neutrons of 1 Kev or less returned by the tamper (See 8A.).

15. Gun Model Tests - Baker, Bistline

It was found that 1.2 crits of 25 could be safely loaded in the target

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immersed in water if covered by .005" Cd. A direct extrapolation indicates 1.4 crits could be so loaded. The differences between this assembly and the final target such as the fact that water filled the interstices between the cubes were in the direction to make this assembly more critical so that more than 1.4 crits could actually be protected against immersion by Cd. The target and the projectile are not critical in water unless the pieces are separated.

17. <u>Instrumentation for Field Testing of Nuclear Components.</u>

This has been taken over by B. D. McDaniel in the G-Division Office.

18. <u>Test of 49 Sphere</u> - Slotin, whole group.

The mixture has the same hydrogen density as Comp B, and its carbon plus oxygen density simulates the carbon plus oxygen plus nitrogen density of Comp B. Due to the absence of nitrogen, the mock-up is a better tamper than Comp B so that if it is safe the real gadget will be even safer. Channels for ion chamber, etc. have been provided.

GROUP G-2, L. G. Parratt, Group Leader

June 20, 1945

I. X-Ray Photographs - Tuck (in charge), T/4 Adler and T/5 Mayers

1.2 Jet Studies for Initiators.

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tends to give a lower limit to the jet velocity. Three values of jet velocity were obtained, in the range 5-7 Km/sec.

1.4 Hyper Jets. A few experiments have been started on low priority, to determine experimentally the upper limit to the velocity that can be obtained in a given material with a given shock.

2. X-Ray Photographs - D. P. MacMillan (in charge), H. Wilcox

A report, LA-308, on work done on initiators by this Section of Group G-2 thus approximately 1 June, entitled "Study of Initiators by X-Ray Flash Photography", has been prepared.

2.2 Melon Seed Initiators.

[redacted]

[redacted]

2.3 Earth Absorption Measurements. Report LA-202, entitled "The Motion of Earth Thrown from Small Craters by Explosive Charges", has been published. No further work on this subject is now contemplated.

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3. X-Ray Equipment, Initiators and Assistance To CM-15 - Cuykendall (in charge), Finlayson, Wangsness, T/3 Schluter, T/4 Kilburg

3.1 X-Ray Tubes. Eleven more standard WL 389 tubes were received during the month. Forty-five new tubes are now on hand.

3.3 Magnetic Focussing. The adjustable anode support in four W.E. experimental tubes (2 each of two types) does not fit well in its guide resulting in uneven electrostatic field distribution and non-reproducibility in cathode-anode spacing. Both "pin-point" cathode types have been tested with the following results: Tube No. 7010, reconditioned by 200 flashes at 150 KV (see last month's report) has remained hard for six test flashes, has again a single focal spot about 0.4 inch in diameter. The intensity measured by integrating ion chambers with 0.134" Pb and 3" dural filters respectively was reasonably constant for these flashes, but is somewhat (20 to 30 percent) lower than that of the "standard" tube under best conditions. The mate to tube 7010, pinpoint No. 7009, decayed to zero intensity after 12 flashes at 300 KV. Focal spots were larger and less uniform in shape than obtained for No. 7010. Variation in cathode-anode spacing has not been made. An attempt to recondition the tube may be made.

It is concluded that one of these tubes shows promise of uniform, small focal spot size at useful intensity, but study of performance is hampered by uncontrolled variation in anode spacing resulting from faulty construction.

One tube of the second type, i.e. doughnut cathode, has shown no diminution in intensity after 12 flashes. In this tube also, the anode is smaller than the cathode, is not firmly supported, and is of unsatisfactory construction which leads to "rim firing" instead of the discharge being confined to the hole in the doughnut,

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Confirmation is seen in several pin-hole photographs where an outline of edge of target, that is, a "frame", exists around a small perfectly round focal spot, and in others a "blob" is found at one side of the same round, centered spot. Three cathode-anode spacings were tried: 1" was too great, 7/8" and 3/4" were satisfactory, less than 3/4" would cause excessive rim-fire because of anode shape.

Radiographs of a model supplied by Tuck show that the intensity of two tubes is questionably satisfactory to be of use in his present work.

The new hollow anode type for convergent magnetic field has not yet been tested.

3.4 <u>Surge Generators and Timers.</u> Work on separate excitation of the cathode arc by means of an auxiliary surge generator has been discontinued.

Simultaneous records of surge current, x-ray intensity thru filters of low and high atomic number respectively, x-ray pulse shape, and focal spot characteristics are being made at low priority, in hope of better understanding the fundamental cause of loss of x-ray intensity when magnetic focussing is employed.

3.6 <u>Assistance to G-10, Initiator Studies.</u> The results of test firings of Po jets at P-site will be reported fully by the G-10 Group. Specifically, the personnel of Group G-2 have (a) operated the P-site equipment for a number of "hot" shots, (b) procured, installed and tested a second set of electronic equipment, with cables, to permit simultaneous operation of two alpha chambers, (c) completed calibration of electronic equipment, determined linearity and the signal strength at which overloading of amplifier occurs, etc., (d) designed and started construction of a light-source and photocell arrangement to observe the length, and obtain some data on the mass distribution of the Po jet.

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3.7 Assistance to CM-16, Instruments for Polonium Intensity Measurements.

Six Simpson Proportional Alpha Counters have been received, unpacked and two set up for test. Proper voltage vs. counting rate plateau does not occur for the methane gas available at the site. An auxiliary power supply was set up so that argon could be employed and a suitable plateau found in one test of three made. Consultation with former members of the Chicago Metallurgical Lab has not found the cause of the unsatisfactory operation.

Drawings and calculations for four Low Geometry Chambers have been checked and shop work ordered. Details of the set-up of the alpha counting equipment have been worked out.

Design of a gamma ray counting instrument for Po measurements has been completed. Four counter tubes are employed so as to compensate for irregularity in space distribution of various samples to be measured. Design of integrated power supply and counting circuits were suggested to Higinbotham, who is responsible for construction of the electronic equipment. A suitable lead house has been designed and sent to the shop for construction. The instrument is expected to measure sources from one-half to fifty curies, distributed anywhere within a sphere of 1-1/2" diameter.

A simple, reliable method of expanding to greater intensity the range of the "integrating", or ionization chamber, type of instrument has not been found. This study is proceeding at low priority than the above work.

A revised plating cell electronic control circuit was constructed and turned over to CM-16 personnel for test. This equipment operates over current ranges up to 25 ma, and for both nitric acid or sodium hydroxide types of plating baths.

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4. General Facilities at P-Site - Crocker (in charge), T/3 Ritner, T/4 Whitworth, White, Garn

Work for Tuck, MacMillan and for G-10's alpha experiment continues, as reported elsewhere.

The Safety Committee visited us and recommended changes in the grounding of the lightning systems and a change in the power service to the charge hutment. They also recommend removing the boulders from around the magazine and piling clean dirt there instead. The changes in lightning arrestor grounds still are to be made but other recommended changes have been completed.

Great progress has been made by Mr. and Mrs. Bluebird who selected the box where the warning flag is kept for their home. Out of deference to them we keep the flag elsewhere and this weekend sees five new, very hungry baby bluebirds.

5. Radiographing Tu Tamper - Parratt (in charge), T. Finlayson

The set-up in the ice house was put in operation about 17 May and research work continued. With a 1 curie source 14 inches from the film, a cylindrical hole between 1/16 and 3/32 inches in diameter can now be detected in the far-away region of Tu 3 inches thick.

Changes in the geometry of Tu tamper pieces have caused delays in actual work with the final geometries, but it is believed that no serious difficulties will be encountered except for the time involved: With a 1 curie source, about 1 week will be required for a complete radiographic examination of one complete tamper of the new geometry.

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GROUP G-3, Edwin M. McMillan, Group Leader

June 20, 1945

PERSONNEL: Section 1 - Clancy, Daly, Fitzhugh, Fowler, Miller, Rosen and Thompson.

Section 2 - Chandler, Chavez, Cohen, Creutz, Davisson, Feder, Foss, Frankel, Fuller, Guttchen, Hershey, Hobday, Jungerman, Klein, Kratz, Lanahan, Major, Nichols, Peterson, Rose, Shank, Stark, VanBeneden, Welton, Wenner, Young, Mallinckrodt.

Section 3 - Fishbine, Schelberg, Smith, Wieneke

SUMMARY:

Section 1 (Fowler) has continued investigation of the pulse-loop method, and has experienced considerable difficulty in getting signals out from the interior of a Tu shell; this may be due to the lack of a suitable insulating material to match the mechanical properties of Tu.

., The attenuation measurement program is being carried out with high priority; also experiments on HE background are being done.

Section 2 (Creutz) has fired a number of scale gadget shots, with lenses and electric detonators, obtaining very clean records. Measurements on these records are presented.

A program of slow implosions to find the energy loss in deformation of the metal has been started. Also experiments are being made to determine the feasibility of recovery of small high-melting spheres placed at the center of the gadget, in order to locate the focus of the shock wave.

The foundation for the full-scale setup is complete; the winding of the field coils has been delayed somewhat by slow delivery of the Cu.

Section 3 (Wieneke) has obtained many records in conjunction with the betatron, from which the time of the betatron pulse can be determined with respect to implosion events. Most of the early records were rather hashy, but now the proper conditions to avoid hash have been determined.

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Section I.

I. Instrumentation. All.

New low voltage tripping circuit put into operation.

measurements. Two of these were detonated by primacord and two by electric detonators. On each shot, three records were taken using three different amplifiers -- a Crouch-Elmore amplifier, a model 600 amplifier and an I-F amplifier.

The background picked up by the Model 600 amplifier was about equal to that picked up by the Crouch-Elmore amplifier. The I-F amplifier picked up about 10 times the background of either of the other amplifiers.

The maximum background picked up by the Model 600 and Crouch-Elmore amplifiers on the primacord shots agrees within 25 percent with the predicted background ($d\mu/dt = 0.3W \times 10^6$). However, the electric detonators appear to increase this background by a factor of about five.

II. Attenuation Experiment. Rosen.

One shot has been made to test the apparatus.

VIII. Exploration Shots. Fowler.

Several shots have been made to investigate the effect of a confining layer around the outside of the explosives on implosions.

X. Pulse-loop Circuits. Rosen.

It has

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been tested by plate shots and subsequently and successfully in two implosion studies.

XII. Pulse-loop Studies of Implosions. Rosen, Thompson, Fowler.

A very good magnetic record was obtained on this shot along with a perfectly clear-cut record from the inside. The actual values of the shock velocity obtained from this and the previous shot will be reported as soon as additional checks can be made.

In the case of the first shot, a good magnetic record was obtained of the motion of the outside. However, no pulses were present on the vertical coil records which would indicate signals from the inside. In the case of the second shot, no magnetic field was used. A high frequency ($\sim$ 12 mc) loop was to broadcast the signals from the inside. The scope trace in this case indicated no record.

[redacted]

[redacted]

XIII. Insulators to match Tu.

Division CM has furnished a number of plastic bonded ThO_2 and TuO_2 discs for use between hemispheres of Tu. These, which were 1/8" thick, were found not to stand up under the implosion conditions (Item XII above). If further work is done o this sort of implosion (composite sphere) 1/4" thick discs will be tried. Also, two high density (~ 10) CaF_3 bonded ThO_2 discs were furnished but they have not been tried under implosion conditions.

Section 2.

I. Background Caused by Detonator Cables.

It has been known for some time that an irregular disturbance of the recor can be produced by the motion of the detonator cables in the magnetic field; as a result of tests at all the sites using the magnetic method, we now know how to avoid this effect. This is done by arranging the cables so that they approach the charge along the polar axis (direction of field), and distribute to the detonation points along meridian planes. With this arrangement, the radial motion caused by the HE blast produces no EMF along the cables.

II. Background Caused by HE.

made by RaLa, Betatron and at Pajarito, evidence is found to indicate that the method of mounting the charge affects the field sensitive background signal.

Betatron shots with a 32" icosahedron show a similar peak about 10 μse earlier. One shot made at the Betatron Site with a 36" icosahedron shows the peak at about the same place as observed at Pajarito.

Further shots at the sites permuting the mounting methods should help clear up this question.

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[redacted]

III.

IV. Scale Gadget Shots.

A series of HE background shots, using marble spheres, has also been made.

1)

Seven HE lens background shots at this scale showed quite good consistency. The background is similar to that from a non-lens charge, but shows three well defined spikes, and has a magnitude in the part following the spikes about three times as great. An average curve of the seven shots was made and used in interpreting the records.

The dotted line is the mean background. The spikes are at S; the points SA, EA, ST, ET, SC, EC, represent the start and end

[redacted]

2)

There are four background shots at this scale. They differ from the 3" lens backgrounds only in having a strong extra peak at about 26 μsec. after the start of the first spike. It is now believed that this extra peak is caused by some interference of the wooden icosahedron with the flow of the explosive gases. Fortunately, the peak comes in such a place as not to obscure any of the interesting features of the record.

One of these (334) had poor focus over part of the record, so that accurate measurements could not be made on that part.

3)

This gave a very clean record, from which good time measurements can be obtained; velocities cannot be measured because of uncertainty in the value of the magnetic field.

4) **Measurements on Above.**

a) **Times**

The times of events have been measured on the original plates with a comparator.

On this scale, the times are: Firing of electric detonators, emergence of shock reflected from Tu, and emergence of shock from center. Also the rise times (EA-SA, ET-ST, EC-SC) have been measured. The results are in the following table.

[redacted]

Times from Start of Al Motion. (μsec.)

The explosive trains used were:

b) Velocities.

The maximum inward velocity was measured from the peak of the record to the base line, and corrected for the value of $1/2\ (3X^2-1)$ at that point. The velocity change in the Tu shock was measured by the vertical displacement in that shock and similarly corrected. The velocity change in the shock from the center not measured because it is made uncertain by a dip in the background at that point.

The maximum compression of the gadget (ρ/ρ_o) was also measured.

[redacted]

 [redacted]

The measurements are:

V. Slow Implosions.

Because of the relatively small amount of HE used, very clean records were obtained. These experiments will be of use to determine the work required to deform metals at high velocities, as suggested by Peierls.

VI. Recovery Attempts.

To determine the point of focus of a collapsing shock wave, Serduke suggested putting spheres of high-melting-point metals in gadgets and recovering them after implosion.

attempts will be made with Ta and W balls. [redacted]

 [redacted]

VII. Full-scale setup.

The foundation for the full-scale charge has been completed. Lucite double detonator assemblies have been tried out successfully on half-scale. However, if possible, 1773 detonators will be used on the full-scale shots because of the timing information that may be obtained.

Section 3.

Project: Correlation of magnetic implosion studies with Betatron work at K Site.

I. Instrumentation.

1. Common timing mark -- Although common timing blanks have been used to tie in the magnetic implosion trace with the betatron timing, some difficulty has been experienced in identifying the first timing blank, resulting in an occasional timing uncertainty of 5 μsec. Apparatus for adding a common mark to the magnetic implosion trace and the betatron timing trace has been introduced. The location of the common timing mark on the traces may be varied between 0 and 80 μsec. after detonation.

2. Elimination of sweep pickup-- A large number of magnetic implosion traces showed a considerable amount of pickup from the electrical detonators. This pickup caused serious distortion in the rate of sweep at the beginning of the trace. The trouble was traced to pickup through the primacord pulse generator and eliminated by the addition of a capacity divider at the input to the sweep circuit.

3. Second pickup coil equipment -- Orders have been placed for another oscilloscope, fast amplifier and camera of the type currently used. This new equipment is to be used in connection with a second pickup coil located with its plane along the

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magnetic field, thus making it possible to study the background for each shot and provide information concerning the asymmetry of implosion.

II. Program:

A. Number of implosions observed by magnetic method - 5/15 to 6/16.

1.

a. Successful records obtained on normal shots -- 20

b. Records with no magnetic trace -- 3

c. Records with one lens purposely not detonated- 2

d. Records with timing between lenses different - 1

e. Records with Pajarito type cradle -- 1

2.

B. Simultaneity of Detonation.

Several shots were made with lenses purposely not detonated or not simultaneously detonated. The data, however, are not extensive enough to be of use in determining whether or not non-simultaneity of detonation can be detected from the magnetic record.

C. Elimination of 'Hash' background.

A considerable amount of high frequency 'hash' is present on most of the magnetic traces. This hash appears to be caused by the passage of the detonator co-ax and the lens monitoring circuit pin wires through the magnetic field. Experiments have shown that if the detonator leads are brought out from the charge in an arrangement suggested by McMillan and similar to that employed at Pajarito, and if pin wires are not used, this hash may be eliminated with a high degree of certainty. This arrangement of detonator leads has been used on all of the most recent shots. Experiments to determine whether or not the pin wires should be used are being conducted.

[redacted]

A number of shots have been taken both with and without shorting switches. The records in each case show no difference in amount of hash. Some very clear records have been obtained by proper arrangement of leads, and elimination of pin wires, no shorting switch being used.

D. Effect of Floating Condensers.

A number of shots were made in which the condenser bank for the electrical detonators was isolated from ground by inserting resistors in the leads from the charging unit. It was hoped by this scheme to cut down the pickup from the discharge of the electrical detonator. Although this method might be profitably employed at other sites using the magnetic method, it resulted in no decrease in the pickup at K Site. During the time the condenser bank was 'floated', the betatron timing became very erratic, and it is suspected that the 'floating' detonator leads prematurely tripped the primacord pulse generator which starts a delay circuit and eventually fires the betatron.

E. Charge background.

The dip occurs just after this drop and just before the drop caused by the arrival at the surface of the shock wave reflected from the center of the Tu.

The record of this shot showed the peak and dip in the same places as before, indicating that they are caused by charge background. This record differs from similar records made at Pajarito in that the peak present in the Pajarito records occurs at a later time.

One shot was made using a charge cradle borrowed from Pajarito. This cradle was of the same general shape as those used ordinarily at K Site but is larger and has no metal parts. The peak and dip for this shot occurred at a later time and the appearance of the record was similar to that of records obtained at Pajarito. On the basis of this shot, it seems that background is a function of the type of mounting. A sling type mounting is at present being devised and it is hoped that its use will eliminate much of the background at present observed.

III. Data.

The large background in the records makes difficult the determination of the points. This undoubtedly causes some of the spread observed in these time intervals.

DOE (3)

GROUP G-4 - W. A. Higinbotham, Group Leader

June 13, 1945

The activities of G-4 have been concentrated on engineering and construction. The cable shop has been expanded, but its facilities are still not adequate. We now have a setup for vacuum impregnating. Anti-fungus spray is available. Suitable wire and components are on hand to build equipment to withstand high humidity, tropical conditions, etc. Checking and life tests have been materially increased. Many circuits used in the first Trinity shot have been revised and improved. 127 pieces of numbered equipment were delivered. 300 volt, 150 ma. supplies and R.F. high voltage supplies for scopes are now manufactured on the outside and an adequate supply is kept on hand.

1. Research Instruments

Time Fiducial - Titterton - A circuit has been designed for K-site which presents a common time pulse on three oscilloscopes in three buildings. The object is to correlate the time of the Betatron pulse, the initiation of the implosion, and the magnetic record.

Line Voltage Pluto - Watts - Consists of an air ionization chamber and two tube d.c. amplifier. There is a selector switch with input resistors up to 10^{10} ohms. There is a regulated power supply for operation from a.c. It may also be operated on one 45 volt battery which supplies the chamber, plates and filaments.

Delayed Gate Circuit (Elmore-Higinbotham) - A triggered "gate" circuit with a variable time delay was built for G-5. The circuit is used to unclamp an amplifier, pulse-lengthener circuit after transients from the electric detonators have subsided and in time for the proper signal.

Video Delay - Higinbotham, Elmore - A simple way to generate a very fast, high current pulse, for calibration of the magnetic method circuits, is to use a mercury switch.

It cannot be triggered. This circuit was built to use with the above. It consists of an amplifier to blow up a trigger pulse for a fast sweep, plus a commercial delay line, followed by a fast linear amplifier, to go to the vertical amplifier of a Model 100 Scope.

2. Health and Safety Circuits -

Safety Circuits for Omega (Watts) - These are now installed and operating. They operate on 0.8 R per hour, turning on warning lights and siren.

3. Field Equipment -

Sonar Locator - Stephenson The ballistics group requested this means of accurately determining the point of impact of a projectile in water. Three hydrophones were spotted about the target. Pre-amps were placed on the beach. Signals travelled by cable to the recording station, 2 miles distant. At the station signals went through logarithmic amplifiers and were recorded on film along with timing signals.

4. Alberta Equipment

Test Unit - Model 220 -(Sands) - A circuit for checking and testing the Model 220 Neutron counters has been designed for overseas use and two units have been delivered to the G-Pit group. These units consist of a sweep circuit to be used with a DuMont 224-A oscilloscope, giving triggered sweeps with calibrated speeds of from 2 to 1000 microseconds per inch; a pulser with calibrated high and low level outputs for checking amplifiers and scalers; and a pulse delay for examining the pulses from amplifiers. The unit complete with power supply is of light portable construction and is completely tropicalized.

Tropicalized Power Supply (Palevsky) - A low voltage power supply for general use in the field has been designed and is in production here. Input 95 - 130 volts, 50-60 cycle a.c. Output +250 volts at 100 ma. and 150 volts at 50 ma., both regulated. Components used will operate safely under all conditions. Construction rugged.

Survey Meter - (Watts) - This is an improved model of the "super suds" described last month. It contains an ionization chamber and one tube amplifier with batteries. There is a selector switch to vary sensitivity. Input resistors are 10^9 to 10^{11} ohms and voltage sensitivity is about 2 volts full scale. This is comparable with the Victoreen as regards sensitivity, but a great deal simpler and more convenient. The " super suds " has been tested after submersion and is not affected.

Antenna Coupler (Hane) - These units were designed so three receivers could be operated from one antenna for the airborne blast measurements. The model is complete and operates satisfactorily with a gain of unity. More units are under construction.

400 cycle Power Supplies - (Hane) - For the job above. Conventional circuits but for airborne use. Model complete.

Receiver Modifications - (R. C. Dye) - Hoffman built F.S.I. receivers are modified for airborne blast measurements informer work. Discriminators are modified and adjusted, A.F.C. removed and circuits stabilized to prevent oscillation.

5. Trinity Equipment -

Portable Alpha Air Samplers - (Watts) - These were described in the March 15 report. Twenty have been built and tested. Two were used to examine the site after the 100 T shot. A complete unit weighs 40 lbs. This includes a battery high voltage supply and methane tank. Methane flows through the chamber, which has an extra thin window.

Recording Gamma Meters (Watts) These consist of a G.M. tube, one stage amplification, a pulse shaping tube, an integrating tube and recording milliammeter. Ten have been built. These will be tried soon on a RaLa shot.

[redacted]

Geophone Equipment (Sands) - Several modifications have been incorporated in the sixteen geophone amplifiers. The range of input signal amplitude has been increased, and the frequency response has been broadened to permit scaling tests with smaller charges to be made with the same equipment. Also, minor circuit changes have been made to improve the linearity of the amplifiers. New control circuits have been constructed which will give greater reliability, and field servicing equipment has been made.

Piezo Gauge Equipment (Sands) - Twelve new amplifiers have been constructed and the sixteen old have been modified to give improved linearity of Signal and incorporating a bucking voltage to the circuit which will allow an adjustment to be made to minimize the effect of the intense radiation at the gauges. Associated control circuits and field testing gear have been made.

Fast Timing Equipment (Titterton) - The fast timing equipment has been redesigned to give more fast signals. This required extension of the sawtooth time generating equipment, the coding and decoding circuits.

Detonator Informer (Titterton) - Greisen will provide explosive switches to be attached to the surface of each lens at a fixed distance from the detonator caps. Series and parallel connections of these switches will indicate the time spread firing of the lenses. This signal will be transmitted by high quality coax. to a 10,000 yd. point where it will be presented on a fast sweep and photographed.

Air Blast Wave Informer (Hane) - This is being done in conjunction with Bill Bright. He will use condenser microphones which frequency modulate modified F.E.I. informers. These are followed by 2 stages of power amplification which deliver 75 watts to the antennas. The latter are directional arrays. Receivers are slightly modified Hallicrafters, type S-36.

[redacted]

<u>Air Blast Equipment</u> - (Elmore) - Two complete set-ups for Barschall's measurement of sound velocity at Trinity have been designed and practically completed in construction. Each set-up contains (1) a chassis with five three inch scopes with associated controls; (2) a chassis containing a five channel amplifier which cannot block, with relays which will reduce the gain at t_o . (3) a 1000 cycle scope blanking circuit which will mix in a longer blanking pulse at t_o . (4) power supply chassis for scope, containing also a simple Thyratron sweep for test purposes.

<u>Alpha Measurement Equipment</u> (Elmore) - Two circuits have been designed and constructed for the Rossi alpha measurement at Trinity. One chassis contains a 35 k.v. scope (DuMont 5RP11) and associated controls. It contains a circuit which will cut off the beam once the input signal has reached a certain level. The second chassis contains a triggered saw-tooth delay furnishing at the output an intensifier gate for the 35 k.v. scope. The circuit also provides a blocking oscillator pulse delayed two microseconds after the intensity gate, for triggering test equipment. Both chassis contain safety features preventing a second intensifier pulse while the camera is opern.

[redacted]

GROUP G-4 - S. H. Neddermeyer and D. Kerst, Group Leaders

June 21, 1945

I. K-SITE OPERATIONS

The shots fired from May 15 to June 15 include the following:

5 blank shots with mockup (200 lb. charges).

3 tests of single lenses with pin pick-up for testing the pin monitoring method.

2 slab tests, each with 12 pins for testing pin monitoring.

A large number of shots with primacords to test detonators and time sequence.

The magnetic pick-up is now used on every shot. Attempts to monitor the initiation of the lenses by insertion of pins either in the primacords or in the surfaces of the charges themselves have been at least tentatively discontinued because of serious interference with the magnetic records, the cause of which is not understood. Two attempts have been made to determine whether the magnetic record is capable of detecting failure of one lens, but without any definite results.

In the series of runs from 126 to 144, the detonator condensers were isolated from ground by means of two resistors in the charging line. Since it was found that this introduced very bad pick-up and that it was possible for the pulse generator to be triggered at the wrong time, this practice was discontinued.

A spark detonator unit has been installed and has been in operation beginning with run 145.

[redacted]

[redacted]

Starting with run 148 a standard timing pip has been used to correlate the magnetic sweep with the x-ray sweep. This eliminates any ambiguity in identification of the usual 5 microsecond marks.

II. EXPERIMENTAL RESULTS AND ANALYSIS OF DATA

The times as plotted are taken from the magnetic records where available. The results for the period May 15 - June 14 include runs 119 - 193. The general trend of the points is essentially unaltered since the last report; however, certain tests and measurements have been made which tend to improve our confidence in the measurements of both radius and time.

A. Time Measurements

In the last report it was shown that the time measurements as determined from the x-ray pulse and the magnetic record were substantially in agreement with those determined from the x-ray record and the HE transit time. During the month some very serious discrepancies arose which were traceable to two different causes.

a. It was found that a large signal was being picked up which got to the magnetic sweep and threw it completely off the scope, so that part of the sweep and some of the timing blanks were missing. This difficulty was corrected by introducing a filter to remove the pick-up.

b. The other difficulty, already mentioned in Section I, arose because of the isolating resistors in the detonator condenser circuits, which were used on runs 126 - 144 inclusive.

Corrections can be made for the discrepancies introduced by (a), but in the case of (b), although the magnetic times might be presumed correct, the times on these points are still somewhat uncertain; it might be proper to discard

[redacted]

them in any over-all evaluation of the data. In this series of runs, where the two times of motion differed by more than a microsecond, the times on the graph have been indicated as uncertain.*

B. Measurements of Radius

Variations in the measured compression ratio arise from three general sources:

a. Uncertainties in measurements of the films themselves.

b. Instrumental effects, such as blast effect on the cloud chamber, jiggling of the cameras, or light sources and the like.

c. Actual physical effects on the gadget itself, such as faulty initiation, faulty charges and effects associated with them.

Since the last report several things have been done to try to pin down the various sources of error.

1. The light sources for the cloud chamber have been narrowed down from 1/4" to 1/8", and continual checks are made to make sure that they remain in perfect adjustment. The illuminated region now extends at most 1/8" back from the inside face of the chamber.

2. To test for the possibility of an effect on the cloud chamber apparatus due to blast or shock, which would exist on the shot photograph, but not on the set-up, five blank charges were fired in which a mock-up was placed inside the cloud chamber building and a plain charge of HE was placed between the noses. The same procedure was then carried out for these charges as for a normal charge, so that under actual firing conditions one can measure a ratio of shot diameter to set-up diameter, which must come out near unity if the effect being tested is small. The results of these five tests are listed in Table II and it is seen that the maximum deviation is ± 1 percent.

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* Five points in this series, for which no magnetic records exist, have been left off the graph.

[redacted] T

These measurements lend strong support to the essential correctness of the diameter measurements listed in Table I. Since the blank test does not precisely simulate actual conditions, a series of shots have been fired, timed around 4 microseconds, so that no compression would be expected.

This is further strong justification for the procedure of computing the compression ratio from the measured shot and measured set-up rather than from the measured shot and the known absolute set-up size.

[redacted] E C [redacted] E T

III. [illegible]

The present personnel of G-5, listed so far as possible according to sub-projects, [illegible]

[illegible]:	Forst, Ogle, Conklin
[illegible]:	[illegible]
[illegible]:	[illegible], Sherman, Streib, [illegible]
Electronic Equip-	
[illegible]	[illegible]
[illegible]	[illegible], Feldman, Koller, Wines
Ion [illegible]	Soren, [illegible]
Photography:	[illegible]
[illegible]	[illegible]

The [illegible] work is being [illegible] by Wieneke, Fishbine, Schelberg and [illegible]

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[redacted]

[illegible]

[redacted]

[redacted]

[redacted]

TABLE II

Summary of Blank Tests

[redacted]

Shot No. 1, 11, 12 [illegible]

Source: approximately 620 [illegible] Ra equivalent

Magnetic detection: magnetic pickup coil; 75 cm below center [illegible] charge,

magnetic field; 124 gauss

Experimental Results

Magnetic detection results

Acceleration time: 1.5 ± .4 μsec

Uncorrected initial velocity. uncertain

[redacted]

[illegible] May [illegible], 1945 [illegible]

Source: Approximately [illegible]40 g Ra equivalent

Magnetic detection: magnetic pickup coil 78 cm below center of charge;

magnetic field [illegible] gauss

Experimental Results

Magnetic detection results

Acceleration time: 2.2 μsec

Uncorrected initial velocity: 1700 m/sec

Shot No. 23, May 30, 1945 (No. 1 Site)

[redacted]

Source: Approximately 542 g Ra equivalent

Magnetic detection: magnetic pick-up coil 64 cm below center of charge;

magnetic field 192 gauss.

Experimental Results

Magnetic detection results

Acceleration time: 0.5 μsec

Uncorrected initial velocity: 1500 to 1700 m/sec

Shot No. 24, June 4, 1945 (No. 2 Site)

Source: Approximately 950 g Ra equivalent

Magnetic detection: magnetic pick-up coil 64 cm below center of charge;

magnetic field 172 gauss.

[redacted]

[redacted]

[illegible] Results

Magnetic detection results

Acceleration time: 0.8 μsec

Uncorrected initial velocity: uncertain

Shot No. 25, June 8, 1945 (No. 1 Site)

Source: Approximately 835 g Ra equivalent

Magnetic detection: magnetic pick-up coil 76 cm below center of charge;

magnetic field 138 gauss.

[redacted]

Magnetic detection results:

Acceleration time: 1.3 ± .3 μsec

Uncorrected initial velocity: 1500 to 1800 m/sec

Shot No. 25, June 13, 1945 (Site No. 2)

Source: Approximately 600 g Ra equivalent

Magnetic detection: magnetic pick-up coil 64 cm below center of charge; magnetic field 190 gauss.

Experimental Results

Four good records obtained. Results not yet evaluated.

Magnetic detection results:

Acceleration time: 0.8 μsec

Uncorrected initial velocity: 1300 m/sec

[redacted]

2. [illegible]

a. Work on the timing circuit continued.

b. Static absorption measurements were taken for the evaluation of the off-center shots. Absorption measurements with Al powder were continued.

c. New 30" chambers were put into production and used with all shots listed above.

3. Geiger-Mueller Counters

Production continued according to request.

4. Alpha Measurements at Trinity

A method has been devised for measuring the e-folding time in an explosive nuclear reaction by means of an ionization chamber feeding directly into a fast oscilloscope through a long co-axial line of special design. Group G-6 has undertaken the construction of the chamber, the co-axial line and part of the electronic circuits. The field operation will be undertaken by Group R-1.

5. Personnel

A. RaLa Detection Equipment in Bayo Firing Site No. 1

Staub, Chromey, Levine

B. RaLa Detection Equipment in Bayo Firing Site No. 2

Allen, Nereson, Everhart, Burditt

C. Magnetic Detection Equipment

Fairbank, Kiszenick, Stone

D. Preparation of Shots (including H. E. Source Transfer Devices, Etc.)

Diven, Menz, Friedrich, Kissee, Jordan, McCaughey

[redacted]

[redacted]

E. Construction of Expendable Electronic Equipment

Harper, Hartig, Wengnaus

F. Construction of Auxiliary Electronic Equipment

Staub, Miller, Levine, LaBarge

G. Development, Construction and Testing of Ion Chambers

Nicodemus, Dollenbaugh, Powers, Volpe, Lustgarten, Ealey, Hudson, McLaughlin, Newbury

H. Evaluation of Data

Koontz, E. Staub

I. Static Absorption Measurements

Koontz, Hall

J. Timing Circuit

Jurney, Chromey

K. Alpha Measurement at Trinity

Rossi (general Planning of experiment, in collaboration with E. Purcell from Rad. Lab); Nicodemus (ionization chamber); Diven, Menz, Friedrich (co-axial line); Allen, Nereson, Hudson, LaBarge (electronic circuits, in collaboration with D. Winter from Rad. Lab. and Electronic Group).

L. Shop

Moloznik

M. Tests for Radiation Hazards

Miller, E. Staub

N. Secretary

H. Meyer

[redacted]

[redacted]

GROUP G-7 [illegible] Group Leader

June 19, 1945

The current gadget detonator program is as follows:

1. First priority is to make the 1773 work in time for Trinity. A dead line of June 30 has been set for acceptance.

2. In event of failure of the 1773, a proven substitute is to be provided by G-7.

3. A new design is to follow which is to be G-7's job jointly with C.I.T. if it is an azide detonator or is a PETN alternate to the azide detonator. It will be X-7's job if it is an independent PETN design.

1773 Detonators

Three G-7 members have been continuing PETN work on a joint program with three X-7 people. It was agreed with X-7 on June 16 to adopt a water precipitated PETN which differs in preparation from the former standard by the use of more dilute solutions and inverting the procedure of pouring the PETN - Acetone solution into the water. The factors governing the choice are summarized below:

Pressure to give this density is reproducible to about +12 percent. Thermal stability is poor since 24 hours at 50° C begins to increase the threshold.

The new standard water precipitated PETN seems to cohere about as well as the old at a density of 1.00.

Pressure reproducibility is the same as above. First tests indicate that thermal stability is better.

[redacted]

[redacted]

CCl_4 precipitated PETN suffers from the decisively important defect that it does not cohere as well as the other two types even at densities as great as 1.22. Pressure to achieve a given density varies by 300 percent.

The low and reproducible threshold of this material is one of its greatest advantages. Thermal stability is comparatively excellent, 2 days at 70° having no effect. Because of the toxic CCl_4 fumes elaborate ventilation would have to be provided if this method were used.

It is clear that the ideal form of PETN has not been arrived at as yet. G-7 will continue to work on the problems, first of tighter standardization of the PETN agreed upon, and secondly to arrive at a type possessing all the advantages of the several types.

2064 Detonators

To provide for item 2 in the gadget detonator program, we have placed in the shop an order for 3000 detonators having the essential physical dimensions of the 1773.

They will be attached physically by the same device intended for the 1773 and will be connected by a splice.

Azide Program

Lead Azide may be used in spark gap or bridge wire detonators and the indications are that either kind will give good timing.

Simultaneity firings for the two kinds have totaled about 1000 detonators, but due to mechanical difficulties connected with the 20,000 PSI loading pressure, an evaluation of performance cannot be based upon that large number. The data to be quoted is from the last six shots of each kind of

[redacted]

[redacted]

detonator made of parts known to be mechanically sound and using our best pressing technique:

The sample is too small to be sure that the difference is significant.

The capacity threshold of the azide spark gap detonator is 50 to 100 $\mu\mu f$, and they can be set off by the static charge on a person under exceptional conditions.

One can safe against this undesirable condition by using a parallel condenser and resistance to divide the voltage of an accidentally applied charge and to permit it to leak off. However, when such components are designed into a detonator they become unreliable due to their small size. We believe that the best way to safe these detonators is to handle them always shorted. Accordingly, our tentative spark gap designs include connectors which automatically short when not connected.

[redacted]

[redacted]

The azide bridge wire detonator can be set off by about 1/2 amp. and is consequently unsafe against accidents involving primary supplies in the Raytheon box. To safe against this, C. C. Lauritsen suggested a series spark gap set for 1000 to 2000 volts not in contact with the explosive. The bridge wire shots quoted above were shot with such safing.

The capacity threshold in the azide bridge wire varies with wire size and voltage a few values of which are:

Wire	Capacity	Volts
1 mil Pt. Alloy	.001 μf	7200
" " "	.003	2700
" " "	.01	2200
1.75 " "	.001	> 8000
" " "	.004	5000
" " "	.01	2800
2/3 " "	.003	> 8000
" " "	.01	4400

Both kinds of azide detonators are being designed here for the gadget. C.I.T. is working on azide bridge wire designs, and the choice will probably be that type unless the spark gap proves to be superior in the next week.

Field Service and Production

An average of 550 detonators and 30 explosive switches per week have been distributed to field sites. Three hundred field service detonators per week have been used for other purposes and 550 1-E 5's have been made per week. These are largely used in the PETN program.

[redacted]

[redacted]

There have recently been a number of failures of field detonators. Some have been due to poor equipment as in the case of triggered spark gap circuits. Others have been due to misuse of equipment as in cases where prima-cord to set off explosion switches has been laid across condenser cables. To improve both situations, the Field Service section is re-working some of the field installations and is issuing more complete operating instructions.

Safety

South Mesa has been operating without sufficient consideration of safe explosive practice. To remedy this, a G-7 Safety Committee has been formed and charged with the job of establishing safer practices. We have enlisted the help of the project safety committee and Mr. Kershaw's office.

[redacted]

[redacted]

10. [illegible]; [illegible] Froman, A.C. Graves, J.H. Roberts,

Second quality 12 L 90 N lenses have been used in three shots, A-57, A-[illegible], and [illegible]

Both records are technically excellent and the 13% difference is believed to be real. It is to be noted that the differences of as much as 9% between velocities obtained in different "identical" shots using 12 L 90 N lenses have been observed previously using fairly thin tuballoy liners. In eight cases of duplicate shots using third scale lenses the average of the differences from the mean of a pair is 3.7% and in four similar cases using half scale lenses this average is 3.9%. The data on s

[redacted]

single shot often yield a probable error in the measured velocity as high as 5% or 4% but on some records this is as low as ½%.

The main purposes of the shot were to determine blast and earth shock effects of shots of this size fired at Site B and to find out if good pin-pulse records could be obtained. It appears that shots of this size can be fired at Site B without causing damage to the installations at this or nearby sites or to other buildings.

Four pins were placed under the top detonation point and four under a triple interaction point to measure the velocity. The velocities under the two points were the same (4240 meters/sec) and the surface under the top detonation point lead the surface under the triple interaction point by 0.1 µsec.

On this same shot, twenty-four pins were placed at a distance of 20.4 mm from the inner surface of the tuballoy. Several pins were placed under detonation points, interaction points, and at selected "random" points. The twelve pins near the apex of the hemisphere were connected to give negative pulses was early relative to that of the positive pulses indicating that some disturbance from the rarefaction wave from the edge of the hemisphere may have been present. The greatest angle of any pin from the apex was 46° 27'.

[redacted]

Rarefaction Wave

Two shots were fired to determine whether the velocity of the hemisphere was being affected by the rarefaction wave from the edge.

In the first shot, four pins were placed at the apex and four at 63° 27' from it. In the second, four pins were placed at the apex and four at 45° from it. It seems certain that the rarefaction wave could not affect the velocity at the apex. If the velocity were the same at 63° 27' as at the apex, the conclusion would be that the rarefaction wave did not affect the velocity at this angle.

The records obtained are such that the conclusion is a little uncertain. However, the velocity at the apex appears to be at least 10% faster than at 63° 27' but appears to be the same at 45°.

11. LENS TESTING - NO LINER: (V.A. Nedzel)

It was suggested by Mueller that the discrepancy between the calculated and observed transit times through lens charges used in the betatron work might have as a contributing factor a delay in the initiation of the Comp. B inner charge by the baratol component of the lens. Investigation of this delay is important because even a fairly small delay with intimate contact between the lens and inner charge may imply serious delay or even local failure if there are small gaps present.

Preliminary tests were made on a 2½" pentolite cylinder 3" high. Twisted pairs of insulated wires were inserted in 3/16" holes drilled in the explosive, the

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[redacted]

holes being drilled to various depths up from the bottom face of the cylinder. The cylinder was detonated from the top, and a record of the progress of the detonation wave was obtained. The record obtained was excellent and the slope of the distance-time curve indicated a velocity of 7600 ± 200 m/sec.

Then, at Harley's suggestion, a shot was fired using a set-up designed by Hoffman and Martin for the study of Comp. B initiation by baratol in plane geometry. This arrangement consisted of a Tuck conical lens followed by a disc of Comp. B, a disc of baratol, and another disc of Comp. B. Holes were drilled to various depths into the bottom disc of Comp. B and into the baratol. It was observed that there was a good fit between the baratol and Comp. B. The distance-time curve obtained from an excellent record showed two straight lines. The one in the baratol indicated a velocity of 5780 ± 200 m/sec while the other in the Comp. B indicated 7950 ± 200 m/sec.

33. SHOCK AND INITIAL VELOCITIES IN METALS: (V.A. Nedzel and J.H. Roberts)

A final analysis of all data obtained on Al, Cd and Pb leads the following shock and initial material velocities.

	Shock Velocity (m/sec)	Initial Velocity (m/sec)
Aluminum	7100 ± 200	3800 ± 200
Cadmium	4050 ± 200	2900 ± 300
Lead	3200 ± 200	3000 ± 300

There seemed to be little apparent variation of shock velocity with differences of plate thickness and types of charge used so all of the data available was averaged to give the above results. However, the initial velocities seemed quite sen-

[redacted]

sitive to changes in charge and thickness of plate. The results shown above were tained from the last charge arrangement used; namely, thick conical lens shells fil with spherical grained TNT (type E) followed by 1¾" diameter by 5" length of pentol. This data was selected because this charge arrangement showed the smallest variati of initial velocity with thickness in plate; in fact, no variation of velocity bet 1/8" and ½" plates was observed within the precision of the measurements.

Three more shots on tuballoy plates have been fired using the same charg rangement. Six pins were placed at 3/16" from the axis of the lens and three at 1 The results are given in the following table:

Shot	Thickness of Plate	Time by Which Detonation Wave was Early at 3/16" Compared with 1" from axis of lens	Shock Vel. (m/sec)	Initial V (m/sec)
E 97	0.400"	0 μsec	3200	1050
E 98	0.200"	0.24	3000	1200
E 99	0.199"	0.32	3100	1300

16. SHOCK AND INITIAL VELOCITIES IN NON-METALS (V.A. Nedzel)

The shock and initial velocities in specially prepared Mycalex plates we measured for G-3. The Mycalex was so arranged that the shock wave would proceed cleavage planes that were defined in the material. The results obtained on this material along with the results of a re-analysis of older data on other materials pears below.

	Shock Velocity (m/sec)	Initial Velocity (m/sec)
*Ca F_2 (pressed)	4700 ± 400	3800 ± 800
Marble	5800 ± 500	2500 ± 500
Mycalex (transverse)	5500 ± 500	------
*Mycalex (longitudinal)	6100 ± 500	3500 ± 500
Steatite	5700 ± 500	2000 ± 500
Tu-Oxide (bonded)	3400 ± 300	4300 ± 1500

*These are the only materials studied with lens charges and supposedly plane shock waves.

[redacted]

The values of initial velocities listed are either measured at or extrapolated to ½" thick plates.

17. THE PORCUPINE; (J.S. Blair and H.W. Newson)

It was reported last month, that when a 1/16" sheet of Mycalex was placed between a ½" steel plate and the pins, the velocity of the plate was 5500 m/sec. The material velocity of the plate and also of the Mycalex were checked during the past month over distances up to 1 cm.

Straight pins were used to give the material velocity of the steel, and foil-pin combinations of the type developed by Nedzel and Roberts were employed to give the material velocity of the Mycalex. For the steel plate, the material velocity is 6500 ± 200 m/sec; for the Mycalex, the material velocity is 9000 ± 200 m/sec. With such a difference in velocities, it seems probable that the Mycalex spalls away from the steel plate.

In addition, a thin foil was placed on the upper surface of the steel plate. It was found that the observed time between the foil pulse and the first pin pulse was in fair agreement with that calculated on the basis of known shock velocities and the above material velocities. This agreement indicates that no appreciable erosion occurs.

VELOCITIES USEFUL TO THE INITIATOR PROGRAM (H.W. Newson)

As reported last month it has been shown that steel pins are able to penetrate through a sheet of Mycalex (1/16" thick and density 3) and into a steel plate. Records are good when the strength of the shocks are light. However, when heavier shocks are applied by means of a plane lens, the Mycalex becomes conducting and the records are difficult to interpret. This made the experiment discouraging for the much heavier shocks in an implosion.

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Steel pins were mounted inside in the usual manner. The pulses obtained were of good quality and show a reasonable velocity for the steel, 5000 m/sec. Presumably the pins penetrated but the time when the shock wave struck the steel could not be determined accurately enough to tell whether the pins were being eroded. Further experiments will be made to check this point. The penetration of flat plates will also be tested.

<u>JET INITIATOR EXPERIMENTS:</u> (H.W. Newson)

To assist this experiment the jet velocity, shock velocity and material velocity in beryllium have been measured under the conditions of the experiment. The explosive was a cylinder of pentex $1\frac{1}{2}$" dia x 4" long which was detonated at one point, using a beryllium

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plate ½" thick. The shock velocity was 5400 m/sec and the free surface velocity 3900 m/sec.

18. PROPAGATION OF THE CONVERGING SHOCK WAVE IN THE SOLID GADGET: (D.K. Froman, D.G. Marshall & J.H. Roberts)

The time intervals between contacts were 15% longer than those predicted by IBM calculations in each of two shots.

In all cases the final time was obtained by a pin nearly touching the liner and correcting for transit time through the liner.

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22. OVERALL TIMING MEASUREMENTS: (D.K. Froman)

, From the dimensions of the lenses and corresponding inner charges, and the detonation velocities it is expected that the D-type takes 0.4 μ-sec longer than the S-type.

These corrections are small, but errors in them certainly contribute to the fluctuations in times quoted.

23. EFFECT OF DEFECTS IN THE CONSTRUCTION OF A GADGET: (D.G. Marshall)

The penetrations of possible jets produced by air cavities in the gadget were investigated by the pin method. The air cavities were produced by drilling 1/16" holes and partially filling them. The cavities each had the form of two cones having a common axis and a common base, with a base diameter of 1/16" and an apical angle of 118°.

The axes of the air cavities lay along radii of the hemispheres.

When the time of arrival of the pulse produced by contact between the imploded steel surface and the edge of the foil was consistent with the motion of the neighboring surface as indicated by the record of pin contacts, it was concluded that no jet had penetrated the steel. When the equator of the cavity was 0.229" and also when it was 0.100" from the inside surface of the steel, then no jets were observed. When the equator of the cavity coincided with the inside surface of the steel, a jet having about twice the velocity of the neighboring surface was observed. It may be concluded from these results that a 1/16" hole in the tamper is of no importance.

When this was imploded a jet was observed exceeding the velocity of the neighboring surface by about 50%.

(J.S. Blair)

A program has been initiated to test the jet producing properties of cracks which lie in the direction of a converging shock wave and which are of the same order of magnitude as might be expected from the tolerances of the gadget.

[redacted]

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The crack is .215" deep and subtends an arc about $2\frac{1}{4}$" long on the inner surface of the liner. One or more arches are placed under the crack and a group of pins were situated to one side of the crack uniformly spread over 1 cm interval.

Results to date indicate that both 11 mil and 2 mil cracks produce jets. The 2 mil crack jets even when filled with silicone grease.

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GROUP G-10 - C. L. Critchfield, Group Leader

June 20, 1945

The principal developments during the past month have been in modifying the design of the urchin initiator and in setting up for acceptance tests of service units. The modifications in design are chiefly inspired by the members of CM Division who are responsible for the actual assembly of live urchins and may be summarized as follows;

There was difficulty in making the parts fit together, and it proved impossible to close down the outer case.

Acceptance tests are being currently run on this urchin.

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The present efforts of Sampson's section in preparing for routine tests of service units include: 1) vibration tests (instrument completed), 2) leak test, 3) background measurement and calibration (in cooperation with G-engineers), 4) temperature difference across the urchin and 5) gamma ray measurement of activity for possible field use.

The research activities of the group have been slowed down considerably by the effort put on fabrication with the result that no report on these investigations can be made.

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GROUP G-11 - J. E. Mack, Group Leader

June 20, 1945

2. Kingman test and related instrumentation - Brixner

Further recommendations have been made to Shapiro. Brixner has visited Kingman to give instructions to camera operators, diagnose troubles, and advise on techniques.

3. Trinity test instrumentation - Mack

About two-thirds of the effort of the group is now devoted to this test. A report of our activities in the 100 T test and a progress report on the next experiment will be found in LA-289.

4. Sweeping-Image cameras - Brixner

The evaluation of the variations in image velocity has become an important problem with the need for accurate measurement of relatively long times (about 100 μs). Experimental methods of calibration to supplement our calculations of these variations, incidentally using internal calibration methods to eliminate uncertainties from possible variations in lens, slit, and prism relationships, have been proposed to Linschitz.

Multiple slits have been prepared for detailed examination of high explosive lenses, to aid in the determination of the arrival of the shock wave at spherical surfaces.

5. Oscilloscope cameras - Wahlen, Ilfeld

We have exhausted our original supply of fifty oscilloscope cameras, and twenty-five more are on order.

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[illegible]

[illegible] large scale charges now being fired by [illegible] push the cameras nearly [illegible] their limit, so that they must undergo maintenance service after a very few shots. [illegible] relatively few shots are fired, we can consider it more economical to furnish [illegible] service than to try to prevent damage to the delicate camera mechanism.

Measuring and reading devices

Timing measurements with the Cal Tech cameras have been made principally, heretofore, with the aid of our large comparator, which is designed for considerably more accurate work and is relatively cumbersome. We have proposed a scheme for reading with the aid of special reticules furnished by us, which promises to produce equally reliable results with much less work.

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