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MANHATTAN DISTRICT HISTORY

BOOK VIII, LOS ALAMOS PROJECT (Y)

VOLUME 3, AUXILIARY ACTIVITIES

CHAPTER 9, SUPPLEMENTARY ACTIVITIES

DEPARTMENT OF ENERGY DECLASSIFICATION REVIEW
1st Review - Date: 9/19/13
Authority: ADC ADD
Name: C. Kimbrough
2nd Review - Date: 9/26/13
Authority: ADD
Name: K Scheffter
Determination [Circle Number(s)]
1. Classification Retained
2. Classification Changed To:
3. Contains No DOE Classified Information
4. Coordinate With:
5. Classification Cancelled
6. Classified Information Bracketed
7. Other (Specify):
RDD-8, 1/1/03, DOE OC

REVIEWED AND NOT DECLASSIFIED BY U. S. DEPARTMENT OF ENERGY OFFICE OF CLASSIFICATION
9/4/79 DATE
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Department of Energy Declassification Review
1st Review Date: 9/17/13
HS-60 Reviewer
Authority: DC DD
Derived From:
Declassify On:
2nd Review Date:
Name:
HS-60 Reviewer
Authority: DD
Determination: [Circle Number(s)]
1. Classification Retained
2. Classification Changed To:
3. Contains No DOE Classified Info
4. Coordinate With:
5. Declassified
6. Classified Info Bracketed
7. Other (Specify)

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CHAPTER 9, SUPPLEMENTARY ACTIVITIES

SECTION 1 - DETROIT OFFICE

During several months in 1943 Mr. George B. Chadwick, a former Head Engineer with the Navy Bureau of Ordnance, was being considered for, and functioned as, Chief Engineer of the Engineering Group, Ordnance Division, at Los Alamos. At the end of the period Chadwick declined to accept the position, even though by that time he had become familiar with many of the engineering and procurement problems existing at the Laboratory. With the foregoing experience and his familiarity with Navy Ordnance procedure as a background, Chadwick was requested, in August, 1943, to assist in procurement, in the Detroit area, of suitable draftsmen and machinists for employment at the Los Alamos Laboratory. At that time considerable difficulty was experienced in adequately staffing the Los Alamos shops, and need for this activity was urgent. Chadwick complied with the request and established a suitable location in Detroit, where design engineers and shop personnel could be hired and put to work on unclassified jobs, to prove their ability prior to their transfer to Los Alamos. Sub-contract No. 2, under prime contract W-7405-eng-36 with The University of California, was set up to cover Chadwick's services. A total cost of $23,359.35 was incurred under that service sub-contract (see Book VIII, Vol. 2). Early in 1944 Chadwick indicated his desire to terminate his contract, and his office and services were transferred to a University of Michigan contract.

Procurement for Los Alamos by the University of Michigan developed from the initial arrangement whereby the University of Michigan designed and field tested certain devices for detonating the atomic bomb. For security reasons the procurement incident to the early work at the University of Michigan was conducted as a satellite activity of Section T, OSRD. The first "Michigan-fabricated" components to be obtained directly for Los Alamos were scaled down models of bomb assemblies. Chadwick had established the Detroit office at that time (late 1943) and, as he was familiar with the overall designs of the bomb models, he was pressed into service to follow up on the Michigan procurement in the Detroit area. It was thus that procurement of special fabricated items through Chadwick's office in the Detroit area began. The early arrangement was that Chadwick would select a suitable fabricator, make preliminary drawings available to him, and by a process of compromise achieve a design which could be fabricated and could at the same time assure an item which would be suitable for its intended operation function. The University of Michigan would back up Chadwick's action with an order, or orders, for the fabricated articles, and when the items were completed they would be shipped to Chicago for reshipment to New Mexico.

As the Los Alamos field test activities increased in scope and magnitude, more formal procurement arrangements were needed and Chadwick was appointed an authorized representative of the OSRD for the purpose of certifying contracts, etc.

The above arrangements worked satisfactorally as long as Chadwick was able to devote a great deal of his time to supervision, inspection and follow-up work for the items being procured. However, late in 1944 Chadwick was required to spend a considerable amount of his time on Vickers work outside of the Detroit area. That diversion of his attention resulted in inadequate supervision of the Detroit Office. To correct that difficulty, Colonel R. W. Lockridge was assigned as officer in charge of the Detroit office. Operations at Detroit were promptly improved and, in December, 1944, Colonel Lockridge was transferred to Los Alamos, with as assignment as Ordnance Division Group Leader in charge of procurement of special articles. Major F. B. Smith replaced Colonel Lockridge, as officer in charge at Detroit, and served at that location until 10 April 1945.

Toward the end of 1944, in view of the fact that Dr. Bush wished to shrink outstanding OSRD commitments, the University of Michigan accepted contract W22-075-eng-30 from the Manhattan District, to continue the operation of the Detroit office in practically the same manner in which it had been carried on under the OSRD contract OEMsr 1233.

SECTION 2 - THE NORDEN LABORATORIES CORPORATION AND LUKAS-HAROLD CORPORATION

2-1. General - Book VIII, Vol. 2, refers to the particular care which was required to fuse atomic bombs properly, so that detonation within a hundred feet or so of the predetermined height above a target would be assured, to allow less than one chance in ten thousand of failure. General development of this feature proceeded along two principal lines of attack. One was concerned with the use of newly developed electronic techniques, and the other contemplated the possible use of barometric switches. Electronic devices to perform the desired function were anticipated to be of considerable complexity. On the other hand, while barometric switches would be relatively simple mechanical devices, it was nevertheless by no means certain that performance of the desired reliability could be obtained by them on falling bombs. The Norden Laboratories Corporation and Lukas-Harold Corporation (a subsidiary of Carl L. Norden, Inc.), with the approval of the Bureau of Ordnance, Navy Department, participated in the electronic and mechanical fusing developments respectively.

2. Electronic Fusing - Under OSRD Contract OEMsr-1469, Symbol T-111, the Norden Laboratories developed a bomb altimeter system, using a frequency modulated altimeter (R.C.A. type) as a basic component. The work included the development of a suitable antenna system, the necessary alternation of the basic altimeter, and the development of a velocity arming firing circuit. Six complete units were built and delivered. These modified altimeters persisted in showing difficulties that discouraged their use even below 1000 feet. Available records do not indicate that development continued under the contract for this particular apparatus.

3. Barometric Switches - The laboratory of the Lukas-Harold Corporation developed a mechanism known as the "Pressure Sensitive Contactor". That unit was designed to control a circuit operation at a predetermined atmospheric pressure. The assembly employed a set of evacuated bellows, balanced with helical springs. It was equipped with a contact system, actuated by a cam and follower shoe, the circuit being broken when the holding shoe was moved away from the contactor element by motion of the activating bellows. The bellows assembly, employed as the prime component of the unit, was one such as was currently being procured for Norden instruments.

Tests of the barometric switch were conducted in November, 1943, at the Lukas-Harold laboratory, with equipment which had been furnished by the University of Michigan. Flight conditions at various altitudes were simulated in an altitude control chamber at the laboratory. The apparatus was further tested at various amplitudes and frequencies on a vibrating stand and at representative temperatures. Appendix A-1 provides descriptive information of the "Pressure Sensitive Contactor" and contains data obtained through the above laboratory tests.

Book VIII, Vol. 2, refers to extensive field tests which were conducted with barometric switches. It was demonstrated that such a method of fusing was not so sensitive as was desired for absolute elevations, and that barometric firing should be considered as a secondary method only.

SECTION 3 - ARMY AIR FIELDS

3-1. General.

Reference has been made in Book VIII, Vol. 2, to early steps taken by the Delivery Group, Ordnance Division, and other organizations at Los Alamos Laboratory, toward the effective combat delivery of the atomic bomb. In June, 1943, N. F. Ramsey (leader of the Los Alamos Delivery Group, but at that time still working for the Air Forces) began an investigation to determine which of the existing aircraft, after modification, might possess suitable carrying capacity for the intended atomic weapon. Only the B-29 and the British Lancaster bombers appeared to offer the desired characteristics and, of the two, the B-29 was in the favored position. Additional difficulties were anticipated in operating Lancasters from American bases.

Later in 1943 it became evident that a definite delivery program had to be promptly established. General Groves discussed the problem with General Arnold and it was determined that the weapon would be in the form of an aerial bomb, and that it would be delivered by B-29 aircraft. At that time General Groves asked for three modified B-29s and requested that the Army Air Forces assume responsibility for the necessary aircraft modification, conduct of ballistic tests, and organization and training of the combat element. It was determined also that the AAF combat element would be placed under the control of an Army Air Force field commander for operation against the enemy. General Arnold selected Colonel (later Brigadier General) R. C. Wilson to serve as his representative in directing and correlating the foregoing AAF activities and informed him of the decisions which he and General Groves had reached. Colonel Wilson contacted General Groves and received his confirmation of these arrangements. The responsibilities delegated to Colonel Wilson remained in effect until December, 1944, when he was relieved for combat duty. At that time control of the AAF program was assigned to Major General Lauris Norstad with Colonel Wilson continuing to serve in a liaison capacity.

Colonel Wilson arranged for Army Air Force personnel to contact Dr. Oppenheimer, Admiral Parsons and others at the Los Alamos Laboratory, and in November, 1943, details of the B-29 modification plan were discussed between General Groves, Colonel Wilson and Ramsey. Tentative sizes, shapes and weights of the proposed bombs were made available to the AAF and, immediately thereafter, a technical program was established at Wright Field to modify a B-29 aircraft in accordance with Manhattan District requirements. Concurrent with the mechanical development at Wright Field, and throughout later operations, the Army Air Force cooperated with Colonel R. G. Butler, Jr., Army Ordnance, and interested personnel at Los Alamos Laboratory and other locations, in the development of bombing tables. The technical program at Wright Field was placed under the direction of Colonel D. L. Putt, who was assisted in that assignment by Major R. L. Roark.

It was, of course, essential that military security be maintained throughout all written and oral discussions of this activity. This led to the adoption of various code names and terms. Bomb identifications were those which had been established at Los Alamos. The aircraft changes were referred to as "Silver Plate" modifications and the general subject was referred to as a Pullman car being prepared for President Roosevelt and Prime Minister Churchill. As an item of interest, some question occurred at a later date in regard to the term "Silver Plate". It had been coined by Colonels Wilson and Putt in ignorance of the fact that this same code term was currently being applied to another unrelated classified project of the War Department. This inadvertent error was occasioned by the stringent security rules which forbade request to Army Intelligence for a proper code name.

In January, 1944, Wright Field completed modification of the initial B-29. The plane was one of an early Boeing production, and the major changes consisted of the bomb bay modification, and the conversion of a glider attachment and release assembly into a bomb suspension and release mechanism.

While the work was being done at Wright Field the Manhattan District arranged, through the Detroit Office, for construction of full scale facsimiles of the Thin Man and the Fat Man. These models were also completed early in 1944.

3-2. Muroc Army Air Base.

Agreement had been reached between the Manhattan District and the Army Air Forces that experimental field tests of the Wright Field modifications would be conducted at Muroc Army Air Base, California, a satellite station of Wright Field. Before the arrival of the modified aircraft from Wright Field, several inspection trips had been made to Muroc by Los Alamos field-party leaders, including Admiral Parsons, Ramsey, Brode, Bainbridge and others. A cooperative spirit prevailed at the air base. Preliminary plans discussed between AAF and MD representatives resulted in the establishment of a program for developments and tests applicable to bomb dropping techniques as well as other features of vital interest to the Los Alamos Laboratory. The bomber to be tested, with a Wright Field crew, arrived at Muroc in late January, 1944, and shortly thereafter the bomb models were received from Detroit. Book VIII, Vol. 2, refers in detail to the tests which were conducted at Muroc. In general, the suspension and release mechanism proved inadequate and unreliable, and that phase of the operation was brought to an abrupt halt by a premature release of a mounted Thin Man model, causing it to fall on, and seriously damage, the bomb bay doors. As a result of this accident, Wright Field, promptly began a remodification of the suspension and release mechanism. The changes of the original Muroc B-29 were under the direction of Major Roark and developed into an adaptation of a British bomb suspension and release device.

Field test operations at Muroc were resumed in June, 1944, with early results serving as a basis for formulating more extensive plans of operation for the summer and fall of that year. It was decided that a three airplane element could not be properly segregated as a combat operating unit and that the initial plan should be augmented to provide for a squadron of fifteen B-29s. The continued operation, as it was then developing, involved considerable increase in facilities; because of other commitments at Muroc Air Base, and because of security requirements, this resulted in an unexpected revision of plans and a determination that the Manhattan Project activities would be transferred to another Army Air Force Establishment.

3-3. Wendover Army Air Base. (Refer to M.D. History Book VIII, Vol. 2, and to App. B-1)

a. Selection of Test and Training Base. The place to which the Army Air Forces - Manhattan Project activities would be moved from Muroc was discussed in the office of Major General U. G. Ent, Commanding General of the Second Air Force, during the early summer of 1944. Those present at the initial discussion included General Ent, Admiral Parsons, Colonel Wilson, Colonel Tibbets, Colonel Lansdale and Ramsey. The Second Air Force Base at Wendover Field, Utah, - a remote station with limited access and vast, isolated, bombing ranges - was proposed as a suitable training site for the atomic weapon group. Objection to that location was expressed by Admiral Parsons, as he anticipated that the extreme remoteness of the location would present difficulties in procurement and in communication between Wendover and other locations where associated activities were being conducted. Colonel Tibbets stated his opinion that while certain advantages were apparent at Wendover, it should be recognized, nevertheless, that the take-off there of a heavily loaded B-29 would be unsafe under certain wind conditions (from one of the runways an aircraft would be headed toward a mountain). General Ent indicated that Colonel Tibbets, who had had considerable experience and attained prominence in bomber operation, was to be responsible for the AAF atomic bomb field activities. Colonel Tibbets was instructed to investigate the respective advantages of several available air fields and, in carrying out these instructions, he operated a B-29 from various runways at Blythe, Mountain Home and Wendover Army Air Fields. Upon the conclusion of his investigation Colonel Tibbets favored the selection of Wendover Field. During a final discussion of the location of the atomic bomb group the choice was narrowed to the air activities under the command of General Ent and to his preference of a location within that command. On that basis it was agreed to conform with the original proposal and Wendover Army Air Base (code name "Kingman", code symbol "W-47") was designated as the training and test center for the AAF atomic bomb group.

b. Organization. Colonel (then Lieutenant Colonel) P. W. Tibbets, Jr., was officially appointed, about July, 1944, to serve as the commanding officer of the above group. At that time the group had not been formed and Colonel Tibbets' first task was one of organization. In general, the requirements were: that the new group should be self-sufficient to the greatest practicable extent; that it be so constituted as to perform its tactical mission in either or both of the then existing combat theaters; and that it conform with the very definite need for cooperative association with service and civilian personnel of certain Manhattan Project activities.

The first element and nucleus of the new group was made available in September, 1944, when the 393rd Bombardment Squadron (VH) was transferred from Fairmont Army Air Field, Geneva, Nebraska, to Wendover Army Air Base. That squadron had a personnel strength of about 700 and, upon its transfer, was charged with execution of the tactical phase of the new group's mission. Under the reassignment the 393rd was designated as a group of the 313th Bomb Wing (VH).

It was essential that facilities be established for prompt transportation of project personnel and supplies between distantly separated points in the United States and between contemplated zone of interior and overseas bases. The 320th Troop Carrier Squadron was assigned to the new group to perform that function. The 320th became known as the "Green Hornets", or "Green Hornet Air Line", and, from the beginning of its operation, provided such service as to minimize Admiral Parsons' early fear of the inaccessibility of Wendover Field. The "Green Hornets" also promptly became an appreciable factor in solving the Wendover procurement problem for various items of special air force equipment. Later events demonstrated that outstanding efforts on the part of AAF and Manhattan District procurement personnel to a great extent prevented excessive delays, but Los Alamos and the "Green Hornets" remained the final solution in practically every ticklish problem of obtaining laboratory and other equipment for test and development operations.

The 390th Air Service Group - "a group within a group" - composed of the 603rd Air Engineering Squadron and the 1027th Air Material Squadron, was assigned to the new organization to operate overseas in the same manner that a Base organization would function in the United States. Its purpose was to provide housing, personnel and administration facilities, and to cope with problems which might arise in engineering and supply.

The 1395th Military Police Company (Aviation) was assigned to the new group to function in protecting the security of the project.

By direction of the War Department, and the Second Air Force, the foregoing organizations were consolidated and designated as the 509th Composite Group. Headquarters organizations were established and the

509th Composite Group was formally activated on 17 December 1944.

At a later date (6 March 1945) the 1st Ordnance Squadron, Special Aviation, was activated and added to the 509th Composite Group. This organization was constituted to carry out important ordnance projects of the mission and was manned to a large extent by hand-picked skilled machinists, welders and munitions workers.

The established T/O for the 509th Composite Group was for 225 officers and 1542 enlisted men, but because of its unusual mission no existing Table of Organization and Equipment was adequate. Early changes were required and were obtained through established T/O's with standard amendments and modifications by inclosures to the activation order.

All of the personnel were carefully selected on the basis of professional or operational skill, operational experience and unquestionable loyalty and discretion. The senior officers alone were informed of the purpose of the special training; all other members of the organization were led to believe that they were preparing for an aerial mining attack on the deep ravines of Formosa.

c. Equipment (Aircraft). The initial B-29s assigned to the 393rd Bombardment Squadron were unsatisfactory in a number of respects. The aircraft were constructed at the Boeing, Wichita, Plant and contained some inherent faults. In addition various design difficulties had existed with the "Silver Plate" modifications. Because of uncertainty pertaining to these modifications (attributable in a large part to security) all of the aircraft were not modified in the same manner and none of them complied in all respects with Manhattan District requirements. It had been intended that fifteen B-29s would be made available to the 393rd Bombardment Squadron for test and training purposes; however, in view of the condition of the early units, deliveries were terminated short of that number. Early in 1945, in accordance with Army Air Force practice for the provision of combat equipment, the training aircraft were replaced by bombers to be used for the weapon delivery. A sufficient number of B-29s were made available to provide for the assignment of fifteen to combat service, five to test and development operations and a quantity in reserve. The replacement aircraft were particularly free of production faults and previous troubles with the "Silver Plate" modifications were avoided by stationing S. H. Dike and Capt. Sanjar at the plant to ride hard on the day to day modifying operations. The new B-29s contained very rugged provisions for carrying the bomb, and they were equipped with fuel injection engines, Curtis electrical reversible pitch propellers and pneumatic bomb bay doors. After their receipt by the 509th Composite Group, all armament, with the exception of the tail turret, was removed in order to provide for maximum speed and elevation in flight.

The original equipment of the 320th Troop Carrier Squadron consisted of C-45, C-47 and B-18 transports, all of which had undergone extensive service. That original equipment was replaced by ten brand new C-46s, and then by five trans-Pacific C-54s plus smaller aircraft of the C-45 type.

d. <u>Development, Test and Training.</u> The development, test and training mandatory for proving in delivery of the new atomic weapon were prolonged and extensive. Details of development and test activities (joint participation by the Army Air Forces, representatives of Los Alamos Laboratory and representatives of the Camel Project, Inyokern) have been included in Book VIII, Vol. 2. Reference to that portion of the Manhattan District History is suggested. The training operation began in October, 1944, and continued up to the time of the combat use of the atomic weapon. That activity was not only conducted from Wendover Field but extended to Batista Field, Cuba, to make use of radar facilities and to gain experience over the extensive sea coast line at that location. Later when the combat squadron reached their Tinian Base (see following paragraph) each of the delivery crews participated in combat drops of "Pumpkins" (HE prototype of the Fat Man). These combat drops were primarily for the purpose of providing further training to assure successful operation with the atomic bombs.

Shortly before the transfer of the combat element of 393rd Bombardment Squadron to the overseas base the five B-29s and their respective crews which had been assigned to test and development operations were placed under the direct command of Colonel C. J. Heflin, Base Commander, at Wendover, for continued conduct of their activity at that location.

e. Overseas Movement. The main ground echelon of the 509th Composite Group left Wendover Army Air Base on 26 April 1945 and debarked at Tinian 30 May 1945. Tinian had been selected as the base in the Pacific Theater, under command of Major General LeMay and the XX Air Force, from which delivery of the atomic weapons was to be made. It had previously been determined that Wendover Field would be retained as the zone of interior supporting base and the zone of interior terminal of the "Green Hornet Air Line". While the month of May 1945 marked the beginning of the arrival of the 509th at its overseas destination it is worthy of note that from then until the first week of August, 1945, individuals and equipment continued to arrive each week.

Thus, in the main, the 509th Composite Group came under the operational control of General LeMay and the XX Air Force (personnel and facilities remaining at Wendover field were exceptions) from whom it received all local logistic support. It did, however, continue to employ the direct "Green Hornet" special line of communication and supply from Wendover field. Accounts of the Army Air Force operation at Tinian, including outlines of the participation by Brigadier General T. F. Farrell, Admiral Parsons, Colonel E. E. Kirkpatrick and other Manhattan District personnel, have been provided in Book VIII, Vol. 2. Also, descriptive accounts of combat delivery of the two atomic bombs are included in Book VIII, Vol. 2 and are referred to in Appendix D-1.

3-4. Roswell Army Air Field.

After the cessation of hostilities with Japan, the 509th Composite Group was moved from Tinian and Wendover to Roswell Army Air Field, New Mexico. Roswell at that time was under the command of the Second Air Force. In line with other service organizations the 509th's transition to peacetime service was coupled with prompt and drastic reduction in personnel strength until only a skeleton of the wartime organization remained. It had, however, been determined that at least a nucleus of the 509th would be retained in order that it should serve in training and developing peacetime units in atomic warfare.

As the year of 1945 drew to a close, more and more favorable consideration was given to the proposal to determine the effects of atomic bombings on naval vessels. Various discussions of this subject resulted in the creation, on 11 January 1946, of Army and Navy joint Task Force One with instruction to proceed with "Operation Crossroads" (see Book VIII, Vol. 3, Chapter 8).

The 58th Wing, assigned to the Fourth Air Force, had been outstanding, during the war, in the general B-29 program. For that reason it was desired that it be charged with Air Force experimentation and operations with special bombs during peacetime. Also it was desired that the 509th Composite Group serve as the operating subordinate group in the Air Force portion of Operation Crossroads. On 15 January 1946, a board of officers, which included representatives of both the Second Air Force and the Fourth Air Force, met at Roswell Army Air Field to formulate details for the transfer of command of that location from the Second Air Force to the Fourth Air Force. That transfer was effected, and on 17 January the 509th Composite Group and all of its attached and assigned units were assigned to the 58th Wing by authority contained in confirming G.O. 15, Fourth Air Force, dated 31 January 1946. On 29 January, by command of General Arnold, Brigadier General R. M. Ramey, Commanding General of the 58th Wing, was directed: - "To take necessary action to organize, train and equip this force to participate in Joint Army and Navy tests of the atomic bomb to be conducted at Bikini Atoll".

Colonel Tibbets, the initial commanding officer of the 509th, was selected to serve on General Ramey's staff as Technical Director and Colonel W. H. Blanchard succeeded him in command of the 509th. In general the initial organizations making up the 509th Composite Group (393rd Bombardment Squadron, 320th Troop Carrier Squadron, etc.) were retained and steps were promptly taken to increase their strength in personnel and equipment to that required under Operation Crossroads.

The 509th Composite Group, 58th Bombardment Wing, after being reconstituted as outlined above, acted in full compliance with the directive regarding Operation Crossroads. Personnel and equipment were brought up to the desired strength, and development, training and operational activities proceeded in full cooperative effort with the Manhattan District participation in the overall task. Accounts of the 58th Bombardment Wing and the 509th Composite Group activities are provided in Appendix B-2 and are not repeated in this portion of the Manhattan District History.

SECTION 4 - EXPLOSIVES RESEARCH LABORATORY

The Explosives Research Laboratory, Bruceton, Pa., (ERL) was operated throughout the war by Division 8, N.D.R.C. This laboratory was located in buildings constructed for this purpose on the grounds of the U. S. Bureau of Mines. Funds were provided by the OSRD through a contract with the Carnegie Institute of Technology (OEMsr-202) and through transfer of funds to the Bureau of Mines.

The laboratory was begun late in 1940 by Dr. G. B. Kistiakowsky, who later became Chief of Division 8, (Explosives), NDRC, and who still later became Chief of X Division, Los Alamos Laboratory. After Dr. Kistiakowsky became Chief of Division 8, the senior technical men at ERL were Dr. L. P. Hammett, Director of Research (in charge of work on propellants) and Dr. D. P. MacDougall, Deputy Director of Research (in charge of work on high explosives).

The first investigation for Los Alamos carried out at ERL was in the field of propellants. Through informal arrangements with Dr. G. B. Kistiakowsky and Dr. J. O. Hirshfelder, S. J. Jacobs of ERL conducted a study of the burning rate and general behavior of a special cordite at very high pressures, higher than those normally of interest to gun designers. This work was started early in 1944.

Early in the spring of 1944, some work on high explosives for Los Alamos was started at ERL on an informal basis through arrangements between Kistiakowsky and MacDougall. Later, this arrangement was formalized through official NDRC, OSRD and Manhattan District channels. (See App. A-2.)

The Manhattan District made available $250,000 to OSRD for the fiscal year 1945, in return for the services of about one half of MacDougall's staff working on high explosives at ERL. It was also agreed that ERL would procure items for Los Alamos when requested.

During the fiscal year 1945 and for a short period in the fiscal year 1946, there were, on the average, about 17 professional personnel (B.S. and Ph.D) at ERL working full time on problems for Los Alamos. The cost of this work was approximately $200,000 per year. (App. A-3 provides ERL details of cost from August, 1944, to June, 1945, inclusive.)

Direct technical liaison was maintained by MacDougall and Kistiakowsky, the former visiting Los Alamos a number of times, and the latter making several visits to ERL. A number of other Los Alamos personnel, including Neddermeyer, Bethe, Peierls and Ackerman also paid visits to ERL. Technical reports on the various projects under way at ERL were sent directly to X Division at Los Alamos by MacDougall at approximately biweekly intervals.

A large number of major and minor investigations were undertaken by the ERL group for the Los Alamos Laboratory (Refer to Book VIII, Vol. 2, paragraphs 7.26, 7.61, 7.70, 16.7, 16.16, 16.25, 16.27, and 16.32.) These included, among others, such topics as:

(1) Interaction of Detonation Waves.

(2) Initiation Through Barrier Materials.

(3) Development of Low Velocity Explosives and Study of Their Detonation Velocities and other Properties.

(4) Detonation Waves Traveling in Curved Paths.

(5) Detonation Wave Shapes in Plane Wave and Convergent Wave Lenses, and Lens Development in General.

(6) Inert Materials as Possible Slow Lens Components.

(7) Comparison of Impulses Given to Metal Fragments by Various Portions of a Lens Surface.

(8) Detonation Velocity in Primacord.

(9) Casting Techniques for Composition B and Baratol.

(10) Metal Jet Formation by Detonation Wave Interaction.

(11) Detonation Velocity in Lenses as a Function of the Radius of Curvature of the Wave.

(12) Procurement of Special Primacord from Ensign-Bickford Co.

The most important contributions by the ERL group were probably:

(1) The proposal, and suggested design, in June, 1944, of the spiral lens, by E. M. Boggs of the ERL staff.

(2) The development and extensive investigation of Baratol for use as the Slow Lens Components.

(3) Major participation in the study of the design and behavior of explosive lenses.

SECTION 5 - PURDUE UNIVERSITY

In the fall of 1942, shortly after the initiation of the Los Alamos Project, the scientists at the Laboratory began to look around for the personnel and facilities necessary for the solution of an important special problem in nuclear research. This was the problem of the measurement of the deuterium tritium and helium 3 deuterium cross sections, or as then described, the measurement of the cross section of the reactions obtained when helium 3 was bombarded with deuterium and hydrogen 3 was bombarded with deuterium. With the sources of hydrogen 3 ions which were then available, it was necessary to accelerate the hydrogen 3 and helium 3 ions and bombard deuterium, and a separation of tritium from deuterium and hydrogen was not possible at that time.

The energies desired for this research work were between a tenth of a million electron volts and one and one half million electron volts, and a search was started for an available cyclotron which would give these low energies. The services of Dr. M. G. Holloway of Cornell University were obtained, and, on 29 September 1942, Dr. J. R. Oppenheimer authorized him to investigate the cyclotrons at various universities. Dr. Holloway first visited the University of Rochester, Yale University and the University of Michigan, to discuss the possible use of their cyclotrons, and then, accompanied by Dr. Oppenheimer and Dr. John H. Manley, he visited Purdue University, in Lafayette, Indiana. There they conferred with Dr. Lark-Horovitz, Chairman of the Physics Department, and agreement was reached for the use of the Purdue cyclotron for the proposed work.

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A contract was made between OSRD and the Purdue Research Foundation, Contract No. OEMsr-793 (Purdue Research Foundation Case No. 459, Fellowship No. 203.) This contract was taken over, in July 1943, by the Manhattan District, under Contract No. W-7405-eng-146, negotiated by Lt.Col. (then Major) Stanley L. Stewart, serving as Manhattan District contracting officer. This contract terminated on 30 September 1943. (See Book VIII, Vol. 2, App. 7, No. 15.)

The business representative for the Purdue Research Foundation was Research Director G. Stanley Meikle. Dr. Holloway reported, in the beginning of the work, to Dr. Manley at the Metallurgical Laboratory, and, later, to Dr. R. F. Bacher at Los Alamos.

The initial arrangements with Purdue University provided for the transfer of some of the University's personnel for work on the research project; among them were Dr. R. E. Schreiber and Dr. L. D. P. King, who remained on the staff of the Los Alamos Laboratory after this work was completed.

A number of graduate students and technicians in the Physics Department were hired also, on a part-time basis, including: Harry F. Daghlian, Jr.; Ansley Irving Moy; Ralph Bray; Arthur E. Middleton; Don J. Wendam; Robert G. Carter; and Richard Clay.

Dr. Holloway started work at Purdue on 1 November 1942; Dr. King and Dr. Schreiber began work soon thereafter, and they were joined by Dr. Charlie Baker on 10 November. Work was begun immediately on the setting up of guarding procedures for the cyclotron room, the installation of grilles for security purposes, and reconstruction of the R. F. system of the cyclotron in order to get the desired low energies.

SECRET

The technical work encountered many difficulties but the cross sections required were successfully measured, and final reports were submitted to Dr. Oppenheimer at Los Alamos.

The helium 3 used in the experiments was obtained from nitrogen resulting from the reduction of air. The tritium came in two samples, furnished from the University of California by Emilio Segré, Milton Kahn and Martin Kamen. The analysis of the deuterium as to its purity was performed first by the University of Minnesota group under Dr. A. O. C. Nier, and later by the Columbia University group under Dr. M. G. Inghram and Dr. R. H. Crist.

Before the work at Purdue was terminated, on 30 September 1943, the cyclotron was remade to give the original high energy particles. The personnel who transferred to Los Alamos after the completion of the Purdue project included not only Drs. Holloway, King and Schreiber but also Drs. Baker, Carter and Daghlian.

The total Manhattan District costs under Contract No. W-7405-eng-146, from July to September 1943 inclusive, amounted to $11,371.

As a matter of incidental interest, it may be noted that the term "barn", which was adapted generally at Los Alamos and elsewhere to designate a unit of cross section, was invented at Purdue during the course of the work herein described.

REFERENCES

Additional or confirmatory information about the work at Purdue University may be found in Book VIII, Vol. 2, par. 1.4, 1.15, 3.125, and App. 7-15; also, references 3,4,5 and 6 of Appendix B of this chapter.

SECRET

MANHATTAN DISTRICT HISTORY

BOOK VIII, LOS ALAMOS PROJECT (Y)

VOLUME 3, AUXILIARY ACTIVITIES

CHAPTER 9, SUPPLEMENTARY ACTIVITIES

APPENDIX A

1. Report (unnumbered) Tests of Pressure - Sensitive Contactor (including enclosures). - 1 January 1944 - L. T. E. Thompson

2. a. Correspondence relating to assignment of work to the Explosive Research Laboratory

   b. Project Costs, Explosive Research Laboratory

SECRET

APPENDIX A-1

Dr. R. B. Brode

L. T. E. Thompson

January 1, 1944

TESTS OF PRESSURE-S[illegible] CONTACTOR [illegible]

Enclosure: (A) Sketch showing assembly used for present tests

(B) Plot of results of tests made at high rates of dive

(C) Data sheet showing pressure increase in chamber, measured with high-frequency pressure gauge, and time measurements by motion picture chronograph

The enclosures show the results of testing the double-bellows assembly set up as the control for a contact break (or make) at a predetermined altitude. The tests were made with the assembly in a large bell jar fitted with a controlled orifice and connected to a standard pressure gauge. The entire unit was placed in a large chamber, temperature controlled.

The bellows were exhausted to a pressure of the order of 5 mm. Hg. The cam arrangement shown in the sketch produces a positive break and is preferred to an ordinary contact break, though other arrangements can easily be designed. A sketch previously submitted shows the form first used with an ordinary contact. The bellows system so mounted has a fairly high natural frequency, probably at least 50 v.p.s., and accordingly will have very little lag compared with the lags of ordinary altimeters, even at high rates of dive. The bellows used for this work are those procured for Norden instruments from the Clifford Manufacturing Company, 564 E. First Street, Boston, Mass. The springs shown in the sketch were made of beryllium-copper.

The test runs shown on enclosure (B) include four "dives" from 8,000 feet altitude, temperature -10°C, and four at 26°C. Other tests have been made which are consistent with these but they were less well controlled and these are presented as typical. The "altitudes" given are those obtained in static calibration checks of the standard pressure gauge with a sensitive altimeter. The standard pressure gauge is one developed at the local laboratory, having a high natural frequency so that it will follow without significant lag the highest rates of change experienced in work of this kind. The gauge records optically. A moving picture chronograph was used to photograph the position of the indicator on the scale and at the same time to show the appearance (or disappearance) of light in a neon bulb connected through the contactor. The slopes of the curves of enclosure (B) give the rates of descent of these tests, being in the range about 500 ft./sec. to 1100 ft./sec. The dotted and

A.1

Dr. R. B. Brode

L. T. E. Thompson   January 1[illegible]

PRESSURE-SENSITIVE CONTACTOR

of each curve indicate the adjacent frames of the motion picture record between which the light was turned off.

It will be noted from these records that the break occurred in each case within 25 to 40 feet of a representative mean position. The actual variation was presumably considerably less than ± 35 feet, but no attempt was made to obtain greater refinement since these limits of fluctuation are quite acceptable.

No important variation with temperature was observed or expected. If it should be desired to produce a closer control with respect to temperature, it would be possible to make the springs (of beryllium-copper) of such characteristics that when the supports are placed on an Invar (or ordinary steel) base the effect of temperature change in the residual gas would be nearly compensated by the effect on the springs.

It would be possible to make an adjustable control for the contactor which could be set to correct for variations in expected temperatures if this correction is considered justified. The setting can be made, of course, for any desired low altitude. In these tests the altitude of break was of the order of 900 feet.

The dynamic pressure may have an appreciable effect in determining the point of contactor action, depending on the location of the inlet ports, particularly in the case of yawing motion. To compensate for yaw it may be sufficient to use three or four inlet ports.

LTET:ew

(copied 14 Nov 47 by df)

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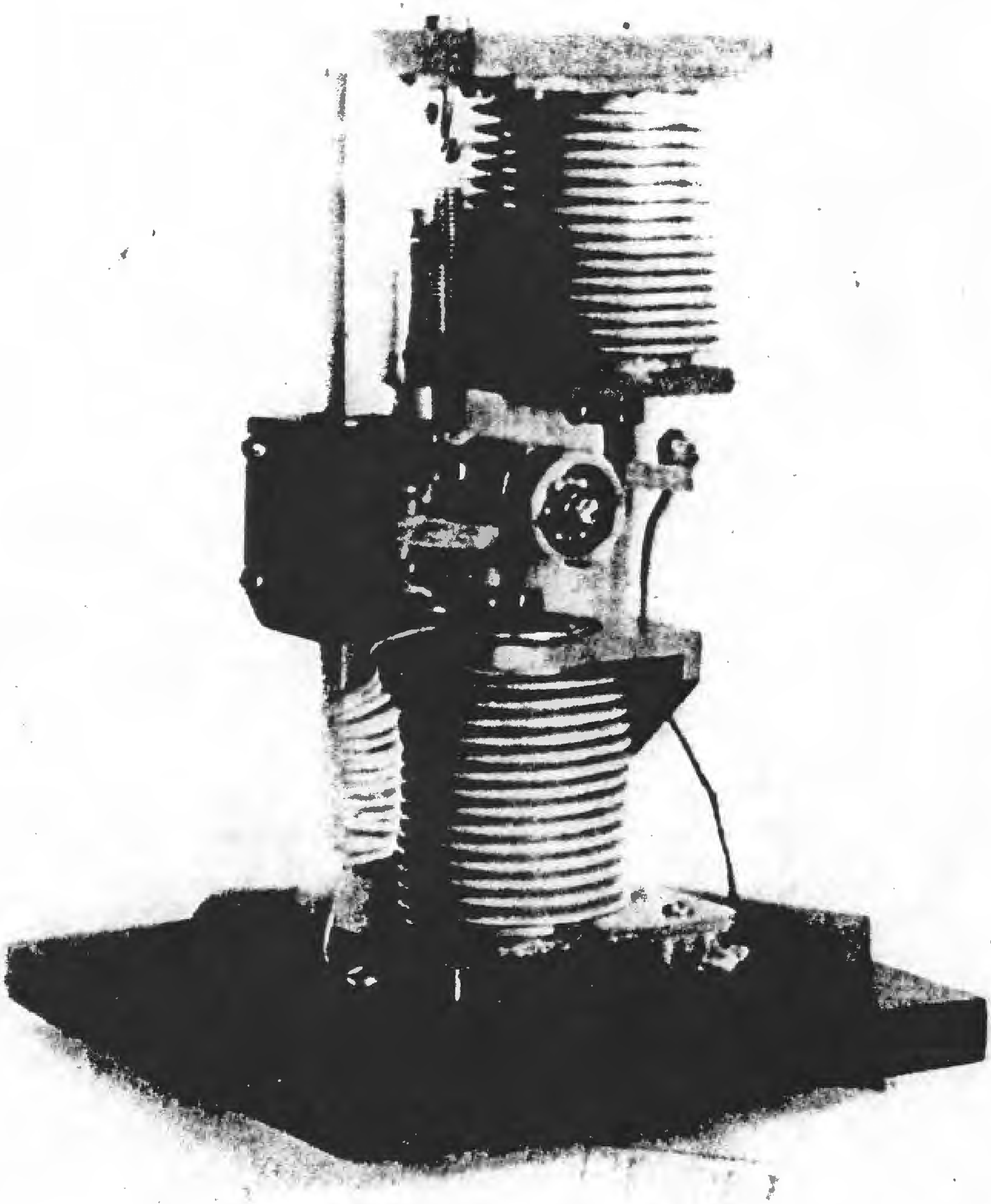

THE LUKAS-HAROLD CORP.
Indianapolis, Indiana

C
O
P
Y

RESTRICTED DATA

MEMORANDUM LABORATORY REPORT

6 January 1944

Subject: Pressure Sensitive Contactor

DESCRIPTION OF MODEL

A preliminary model of an atmospheric pressure actuated mechanism designed to open or close an electric circuit has been built and tested. The operating force is generated by evacuated bellows balanced with helical springs. The bellows are mounted with their axes parallel and spaced about one inch apart. Opposite ends of the bellows are fixed to supports which are integral with the base plate. Thin bronze straps attached to the free ends of the bellows are wrapped in reverse directions around a rotatable cylinder midway between them. The torque exerted by the bellows is balanced by the two helical springs acting upon the cylinder through two light weight arms. An additional arm serves as a cam upon which the shoe or follower which trips the contact rides. The opposite arm is counterbalanced with a suitable small weight. The cam follower is mounted on a light leaf spring which also carries one of the contacts. The other contact is fixed to a somewhat stiffer spring which permits only limited movement when the shoe is retracted while surrounding pressure is being reduced. A schematic sketch of the device is shown on Sheet 2. In any further development of this unit, it might be better to substitute an aluminum disk, in which the ball bearing would be mounted, for the three separate arms.

ADJUSTMENT

As adjusted for operation, the tension on the springs is increased to cause the spring arms and contact cam to form an approximate right angle with the axes of the springs and bellows. In the present model final adjustment of the spring tension is made to position the system so that the follower will slip from the cam at the atmospheric pressure corresponding to that of the required altitude. This setting is now made by trial but an adjustment of the spring tension or of the contact shoe can be designed to give a predetermined circuit break.

INERTIA AND VIBRATION EFFECTS

The moving parts of this model were balanced roughly. With careful balancing and proper orientation of the installation no important errors should result from acceleration. At present, the cam arm is statically balanced by a small brass weight on the opposite spring arm.

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ATOMIC ENERGY ACT 1946
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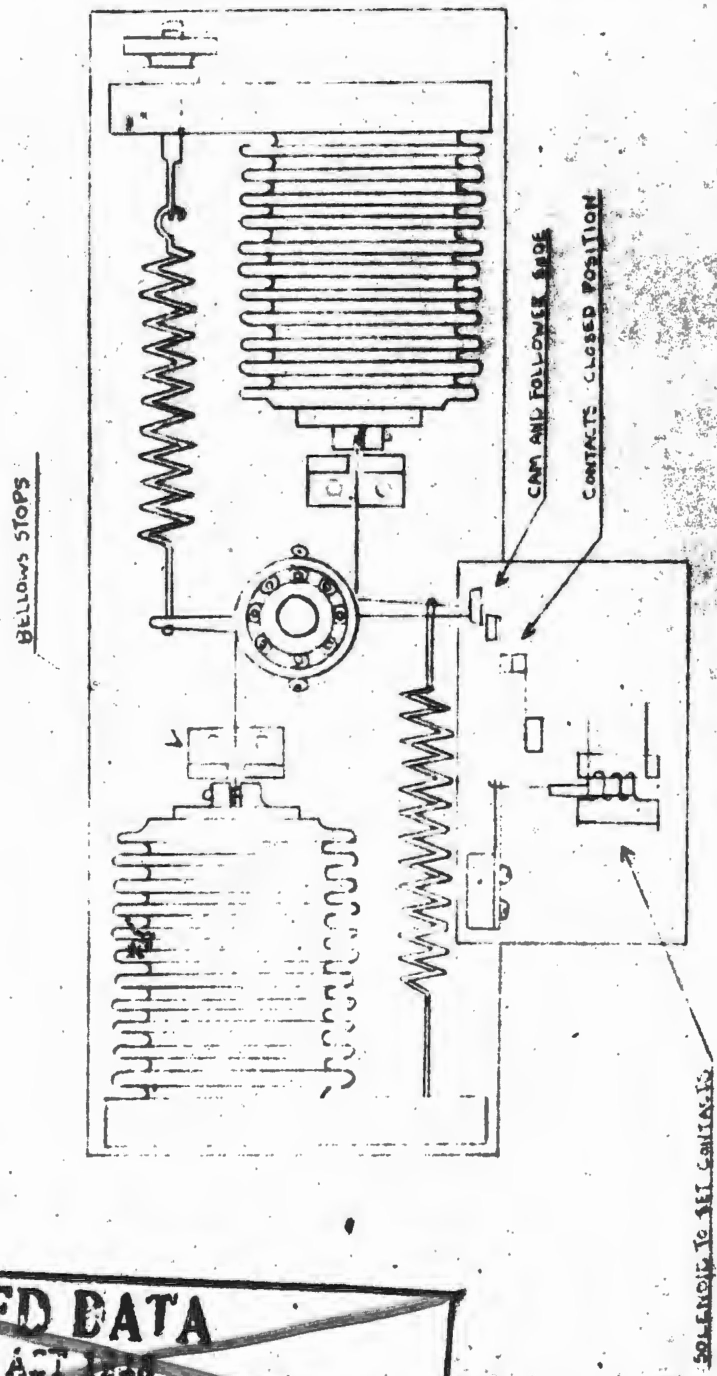
Approx Full Size
LHCorp Dec 13,43
Revised Dec 31,43



PRESSURE SENSITIVE CONTACTOR

RESTRICTED DATA
ATOMIC ENERGY ACT 1946
Specific Clearance Required for all recipients

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RESTRICTED DATA

Special Clearance Required for all ...

C O P Y

MEMORANDUM LABORATORY REPORT
6 January 1944

Subject: Pressure Sensitive Contactor

INERTIA AND VIBRATION EFFECTS (Continued)

The inertia and stiffness of the system are of a satisfactory order. No actual tests have been made to determine the effect of vibration upon the dependability of operation, but it is believed that the contactor system can be designed to prevent any serious effect of vibrations likely to occur.

CAM DISPLACEMENT

With the present model it has been found that the cam travel varies from .013" per 1000 ft. near sea level to .017" per 1000 ft. at an altitude of 8000 ft. Hence a difference of approximately .00015" in the relative setting of the cam step and of the cam follower may result in a deviation of 10 feet in the altitude of release. This accuracy is not unusual for such construction and with proper design the error caused by dimensional variations should be less than 10 feet.

BELLOWS CHARACTERISTICS

No quantitative results are available here concerning the reproducibility or aging characteristics of the sylphon bellows which actuate this mechanism. Carl L. Norden, Inc. experience indicates that excellent uniformity may be expected with careful installation and a "running in" period. Norden uses a fixture for extending and contracting the bellows continuously for eight hours.

BALANCING SPRINGS

The balancing springs are of beryllium copper wire .058" diameter having 9½ turns approximately ½ inch O.D. The springs are so made that a force of one ounce causes an extension of approximately .001". This material is widely used in aircraft instruments. It has unusual freedom from creep under prolonged stress, if the analysis and heat treatment are very carefully controlled.

TEMPERATURE EFFECTS

The selection of metals used for base plate, bellows and springs may be made with regard for their coefficients of expansion, as a means for eliminating temperature effects. As originally constructed, steel springs were employed with an aluminum base plate and bronze bellows. This combination results in an error of several hundred feet when ambient temperature is reduced from 25° C. to something less than 0° C. The residual air or other gas in the bellows causes a temperature effect in the same direction as the use of a steel spring and an aluminum base.

RESTRICTED DATA

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MEMORANDUM LABORATORY REPORT
6 January 1944

Subject: Pressure Sensitive Contactor

TEMPERATURE EFFECTS (Continued)

In the present model, bellows are evacuated to a lower pressure, (approximately 5 mm. Hg.), and the copper spring (with aluminum base) results in only a small temperature effect. Further reduction can be accomplished by selection of base metal and design of spring to balance approximately the temperature effect on air pressure in the bellows.

Temperature compensation will doubtless always be an approximation since varying times of exposure to low temperature will result in differences of temperature of the components of different mass or shape.

METHOD OF TEST

Performance tests were made by placing the contactor under a bell jar, exhausting the air to correspond to the desired altitude and then admitting air to simulate a "dive". Temperature control was obtained by placing the bell jar in a cold chamber. A "Pressovac" pump was used to exhaust the air. Rate of dive was controlled by an improvised sliding valve having a relatively large port area. Pressure (altitude) was measured by means of an optical pressure gauge developed and calibrated at this laboratory. This consists of a small chamber closed by a disk at the periphery of which is an annular flexible membrane. The disk is supported by a stiff spring within the chamber. The recording system consists of a twisted filament of steel which is coupled to the disk and rotated as the pressure on the disk changes. Light-weight mirrors are attached to the filament in a series of angular positions and pressure changes are indicated by this optical lever on overlapping ground glass scales. The gauge was connected to the bell jar by a six foot length of ¼" I.D. rubber vacuum tubing. The contacts of the model were connected into a 110v A.C. circuit with a small neon lamp. A Mitchell motion picture camera operated at approximately 20 frames per second photographed the neon lamp, the ground glass pressure gauge scale and a .01 second stop watch. Only the part of the dive immediately preceding and following the contact break was photographed.

RESULTS OF TESTS

A series of test runs was made as described. Runs No. 1 to No. 5 inclusive were made at room temperature (26°C), and an initial altitude of 8000 ft. The dive rate was regulated by hand using the indication of the sensitive altimeter as a guide. The camera was started at an altitude of about 2500 feet.

MEMORANDUM LABORATORY REPORT
6 January 1944

Subject: Pressure Sensitive Contactor

RESULTS OF TESTS (Continued)

Runs No. 1B to No. 5B inclusive were made after operating the cold chamber for four hours. Temperature within bell jar was then -10°C. Procedure was identical with that employed for room temperature "dives" except that because of low temperature of inlet valve, operation was more difficult and lower "dive" rates resulted.

These runs are plotted on Sheet 6 and data are recorded in Tables I and II, Sheet 7. Since the pressure gauge readings are non linear with respect to altitude, an approximate scale of altitude has been added to the plots on Sheet 6. The dive rates were in the range 600 F.S. to 1100 f.s.

OTHER TESTS

The tests recorded here were preceded by numerous visual and recorded observations. When first assembled and subsequently after each design change, many visual tests were made in which the air pressure was increased very gradually and pressure gauge scale read at the instant of contact make or break as indicated by a neon lamp.

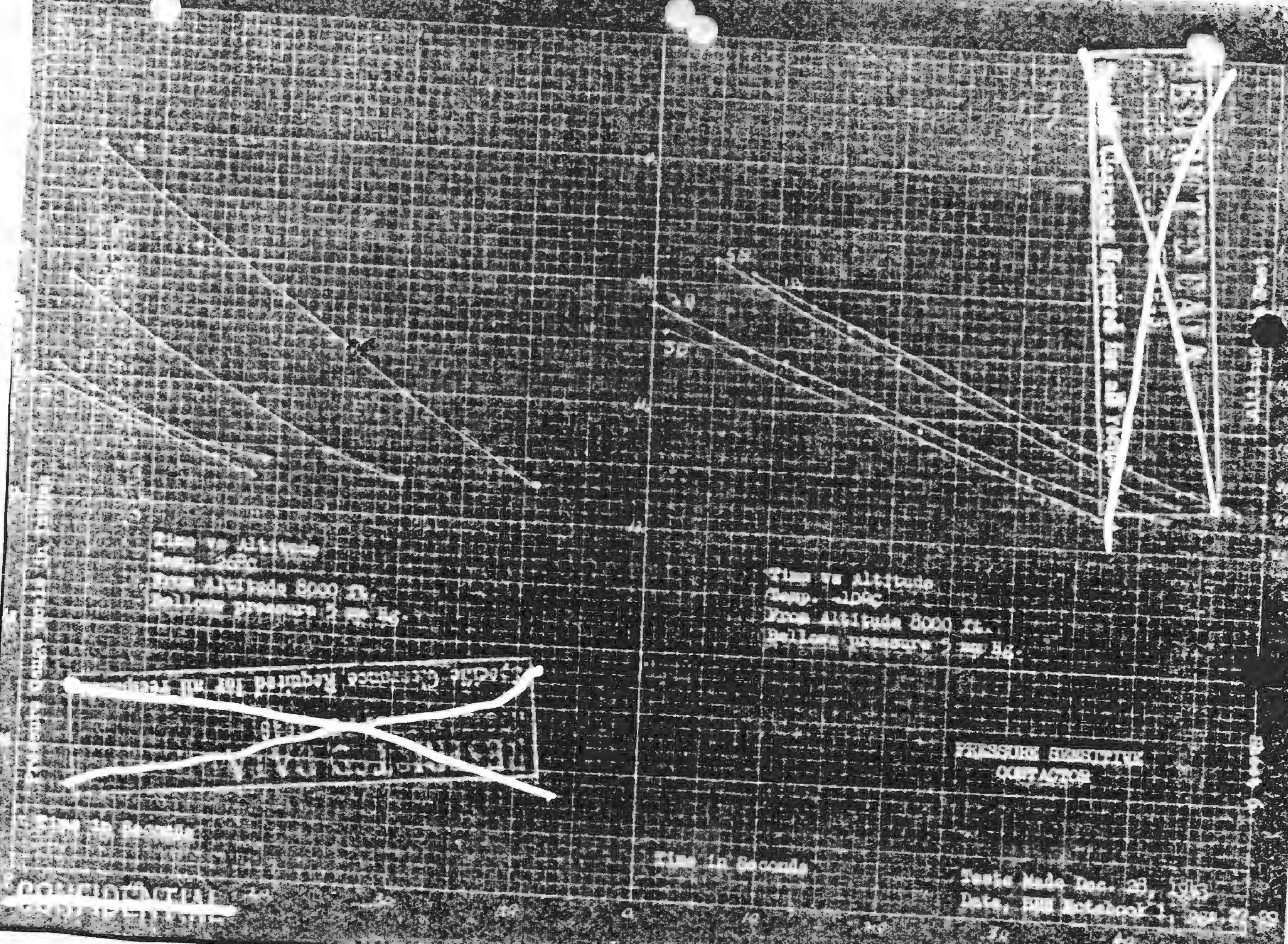
After such tests demonstrated a reasonable expectancy of satisfactory results, motion picture recordings of the type reported on Sheet 6 were made. One such series of dives (at room temperature and dive rates of 450 to 1000 feet per second) was plotted and it was found that all contact "makes" fell within a zone of not more than 70 feet altitude difference. Because construction of the device at that time did not provide proper temperature compensation and since the contacts were arranged to "make" instead of "break" these data are not recorded here.

PRECISION OF RESULTS

It will be noted from the plots that the break occurred in most cases within a span of 25 to 40 feet. The mean variation from a mean position was less than ± 35 feet.

ALTITUDE VALUES

The precision of the altitude data is subject to possible errors of ± 5 feet in reading the pressure gauge scale and possibly ± 5 feet in reliability of the actual reading. The lag of pressure for any given rate of dive in the rubber connecting tube is known to be an unimportant factor, though it was not measured in the present tests. The standard pressure gauge was calibrated for altitude by comparison at several steady pressures with a sensitive altimeter of good quality.


Time vs Altitude
From Altitude 8000 ft.
Bellows pressure
Time vs Altitude
From Altitude 8000 ft.
Bellows pressure
Time in Seconds
Time in Seconds
PRESSURE SENSITIVE
CONTACTOR
Tests Made Dec. 28

TIME INTERVALS IN SECONDS VS. PRESSURE GAUGE SCALE IN INCHES

TABLE I

"Dive" from Approx. 8000 ft. Altitude
Temperature 26°C.

Run No. 1	Run No. 2 P.G. In.	Run No. 2 T. Sec.	Run No. 3 P.G. In.	Run No. 3 T. Sec.	Run No. 4 P.G. In.	Run No. 4 T. Sec.	Run No. 5 P.G. In.	Run No. 5 T. Sec.
Film too light to read	10.9	.02	10.2	.03	9.1	.05	11.0	.00
	11.1	.05	10.7	.10	9.5	.10	11.2	.05
	11.35	.10	11.1	.18	9.9	.13	11.4	.11
	11.5*	.14	11.5*	.24	10.2	.20	11.6*	.15
	11.6	.19	11.7	.30	10.6	.24	11.75	.19
					11.0	.30		
					11.3*	.35		
					11.7	.41		

TABLE II

"Dive" from Approx. 8000 ft. Altitude
Temperature -10°C.

Run No. 1B P.G. In.	Run No. 1B T. Sec.	Run No. 2B P.G. In.	Run No. 2B T. Sec.	Run No. 3B P.G. In.	Run No. 3B T. Sec.	Run No. 4B P.G. In.	Run No. 4B T. Sec.	Run No. 5B P.G. In.	Run No. 5B T. Sec.
9.9	.08	10.2	.0	10.4	.01	Stop Watch Not Running		9.8	.05
10.15	.13	10.4	.05	10.6	.07			10.1	.10
10.4	.19	10.6	.11	10.8	.12			10.3	.16
10.6	.23	10.8	.16	11.0	.18			10.55	.20
10.8	.29	11.0	.21	11.2	.22			10.8	.25
11.05	.33	11.1	.26	11.4	.29			11.0	.30
11.3	.39	11.35	.31	11.6*	.32			11.3	.35
11.5*	.43	11.55*	.37	11.8	.38			11.55*	.41
11.65	.48	11.75	.42					11.87	
								(Following frames too light to read)	

* Indicates last frame in which lamp is glowing (contact break)

1-1-44

MEMORANDUM LABORATORY REPORT
6 January 1944

Subject: Pressure Sensitive Contactor

TIME INTERVALS

There is an uncertainty averaging .01 second caused by exposures being too long to sharply define the second hand of the stop watch. Also the hand of a .01 second stop watch tends to move irregularly, sometimes with jumps of .02 or .03 second at one time. Instances of the latter kind are doubtless the cause of the major deviations plotted on Sheet 6. For any one dive the uncertainty of altitude at a given point is of the order of 15 to 20 feet.

B. R. Haueisen

BRH:aer

APPENDIX A-2a

NO. 2 OF 6 COPIES, SERIES A
[illegible] 1 PAG.

Program for ERL - Bruceton

August 8, 1944

1. Slow cast explosives
   (a) Best compositions (including control of particle size, etc.) of Baronal, Macarite
   (b) Shots in the dark

2. Slow non-cast materials
   (a) Pressed
   (b) Dynamites

3. Casting of composite (lens) charges
   (a) One piece
   (b) Separate charges

4. Cooperation with Yorktown Mine Depot if the latter is ordered to make H. E. for us.

5. Study of all-cast lenses by optical camera.

6. Further study of delaying partitions with emphasis on short delays and thin and light partitions.

7. Spalling studies.

8. Order two duplicates of the rotating drum camera if such can delivered by late November.

9. Emergency and special procurement, such as Primacord, etc.

Memorandum of Substance of a Telephone Conversation of Tolman with Conant, on August 9, 1944, re Program for E.R.L., Bruceton.

A. Information transmitted to Conant

1. A conference was held on August 8, 1944 among Kistiakowsky, MacDougall and Tolman. They agreed on an urgent but rea- sonable program of work at Bruceton involving nine specific items. (See Program for E.R.L., Bruceton, August 8, 1944.)

2. The program would correspond to an annual budget of about $250,000, i.e., one fourth the present total Bruceton budget, would take somewhat more than one half of MacDougall's time, would take the full time of the groups now under Eyster and Messerly, would involve some minor transfers of personnel between groups, and would use about one fourth of the present Bruceton overhead facilities in the way of drafting rooms, shops, procurement services, etc.

3. The introduction of this program would leave Paul's and Westheimer's groups at Bruceton approximately at their present strength for other kinds of H.E. work. This would retain the possibility of continuing the most urgent H.E. testing and development work now underway at Bruceton for the Army and Navy, but would limit the possibility of undertaking new Army-Navy developments which might be requested in the future.

4. In the future it might be possible to increase the total H.E. work at Bruceton to some extent, if the amount of propellant work at the Bruceton site should be decreased, and if per- sonnel and equipment for H.E. work could be obtained to utilize the space thus made available.

5. It is proposed that the program for the work at Bruceton should be determined by Kistiakowsky, in consultation with MacDougall, and with the advice of Conant and Tolman. Kistiakowsky would plan to visit Bruceton about once in six weeks and MacDougall would visit Y about once in six weeks. Occasional visits of Captain Ackerman, Lieutenant Hopper and Neddermeyer to Bruceton might be needed.

6. MacDougall would make preliminary weekly reports of his work to Kistiakowsky and more complete monthly reports to Kistia- kowsky, Conant and Tolman with a copy for the Manhattan Dis- trict.

B. Action to be taken by Conant

7. It was agreed that Conant would discuss this matter with Connor, as Chief of Division 8, and try as soon as possible to secure his approval of the proposed program.

8. It was agreed that Conant would arrange with the Manhattan District to transfer $250,000 to the OSRD for the support of the program for one year starting August 1, 1944. Salaries, travel, procurement and share of overhead at Bruceton for the proposed work would be charged against this transfer and reported to the District at such intervals as arranged.

9. It was agreed that Conant would [illegible] to the NDRC, at the August 11 meeting, that they recommend to the Director of OSRD that this transfer be accepted and be expended on the advice of Conant and Tolman, as a sub-committee reporting financial and administrative arrangements, but not technical progress or results, to the NDRC.

Richard C. Tolman
Richard C. Tolman
Vice Chairman, NDRC

Copies to
Dr. Conant
Dr. Kistiakowsky
Dr. MacDougall
Dr. Oppenheimer
Captain Parsons

~~This document contains information affecting the national defense of the United States within the meaning of the Espionage Act, U. S. C. 50; 31 and 32. Its transmission or the revelation of its contents in any manner to an unauthorized person is prohibited by law.~~

CONFIDENTIAL

August 12, 1944

Dr. Ralph Connor
Chief, Division 8
1703 32nd Street, N. W.
Washington 25, D. C.

Dear Dr. Connor:

This is to confirm my telephone conversation. The NDRC at its meeting yesterday agreed to the following arrangements in regard to the use of approximately one-quarter of the Bruceton facilities for special work by the Manhattan District: The War Department will transfer to NDRC $250,000 for the year; this transfer will make the NDRC that much richer but will not affect the size of the budget of Bruceton. Approximately this amount of money previously budgeted for the HS work will be replaced by the new funds. If the new work expands, whether in terms of personnel or special procurement, it will be possible to have this amount of money increased by direct application to the War Department through the Committee referred to below and not through the usual budgetary controls of NDRC.

The work done at Bruceton under this new arrangement will be the responsibility of Dr. Tolman and myself, and you, as Division Chief, and your Division are relieved of responsibility for either the scientific aspects of the work or the expenditure of the funds transferred in this area. I understand from you that actually Dr. Hammond, the director of the Bruceton Laboratory, will designate to Dr. MacDougall the direction of this work. Dr. MacDougall will in turn keep in close contact with Dr. George Kistiakowsky, now working for the War Department, and these two in turn will from time to time consult Dr. Tolman and myself. Because of the special secret nature of the project, there will be no reports through the usual channels, and as I said before, the usual NDRC mechanisms are relieved of the responsibility for the technical direction.

Very sincerely yours,

Original signed by

Dr. James B. Conant
Chairman, NDRC

cc: Dean Edward L. Moreland
Dr. Richard C. Tolman ✓
Dr. Irvin Stewart

CONFIDENTIAL

August 19, 1944

~~CONFIDENTIAL~~

Dr. James B. Conant, Chairman
National Defense Research Committee
1530 P Street, N. W.
Washington 25, D. C.

Dear Dr. Conant:

This is to acknowledge your letter of August 12, and to signify our approval of the arrangements for the transfer of funds from the Manhattan District to cover experimental work carried out at the Explosives Research Laboratory.

I should like to elaborate further on a few points which I believe we covered in our telephone conversation. Dr. MacDougall and his group will be administratively responsible to Dr. Hammett, Director of the Explosives Research Laboratory. Neither Dr. Hammett nor myself plan to exert any technical direction in this field, but it seems very desirable to have one person who is responsible for administrative details of the entire laboratory. These details will include such things as allocation of mechanical help, assignment of working space, secretarial help, etc. I am sure that in deciding on such matters, Dr. Hammett will bear in mind the high priority of the work which Dr. MacDougall will be doing.

In accounting for the expenditures made on this project at ERL, we shall keep a fairly accurate record of the money spent for salaries and for major items of equipment and supplies. It is my understanding that it will be satisfactory for us to estimate the amount spent for routine equipment and supplies and for services, such as mechanical help and stenographic help and such items which are a routine part of the workings of a laboratory. We shall do this by assuming that if one-fourth of the ERL personnel is engaged on this project, approximately one-fourth of the routine expenditures will be for this specific project

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

Dr. James B. Conant
Page - 2

August 19, 1944

unless special circumstances have obviously altered this proportion.

Very truly yours

R.C.

Ralph Connor
Chief - Division 3

cc: Dr. L. P. Hammett
Mr. [illegible] Roy
Dr. Irvin Stewart
Dr. R. C. Tolman ✓
Dean E. L. Moreland

RC:mc

~~CONFIDENTIAL~~

~~This document contains information affecting the national defense of the United States within the meaning of the Espionage Act, U. S. C. 50: 31 and 32. Its transmission or the revelation of its contents in any manner to an unauthorized person is prohibited by law.~~

[redacted]

EXPLOSIVES RESEARCH LABORATORY

BRUCETON, PENNSYLVANIA

BUREAU OF MINES
CARNEGIE INSTITUTE OF TECHNOLOGY

OPERATING UNDER THE SUPERVISION OF THE
NATIONAL DEFENSE RESEARCH COMMITTEE

Address Reply to
4800 FORBES STREET
PITTSBURGH 13, PA.

Telephone
CARRICK 6900
OLYMPIA 5551

August 24, 1944

Dr. James B. Conant, Chairman
National Defense Research Committee
1530 P Street, N. W.
Washington 25, D. C.

Dear Dr. Conant:

The following arrangements were made at a conference of Dr. Tolman, Dr. D. P. MacDougall and myself with respect to the charges to be made against Project Q for work carried out in this laboratory. These are essentially in agreement with your letter of August 12 to Dr. Connor and with his reply of August 19.

Salaries and travel expenses of personnel working on the project and overhead paid on the basis of these salaries to the Carnegie Institute of Technology will be charged to Project Q.

A separate record of all orders for equipment and supplies amounting to more than $250 will be kept and those items which are to be used on the project will be charged to Project Q.

The remainder of the expenditures of the Explosives Research Laboratory for purchase of supplies and equipment (estimated to be of the order of $5000 per month) will be prorated and an amount charged to Project Q which bears the same ratio to the total sum as the number of the technical staff working on the project does to the total technical staff of the laboratory. Other expenses of the laboratory for such services as transportation, power, telephone, general upkeep and the like will be prorated on the same basis.

A monthly statement showing the amounts against Project Q under each of these categories will be made to you with copies to Dr. Tolman and Dr. Stewart.

Sincerely yours,

Louis P. Hammett

LPH rmm
cc: ✓Dr. R. C. Tolman
Dr. Irvin Stewart
Dr. Ralph Connor

[redacted]

A-2 (7)

APPENDIX A-2b

Explosives Research Laboratory
Bruceton, Pennsylvania

Sums Chargeable to Project 4 for August, 1944

Direct expenses assigned to Project 4

Salaries of personnel in Project 4	$4418
Overhead on C.I.T. salaries included above (3810)	474
Travel expenses of personnel on Project 4	220
Supplies and equipment (Items over 250)	5960

General laboratories expenses

Supplies & equipment total	$27,887	
Items over $250	11,670	
Supplies & equipment to be prorated		16,217
Salaries and wages of guards, office force, maintenance staff, shop		15,399
Communications, power, transportation		1,491
		33,107

Total technical staff	68)		
Staff assigned to Project 4	12)	(33,107 x 12/68	5842

Total sum chargeable to Project 4 for August, 1944	$16914

Louis P. Hammett

~~CONFIDENTIAL~~

Explosives Research Laboratory
Bruceton, Pennsylvania

Sums Chargeable to Project Q for September, 1944

Direct expenses assigned to Project Q

Salaries of personnel in Project Q		$4993
Overhead in C.I.T. salaries included above (4076)		550
Travel expenses of personnel on Project Q		50
Supplies and equipment (items over $250)		3070

General laboratory expenses

Supplies, equipment and upkeep total	$24177	
Supply and equipment items over $250	7749	
Supplies and equipment to be prorated		$16,428
Salaries and wages of guards, office force, maintenance staff, shop		16,279
Communications, power, transporation		1,512
		$34,219

Total technical staff	68)		
Staff assigned to Project Q	13)	(34,219 x 13/68	6542

Total sum chargeable to Project Q for September, 1944 — $15205

LPH

Louis P. Hammett

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Explosives Research Laboratory
Bruceton, Pennsylvania

<u>Sums Chargeable to Project Q for October, 1944</u>

Direct expenses assigned to Project Q

Salaries of personnel in Project Q			
Overhead in C.I.T. salaries included above ($4518)			$5467
Travel expenses of personnel on Project Q			610
Supplies and equipment (items over $250)			225
			680

General laboratory expenses

Supplies, equipment and upkeep total	$20787		
Supply and equipment items over $250	1330		
Supplies and equipment to be prorated		$19457	
Salaries and wages of guards, office force, maintenance staff, shop		18223	
Communications, power, transportation		2034	
		$39714	
Total technical staff 68)			
Staff assigned to (39,714 x 14/68			
Project Q 14)			8177

Total sum chargeable to Project Q for October, 1944 $15159

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Explosives Research Laboratory
Bruceton, Pennsylvania

Sums Chargeable to Project Q for November, 1944

Direct expenses assigned to Project Q			
Salaries of personnel in Project Q			
Overhead in C.I.T. salaries included above ($5095)			$5831
Travel expenses of personnel on Project Q			688
Supplies and equipment (items over $250)			---
			1982
General laboratory expenses			
Supplies, equipment and upkeep total	$19162		
Supply and equipment items over $250	4102		
Supplies and equipment to be prorated		$15060	
Salaries and wages of guards, office force, maintanance staff, shop		17010	
Communications, power, transportation		2845	
		$34915	
Total technical staff 59) Staff assigned to Project Q 14)	(34,915 x 14/59		8285
Total sum chargeable to Project Q for November, 1944			$16,786

LPH

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Explosives Research Laboratory
Bruceton, Pennsylvania

Sums Chargeable to Project Q for December, 1944

Direct expenses assigned to Project Q			
Salaries of personnel in Project Q			\$5831
Overhead in C.I.T. salaries included above (\$5095)			
Travel expenses of personnel on Project Q			688
Supplies and equipment (items over \$250)			225

General laboratory expenses			
Supplies, equipment and upkeep total	\$27571		
Supply and equipment items over \$250	9418		
Supplies and equipment to be prorated		\$18153	
Salaries and wages of guards, office force, maintenance staff, shop		17524	
Communications, power, transportation		1414	
		\$37091	
Total technical staff 59) Staff assigned to Project Q 14)	(37091 x 14/59		8801
Total sum chargeable to Project Q for December, 1944			\$15545

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Explosives Research Laboratory
Bruceton, Pennsylvania

Sums Chargeable to Project Q for January, 1945

Direct expenses assigned to Project Q			
Salaries of personnel in Project Q			$5831
Overhead in C.I.T. salaries included above ($5095)			688
Travel expenses of personnel on Project Q			---
Supplies and equipment (items over $250)			300
General laboratory expenses			
Supplies, equipment and upkeep total	$20415		
Supply and equipment items over $250	7356		
Supplies and equipment to be prorated		$13057	
Salaries and wages of guards, office force, maintenance staff, shop		19244	
Communications, power, transportation		1133	
		$33434	
Total technical staff 59; Staff assigned to Project Q 14	33434 x 14/59		7933
Total sum chargeable to Project Q for January, 1945			$14752

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Explosives Research Laboratory
Bruceton, Pennsylvania

Sums Chargeable to Project Q for February, 1945

Direct expenses assigned to Project Q			
Salaries of personnel in Project Q			
Overhead in C.I.T. salaries included above ($3035)			$5831
Travel expenses of personnel on Project Q			688
Supplies and equipment (items over $4000)			200
			4000
General Laboratory Expenses			
Supplies, equipment and upkeep total	$22996		
Supply and equipment items over $250	9051		
Supplies and equipment to be prorated		$13945	
Salaries and wages of guards, office force, maintenance staff, shop		19195	
Communications, power, transportation		768	
		$33908	
Total technical staff 59) Staff assigned to Project Q 14)	(33908 × 14/59		8046
Total sum chargeable to Project Q for February, 1945			$18765

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Explosives Research Laboratory
Bruceton, Pennsylvania

Sums Chargeable to Project Q for March, 1945

Direct expenses assigned to Project Q			
Salaries of personnel in Project Q			
Overhead on C.I.T. salaries included above ($4861)			$5597
Travel expenses of personnel on Project Q			656
Supplies and equipment (items over $250)			--
			--
General Laboratory Expenses			
Supplies, equipment and upkeep total	$22565		
Supply and equipment items over $250	6075		
Supplies and equipment to be prorated		$16490	
Salaries and wages of guards, office force, maintenance staff, shop		20793	
Communications, power, transportation		5057	
		$42340	
Total technical staff 15) Staff assigned to Project Q 61)	42340 x 15/61		10410
Total sum chargeable to Project Q for March, 1945			$16663

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Explosives Research Laboratory
Bruceton, Pennsylvania

Sums Chargeable to Project Q for April, 1945

Direct expenses assigned to Project Q			
Salaries of personnel in Project Q			
Overhead on C.I.T. salaries included above ($4861)			$5597
Travel expenses of personnel on Project Q			656
Supplies and equipment (items over $250)			---

General Laboratory Expenses			
Supplies, equipment and upkeep total	$29933		
Supply and equipment items over $250	18061		
Supplies and equipment to be prorated		$11872	
Salaries and wages of guards, office force, maintenance staff, shop		19252	
Communications, power, transportation		1094	
		$32218	
Total technical staff 61) / Staff assigned to Project Q 15)	(32218 x 15/61		7922
Total sum chargeable to Project Q for April, 1945			$14175

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<u>Sums Chargeable to Project Q for May, 1945</u>

Direct expenses assigned to Project Q			
Salaries of personnel in Project Q			
Overhead in C.I.T. salaries included above ($2430)			$3166
Travel expenses of personnel on Project Q			328
Supplies and equipment (items over $200)			---
			400
General Laboratory Expenses			
Supplies, equipment and upkeep total	$29049		
Supply and equipment items over $250	4879		
Supplies and equipment to be prorated		$24170	
Salaries and wages of guards, office force, maintenance staff, shop		20461	
Communications, power, transporation		1699	
		$46330	
Total technical staff 51) / Staff assigned to Project Q 7.5)	(46330 x 7.5/51		6813
Total sum chargeable to Project Q for May, 1945			$10707

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Explosives Research Laboratory
Bruceton, Pennsylvania

Sums Chargeable to Project Q for June, 1945

Direct expenses assigned to Project Q			
Salaries of personnel in Project Q			$ 938
Overhead in C.I.T. salaries included above			141
Travel expenses of personnel on Project Q			---
Supplies and equipment (items over $200)			---
General Laboratory Expenses			
Supplies, equipment and upkeep total	$37018		
Supply and equipment items over $250	6456		
Supplies and equipment to be prorated		$30562	
Salaries and wages of guards, office force, maintenance staff, shop		20422	
Communications, power, transportation		2712	
		$53696	
Total technical staff 51; Staff assigned to Project Q 3	53696 x 3/51		3158
Total sum chargeable to Project Q for June, 1945			$4237

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MANHATTAN DISTRICT HISTORY

BOOK VIII, LOS ALAMOS PROJECT (Y)

VOLUME 3, AUXILIARY ACTIVITIES

CHAPTER 9, SUPPLEMENTARY ACTIVITIES

APPENDIX B

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3. Memorandum by Dr. M. G. Holloway, dated 9 May 1947, "Work done at Purdue on the Measurement of the Deuterium Tritium and Helium 3 Deuterium Cross Sections". Manhattan District History files.

4. Final Reports (LAMS 2 and LAMS 11). Document Room, Los Alamos Laboratory.

5. Letter from Lt. E. Truslow, Los Alamos Laboratory, dated 3 April 1947. Manhattan District History files.

6. "Manhattan District Project Cost Summary for the period ending June 30, 1947", page 13. AEC files.

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