FILE NO. 6-113

TITLE Nike Explosion, Middletown, New Jersey

CLOSED 9/25/59

RECEIVED - June 5, 1958
ASSIGNED - Tom Egan
REASSIGNED -
Honorable Henry M. Jackson  
United States Senate  
Everett, Washington  

Dear Senator Jackson:

In reply to your letter of 8 August concerning the establishment of an independent committee to review the safety measures which have been taken in connection with the deployment and storage of warheads for NIKE HERCULES, I should like to bring you up to date on the status of the committee.

I formally established such a committee on 20 August 1958, and sent letters immediately thereafter to six distinguished and public spirited citizens representing science, industry, and organized labor. The mission of this committee will include but not be confined to the safety measures for NIKE HERCULES warheads. I have charged it with reviewing the adequacy of safety measures for all Army air defense systems in the United States, both now deployed and those to be deployed in the future as soon as the systems have been developed sufficiently that such a review is meaningful. I have designated this committee as the Committee on Safeguards for Army Air Defense Weapons.

The committee will meet during the period October 6-10, 1958, to review the safeguards of the NIKE systems. The findings and recommendations to be reported to me will include -- but not necessarily be limited to -- those concerning:

a. Safety features of the warheads.  
b. Standard operating procedures.  
c. Procedures employed during transit of missiles and warheads.  
d. Safety features of the missile systems.  
e. Command controls.

It is anticipated that most of the committee's report will be unclassified and that its findings will serve to strengthen the American public's confidence in the Army's air defense units. Accordingly, the Department of the Army plans to publicize widely the unclassified portion of the committee's report. Copies of these releases will be furnished you if you so desire.

Some of the persons invited found it impossible to accept due to a very heavy schedule of previous commitments, however, the following have accepted and form the present composition of the committee:

Mr. Clifford F. Hood, President of United States Steel Corporation, Chairman  
Mr. Charles A. Cary, member of the Board of Directors, DuPont de Nemours Co., member  
Dr. Charles C. Lauritsen, Professor of Physics, California Institute of Technology, member
Dr. W. P. Yant, Director of Research, Mine Safety Appliance Company, Member
Mr. Milton Karr, Assistant Chief Engineer, Consolidated Western Steel Division,
United States Steel Corporation, Technical Advisor to the committee

I feel that this committee which you have suggested can do a great service
to the Army and the United States.

Sincerely yours,

/s/

Wilber M. Brucker
Secretary of the Army
Safety System Set Up
In Wake of Nike Blast

United Press International

The Army has set up an independent civilian committee to review safety precautions for its air defense weapons, Sen. Henry M. Jackson disclosed yesterday.

The Washington Democrat made public a letter from Army Secretary Wilber M. Brucker stating that the committee was established in August. Jackson had proposed formation of such a panel after six enlisted men and four civilians were killed by an explosion at a Middletown (N.J.) Nike installation last May.

Jackson had suggested a committee to review safety aspects of Nike air defense systems.

But he added that he has charged the new group "with reviewing the adequacy of safety measures for all Army air defense systems in the United States, both now deployed and those to be deployed as soon as the systems have been developed sufficiently that such a review is meaningful."

Brucker said the committee—to be known as the Committee on Safeguards for Army Defense Weapons—will meet next week, Monday through Friday, to review safeguards for the Nike defense systems.
August 8, 1958

Dear Mr. Secretary:

Many thanks for your letter of August 5, 1958, concerning the NIKE explosion at Middletown, New Jersey. I am impressed with the prompt action which you have taken to establish an independent committee to review the safety measures which have been taken in connection with the deployment and storage of warheads for NIKE-HERCULES.

I am very much interested in this independent committee, and will await the final action of your office after appropriate implementing directives have been prepared.

Sincerely yours,

Henry M. Jackson
Acting Chairman

Honorable Wilber M. Brucker
Secretary of the Army
Washington 25, D. C.

6-113-19
Honorable Henry M. Jackson

United States Senate

Dear Senator Jackson:

The proceedings of your committee hearing on the unfortunate NIKE explosion at Middletown, New Jersey, have been brought to my attention.

Please be assured that I fully understand the Subcommittee's desire both to inquire into the cause of the accident and to be assured that every possible safety measure has been taken to prevent a recurrence. May I add that I deeply appreciate the manner in which you, as Chairman, and the other members of the Subcommittee conducted the hearing.

You have suggested that an independent committee, composed of personnel outside of the Department of Defense and including scientists and representatives of industry, be appointed to review the safety measures which have been taken in connection with the deployment and storage of warheads for NIKE-HERCULES. I heartily agree with you, and have directed my staff to prepare appropriate implementing directives for my consideration. I shall be most happy to inform you of the final action.

Sincerely,

Wilber M. Brucker
Secretary of the Army
Honorable Henry M. Jackson
United States Senate

Dear Senator Jackson:

The proceedings of your committee hearing on the unfortunate NIKE explosion at Middletown, New Jersey, have been brought to my attention.

Please be assured that I fully understand the Subcommittee's desire both to inquire into the cause of the accident and to be assured that every possible safety measure has been taken to prevent a recurrence. May I add that I deeply appreciate the manner in which you, as Chairman, and the other members of the Subcommittee conducted the hearing.

You have suggested that an independent committee, composed of personnel outside of the Department of Defense and including scientists and representatives of industry, be appointed to review the safety measures which have been taken in connection with the deployment and storage of warheads for NIKE-Hercules. I heartily agree with you, and have directed my staff to prepare appropriate implementing directives for my consideration. I shall be most happy to inform you of the final action.

Sincerely,

(signed) Wilber M. Brucker
Secretary of the Army.
July 24, 1953

Senator Francis Case
United States Senate
Washington 25, D. C.

Dear Senator Case:

Senator John L. McClellan has appointed me Acting Chairman of the Senate Permanent Subcommittee on Investigations. On Wednesday, July 24, 1953, the Subcommittee will hold an executive session, starting at 10:00 a.m. in room 357, on the NIKE explosion in Middletown, New Jersey. At this time the Army will brief us on the results of their investigation of this explosion. It is anticipated that the briefing and questioning will consume approximately one and a half hours.

You are cordially invited to be present at this session, with the right to examine any witnesses, as I know you are very much interested in this subject matter. I am also extending a similar invitation to Senator Stennis.

Sincerely yours,

Henry M. Jackson
Acting Chairman
July 24, 1958

Senator John Stennis
United States Senate
Washington 25, D. C.

Dear Senator Stennis:

Senator John L. McClellan has appointed me Acting Chairman of the Senate Permanent Subcommittee on Investigations. On Wednesday, July 30, 1958, the Subcommittee will hold an executive session, starting at 10:00 a.m. in room 357, on the NIKE explosion in Middletown, New Jersey. At this time the Army will brief us on the results of their investigation of this explosion. It is anticipated that the briefing and questioning will consume approximately one and a half hours.

You are cordially invited to be present at this session, with the right to examine any witnesses, as I know you are very much interested in this subject matter. I am also extending a similar invitation to Senator Case of South Dakota.

Sincerely yours,

Henry M. Jackson
Acting Chairman
WITNESS SHEET

On May 22, 1958, 8 Ajax Nike missiles exploded at Middletown, New Jersey, launching base killing 9 men and injuring 3 and showering 24 live but non-atomic warheads over a wide area.

The Army conducted an investigation and concluded, "That the most probable cause of the explosion was the crushing or rupturing of a detonator cap." There was no evidence of gross carelessness, smoking, inattention to operations or any other possible cause such as sabotage.

The Army investigative file consists of approximately 225 pages. Army officials this morning will brief the Subcommittee on the results of its investigations and the various recommendations that have been put into force.
Army to Install Hercules On D. C. Defense Sites

Contracts awards totaling nearly $2 million have been made to convert Washington-Baltimore Defense Area Nike sites from Ajax to Hercules missile capability, the Army Engineer Corps announced today.

The awards were among $17 million let in the past month by Col. George B. Sumner, District Engineer of the Washington area for the Army Engineer Corps.

The conversion to Nike Hercules will take place at four separate installations. Hercules with its 100-mile range and atomic warhead capacity is considerably more potent than Ajax which has been protecting the Nation's population centers for the past few years.

The change-overs throughout the country originally were slated for completion by last month. An explosion at a Nike site in New Jersey earlier this year delayed the project until an investigation could be made.

Conversion of each installation is expected to require about one year.

A total of four contracts were let to three builders to proceed with the Nike conversions here: Grunley, Walsh & Blanche, Inc., of Washington; Thomas W. Yoder Co., Inc., of Bethesda, and Malan Construction Co., of New York.

Largest single contract award announced by Col. Sumner was $9.8 million to build 616 family dwellings for personnel at Fort Belvoir. The proposed location of these so-called Capehart homes within sight of historic Woodlawn Mansion has aroused the protest of the Mount Vernon Ladies' Association and the Virginia congressional delegation.

Other contracts include construction of nurses' quarters and bachelor officers' quarters and airport runway lighting also at Fort Belvoir, $398,500; air conditioning of the main hospital and changes in the electrical distribution system at the Walter Reed Army Medical Center, $3.3 million; replacement of heating and air-conditioning equipment at Army Map Service, $433,500, and an enlisted men's club and recreation center at Vint Hill Farms Station, located near Manassas, Va., $237,000.
FUELING THE NIKE—Warrant Officer Jack Jacobs (center) shows National Guardsmen how to fuel the Nike antiaircraft missile. The Guardsmen are (left to right) Pvt. William Jackson, 19; Pvt. Roy Bargeron, 22; Specialist 3/c Roland Smith, 20; Specialist 3/c Elmer Hershberger, 21; Pfc. Carl Saperstein, 23, and Corpl. Walter Leibson, 23. Pvt. Bargeron's "space suit" protects him from the highly dangerous acid fuel.

Middle East Crisis Seen as Grim Reality
To Guardsmen Learning Nike Fire

By RICHARD O'LONE
Star Staff Writer

The Middle East crisis is providing a note of grim reality for District National Guardsmen learning to operate Washington's last line of air defense—the Nike batteries.

For nearly two weeks members of the 340th and 380th Missile Battalions have been stationed at Nike sites in nearby Maryland, learning from Regular Army experts how to fire the slender, deadly antiaircraft missiles.

Eventually, after more advanced training, these units will take over some Nike sites on a full-time basis, and will operate...
Advanced training, these units will take over some Nike sites on a full-time basis, and will operate the Hercules missile—a nuclear weapon slated to replace the present Nike-Ajax.

This unique training procedure represents the battalions' switch to missiles from the nearly obsolete 90-mm. anti-aircraft guns.

Their 15-day training period began just a few days before United States Marines swarmed ashore in Lebanon.

One-Hour Alert

On at least one Nike site, the citizen-soldiers—about one-fourth of them teen-agers—were learning their vital duties while the Regular Army instructors were on a 1-hour alert.

This, according to the commanding officer of the Mount Calvert site, Capt. John Jordan, means he must be ready to fire on one hour’s notice.

Capt. Jordan pointed out he can fire in a lot less than one hour, but the alert status meant that none of his personnel could go home if they lived more than an hour's drive from the site.

Capt. Thurston Lonning, 39, of 1906 N street N.W., is in command of the Guardsmen training at Mount Calvert site, located in Croom, Md., amid rolling tobacco fields about 18 miles from Washington.

He said he was sure his men, of the 380th Battalion, were aware of how critical the world situation is.

Know Importance of Job

"The only way I can describe my men is to say they are dedicated," he said. "They know how important their job is. It costs them time and money. Some of them give up their vacations for it."

When the National Guard takes over the Nike sites, he said, one group will remain on active duty at all times, and the others will spend their weekly training periods at the posts.

The commanding officer of the 380th is Lieut. Col. Andrew G. Conlyn, of Vienna, Va., an assistant Corporation Counsel for the District. He said he is pleased with the progress his men have made.

"I think some of them got a little jittery about going on active duty last week," he said, grinning. "But I don't think we'll have to go yet."

For three more days, sirens will wail across the Maryland countryside as Guardsmen drill and drill again.
MEMORANDUM

July 22, 1958

TO: Donald O'Donnell
FROM: Tom Egan
SUBJECT: NIKE Explosion

The Army investigative file concerning the NIKE explosion at Middletown, New Jersey, was reviewed by the writer on July 11, 1958. The file, which consisted of 227 pages of testimony, 4 pages of findings, 2 pages of recommendations, and exhibits and photographs, is substantially the same material that was provided by the Army on July 2, 1958, or covered in the writer's memorandum concerning his visit to Middletown. The highlights of the file will be set out.

Under the caption "Findings" the following points were listed:

(1) The explosion occurred at 1350 on May 22, 1958.

(2) There were three main but separate operations in progress at the time of the explosion:

(a) The battalion was preparing to go from a three-hour state of alert to a 15-minute state of alert.

(b) Two ordnance civilians were replacing a defective hydraulic operating cylinder under the erecting arm of launcher #3 of Section A.

(c) Three ordnance civilian and three enlisted men were doing modification work at Section A.

(3) The missiles above ground at the time of the explosion were seven in Section A, four in Section B, and three in Section C.

(4) Eight missiles were destroyed and two others were damaged. Of the eight missiles which were destroyed, seven were above ground in Section A and one in Section B.

(5) The report lists the names of the injured persons.

(6) The battalion was preparing to go into the 15-minute state of alert. This has been ruled out as a possible cause of the explosion.

(7) The replacement of the hydraulic operating cylinder on launcher #3 of Section A was ruled out as the cause of the explosion.
(8) Missile #5 was the first missile to explode:

(a) The rail upon which Missile 5 was resting was deformed and displaced rearward as a result of the explosion, and prior to being damaged by the blast from either the right or left side.

(b) Missile #4 was perforated by fragments from the center warhead of Missile #5.

(c) Missiles 2 and 4 were perforated by fragments from the right.

(d) Missiles 6 and 7 were perforated by fragments from the left.

(e) Launching and handling rail of Missile 6 was damaged prior to the damage of the warhead of #6 Missile.

(9) PETN (letter designation for the fuel used to detonate the missiles) relay cap in Missile #5 was first to explode.

(10) It cannot be determined if this relay cap was caused to detonate by personnel.

(11) Rupture of the #5 PETN relay cap set off the explosion.

(12) The most likely cause of the explosion:

(a) Excessive tightening of the detonating cord coupling nut. That is, the nut was more than finger tight.

(b) Use of string soldering wire or aluminum wire around detonating cord lead sleeve next to the collar of the detonating cap. This would have been done in order to make the PETN relay cap fit more snugly.

(c) Scraping, crushing, etc. of the PETN relay cap caused the rupture of the cap.

(13) There was no smoking, skylarking, etc. as the cause of the explosion.

(14) Center warhead of Missile #4 was on the ground and forward of the noses of Missiles 6 and 7.

(15) Missiles 1 and 3 which were launched were perforated before they launched.

(16) Missile #4 in Section B launched; the cause is not determinable.
RECOMMENDATIONS

(1) The personnel handling the NIKE Ajax strictly complied with authorized procedures.

(2) The number of live missiles above ground was limited by the Commanding General of the U. S. Army Air Defense.

The investigative team was composed of:

(1) Colonel Robert W. Hain.
(3) Captain John E. Hunt.

The personnel interviewed concerning the explosion are as follows:

(1) First Lt. Thomas H. Casey. He had visited the area about ten minutes prior to the explosion.

(2) First Lt. Robert F. Daly. He was Commanding Officer. It is his opinion that the explosion was caused by rupture of the primer cord.


(5) Specialist 3/c Eldridge L. Newell. Was at Section C at the time of the explosion and claims to have heard a sharp "crack."

(6) Third Class Hubert Allen DeWitt.

(7) Third Class Martin J. Wenzel.

(8) CWO Harry A. Ross. Conducting command calibration.


(10) CWO Edward V. Trittenback.

(11) Specialist 3/c Joel T. Wuesthoff. In the Battery control tractor.

(12) Colonel R. C. Costabile. Ordnance Corp, Chief, Intelligence, Safety and Security Office. Costabile was the supervisor of the technical experts investigating the explosion.

(13) CWO Edward J. Walsh. In charge of civilians.

Lt. Colonel Robert H. Holmes.

Pfc. M. J. Vamas.

J. M. Walsh, civilian, left the area at 1:05.

Major W. H. Colebrand. Furnished logistical support and was part of the technical investigating team.

SFC. R. A. Becton.

CWO C. F. Henken, Jr. of Ft. Hancock, N. J. Described the modifications previously made on other missiles.

WO G. G. Sieger.

Specialist Second Class J. H. Krum.

John A. Batly, Chief of Safety Branch and Chief of Ordnance.

During the briefing by Major Thomure, Director of Air Defense, Office of ODCSOPS, he mentioned an unauthorized procedure. The unauthorized procedure was that the end of the primer cord, which has the relay detonator cap attached to the warhead to a finger-type strength, may have had a washer added to it so that the cap would fit more snugly. A number of missiles which were first produced did not have this washer at the neck of the primer cord. The personnel, while working with the NIKES, developed a habit of using soldering wire or other material to make a soft washer. It was pointed out that this is not considered a dangerous procedure, but it has never been adopted by the Army. Thomure indicated that it was remotely possible that the aluminum cap which contained the PETN may have ruptured and spilled into the connection so that when the primer cord was inserted and tightened more than finger tight it could possibly have caused the rest of the cap to explode, and thus result in the chain reaction which would cause the missile to launch. The Ordnance Department believes that this possibility as a cause of the accident is very very remote, but is being fully studied by Ordnance.
MEMORANDUM

TO: Donald O'Donnell
FROM: Tom Egan
SUBJECT: Nike Explosion, Middletown, N. J.

On July 11, 1958, a briefing concerning the Nike explosion at Middletown, New Jersey, was presented at the Pentagon. Present during this briefing were Major General Theimer, Director, Air Defense, DCSOPS; Brig. General Duff, formerly in charge of the Nike sites in the New York area and presently assigned to the Pentagon; Colonel Constabile, Office of the Chief of Ordnance and also a member of the investigating team; Colonel Johnson, Army Legislative Liaison; Major Thomure, DCSOPS, who presented the briefing; Major Giddings, DCSOPS; Major Metzler, Office of Chief of Ordnance; Mr. Bately, Office of Chief of Ordnance, and also a member of the investigating team; Mr. Duncan, R & D expert, Office of Chief of Ordnance; General C. C. Penn, Army Legislative Liaison; Donald O'Donnell; James N. Juliana; and the writer.

The briefing concerned itself with technical information concerning ordnance and the Nike missile. The summary of the investigation, as forwarded to the Subcommittee by the Army, covers the points of the briefing.

Subsequent to the briefing, the above-named persons joined Secretary of Army Brucker in an informal conference in his office. Brucker expressed his views that a public hearing in this matter would be detrimental to the security program of the United States as it would cause undue fear to be created in the populous of the United States which could possibly destroy the Nike program. He further pointed out that he did not feel that an executive session should be held in this matter as no purpose could be accomplished; that an accident has occurred, the cause of which will probably never be ascertained. He felt that if the executive session were to go into the merits of the cause of the accident, there could possibly be a leak which could also be detrimental to the security of the United States. Brucker further stated that he feels that the Congress is always entitled to information they seek from the Military, and that in this case, if the Subcommittee felt it desirable, that perhaps the best type of hearing to have would be an executive hearing in the form of a briefing, as was conducted today so that the Senators might be appraised of the Nike technicalities.
Mr. Donald F. O'Donnell  
Permanent Subcommittee on Investigations  
Committee on Government Operations  
United States Senate  

Dear Mr. O'Donnell:

Reference is made to your verbal request for a detailed report of the results of the investigation which was conducted in connection with the explosion which occurred on May 22 at Battery B of the 526th AAA (NIKE) Missile Battalion at Middletown, N. J.

The report of the investigation has been received and the following detailed summary has been especially prepared to meet the requirement of your Subcommittee:

On 22 May 1958 an explosion occurred at Battery B of the 526th AAA (NIKE) Missile Battalion at Middletown, New Jersey. It resulted in six enlisted men of Battery B of the 526th AAA (NIKE) Missile Battalion, and four Department of Army Ordnance civilians being killed. One warrant officer, since returned to duty, of Battery B of the 526th AAA (NIKE) Missile Battalion, and one Department of Army Ordnance civilian were seriously injured. The launching equipment of one of the three sections was damaged and eight missiles were destroyed or partially destroyed.

At the time of the explosion, three separate activities were taking place in the vicinity of the explosion. The battery personnel were checking missiles in preparation for going on a higher state of alert. This check is known as "Command Calibration", and is an operation that must be performed at least weekly and normally is done each time the battery reverts from a "three hour alert status" to a "15-minute alert status". This requires missiles in each section to be brought above ground and raised to firing position. The missile tracking radar is then beamed toward each of the missiles in turn, and command steering signals are sent from the radar to each missile. Men on the ground near the missile observe the movement of the fins and report back the order received by the missile.

The second activity involved repair of launcher Number Three in Section A by an Ordnance team composed of two civilians. This operation consisted of unbolting the old hydraulic erecting arm piston assembly and
replacing it with a new one. This is a simple operation and requires no electrical tools, welding tools or other heat producing agents. There was no missile on the launcher being repaired.

The third activity was an authorized field modification to the missiles of this Battery by another Ordnance team of three civilian employees. This modification involved the replacement of the two T93E8 safety and arming devices on each missile with the H30A1 safety and arming device, a part of the warhead system. The NIKE AJAX warhead system includes three warheads; one in the nose, center and aft sections of the missile.

In preparation for this modification, the NIKE battery personnel brought a missile above ground and placed it on the end of a launching rack. They then removed the center warhead, the nose section, which contains a warhead, and the explosive gear. To remove these items it was necessary to remove the center and aft hatch-covers and some of the tunnels. The Ordnance personnel then removed the two old safety and arming devices, drilled holes for the brackets of the new devices, and had installed one of the brackets when the explosion occurred. The battery personnel would then have connected the electrical connections to the safety and arming device plate assemblies, replaced the hatch-covers and tunnels, and plugged in the new devices into its plate assembly to complete the operation.

The Board of Officers appointed to investigate the explosion also determined as part of their findings that:

a. The activities of the battery personnel in connection with preparing to go to a 15-minute state of alert (Command Calibration) were not the cause of the explosion.

b. The activities of the two Ordnance civilian employees in connection with the replacement of the hydraulic piston assembly on launcher Number Three of Section A were not the cause of the explosion.

First reports of the incident explained that missiles in the battery area were being modified and a new device was being installed on the missiles. This is the authorized modification explained above. It was thought at first that something connected with this modification may have caused the accident. Thorough consideration of all evidence revealed that, although the explosion was initiated in the area where the modification was being performed, there was no evidence that the device being installed in the missile could have caused the accident. After a thorough study by the Army Ordnance agencies as to the procedure for performing the modification, work will be resumed to complete the task of installing this device on all of the AJAX missiles. This modification has already been performed on about 1000 missiles throughout the country and on about 125 missiles by the Fort Wadsworth Ordnance personnel. At the time of the explosion, there
were three missiles in both Sections A and C, and four missiles in Section B above ground being "Command Calibrated". In addition, four missiles were above ground on the right end of Section A where the modification work was being accomplished. Thus, 14 missiles were above ground in the battery. Three men were above ground in Section C, two below ground in Section B, two below ground in Section A, and 11 above ground in Section A.

During the course of the investigation, the Board interviewed 22 different witnesses. These included all persons available that might have contributed information as to the cause of the accident. These witnesses include:

a. Two enlisted men, below ground in Section A at the time of the explosion in Section A.

b. Three enlisted men, above ground in Section C, about 375 feet away from Section A.

c. Three men, including the Battery Commander, in the battery missile assembly and service building, about 225 feet from Section A.

d. Two men, including the Launching Platoon Leader, in the launching control trailer which is located in the launching area.

e. The Battery Clerk, in the Battery Orderly Room which is located in the launching area.

f. Four men, in the battery control area, which contains the radar and is located several thousand yards south of the launching area.

g. One Ordnance civilian that had been working in the launching area just prior to the explosion and was near the exit gate at the time the explosion occurred.

h. The doctor that attended the injured Ordnance civilian that was working in Section A at the time of the explosion.

i. Two officers from Fort Wadsworth, New York. Fort Wadsworth Ordnance Shops supplied the Ordnance technicians that were performing the authorized modification work at the time of the explosion.

j. One Ordnance Officer from the Department of the Army that supervised an Ordnance technical investigation team also assigned to investigate the cause of the explosion.

k. One member of the Ordnance search teams that searched Middletown for debris from the explosion.
1. One warrant officer from Battery A of the same battalion. This Battery previously had missiles modified by Ordnance teams from Fort Wadsworth.

A resume of the testimony of these persons revealed the following:

a. The two men below ground in Section A heard a terrific explosion followed in about 10 seconds by a second explosion.

b. The three men in Section C also heard two explosions. Two of these men in Section C could contribute nothing to the findings. One man in Section C had just returned from Section A, and had been working with the team making the authorized modification. He gave the latest and best information concerning the activities that were taking place in the vicinity of the explosion. However, nothing in this man's testimony could assist in a final determination as to the exact cause of the explosion.

c. The Ordnance civilian that was seriously injured in the explosion was questioned through his doctor. Even though this man was working within a few feet of the missile that apparently exploded first, he could not contribute to the findings as to the cause. His actions did verify the interval between explosions because he had time to run a considerable distance between the time of the first and second explosion.

d. None of the other witnesses were eye-witnesses to the explosion nor could they contribute more than background data.

e. In addition to the testimony of the witnesses listed above, the Board considered all information that was available from the representatives of the many Army Ordnance agencies; Bell Telephone Labs, Western Electric Corporation, the prime contractor; and Douglas Aircraft, the manufacturer of the missile.

The Board, when not in formal session examining witnesses, spent considerable time going over the wreckage in the launcher area, considering every conceivable hypothesis as to the exact location and cause of the action which initiated the explosions which comprised the accident and consulting at length with experts in fields pertinent to the problem.

The Board concluded that the most probable cause of the explosion was the crushing or rupturing of a detonating cap. Further, there was no evidence of gross carelessness, smoking, inattention to the operations, or any other possible cause such as sabotage.

Actions taken by the Commanding General of the United States Army Air Defense Command since the explosion include a revision of his Tactical Standing Operating Procedures Guide. This revision includes instructions with regard to missile movement and locations for various operations to include practice alerts, inspections, demonstrations, modifications, testing and maintenance. The procedures to be outlined in detail in the revised
The guide will provide for:

a. Limitations on the number of missiles which may be above ground at any one time when conducting section training, training evaluation or command calibration.

b. Upon receiving notice of an impending engagement, sufficient missiles to meet the immediate threat would be brought above ground.

c. If operations other than as specified above are performed on a ready missile (live missile) there will be only one missile above ground.

Immediately after the explosion occurred, the Department of the Army promptly sent teams to Middletown to assist in processing all claims for damages to property resulting from the explosion. It was found that all serious damage resulting from the explosion was confined to the area immediately adjacent to the point of the explosion and within the battery boundaries. Damage outside the battery was limited to broken glass and cracked plaster. Debris from the explosion was found at some distance from the Battery, but fortunately caused little damage. One piece of booster body and missile boat-tail section was found 1/4 miles north of the site near the town of Belford. Two miles further north and presumably from the same missile was an aft warhead, unexploded. Two miles west of the site a piece of unburned booster propellant was found. A small nose warhead was returned to the Battery. The location where this was found is not known. All other missile debris was confined to the launching area. As far as can be determined, all warheads that were part of the eight missiles that were destroyed have been accounted for.

A report as of noon, 25 June 1958, on the extent of the claims made by the residents of Middletown, revealed that 98 claims have been submitted. Of these 98 claims, 95 have been approved and three are still being reviewed. The total amount of the damages for the 98 claims is $13,711.05. The amount claimed on the 95 cases that have been approved, is $12,706.70. The amount that has been approved for payment for these claims is $12,115.05. Two of the claims include both secondary bodily injury, (i.e., sprained ankle while running), and property damage, and amount to about $947 and $300 respectively, and therefore indicate very minor injuries. The average amount of each of the 95 claims is about $140 each.

The Battery remained operative in spite of the explosion. It can take its place in the defense of the New York City area at any time. Army Engineers are rapidly repairing the damage and will return the site to its original condition in a short time.

After careful considerations of all the evidence, the Board concluded that the most probable cause of the explosion was the crushing or rupturing
of a detonating cap. Corrective actions have been taken to prevent a recurrence.

There is inclosed a brief statement which it is contemplated will be used by the Army on which to base a press release and to answer inquiries from the press. It is believed that this inclosure will be of assistance in the event the Subcommittee receives public inquiries on the subject.

Sincerely,

[Signature]

For and in the absence of  

J. H. MICHAELS  
Major General, GS  
Chief of Legislative Liaison

J. E. BASTION, Jr.  
Brig. General, GS  
Deputy Chief of Legislative Liaison

Attachment
FACT SHEET

SUBJECT: NIKE Explosion at Middletown, New Jersey, 22 May 1958

1. On 22 May 1958 an explosion occurred at Battery B of the 526th AAA (NIKE) Missile Battalion at Middletown, New Jersey. It resulted in six enlisted men of Battery B of the 526th AAA (NIKE) Missile Battalion, and four Department of Army Ordnance civilians being killed. One warrant officer, since returned to duty, of Battery B of the 526th AAA (NIKE) Missile Battalion, and one Department of Army Ordnance civilian were seriously injured. The launching equipment of one of the three sections was damaged and eight missiles were destroyed or partially destroyed.

2. At the time of the explosion, three separate activities were taking place in the vicinity of the explosion. The battery personnel were checking missiles in preparation for going on a higher state of alert; a launcher was being repaired by an Ordnance repair team composed of civilian personnel; and a team composed of Ordnance civilian personnel and enlisted men from the NIKE battery was performing an authorized modification on a group of missiles. The Board concluded that the first two operations definitely were not the cause of the explosion. Thorough study of all evidence revealed that, although the explosion appeared to have been initiated in the area where the modification was being performed, there was no evidence that the modified part could have caused the accident.

3. The circumstances have been examined and weighed by a Board of officers. After careful consideration of all the evidence, the Board concluded that the most probable cause of the explosion was the rupturing of a detonating cap. Corrective actions have been taken to prevent a recurrence. Further, there was no evidence of gross carelessness, smoking, inattention to the operations, or any other possible cause such as sabotage.

4. Safety regulations and requirements have been reviewed and tightened. The procedure which may have caused the accident has been corrected and eliminated. The Middletown incident was the first explosion since AJAX missiles became operational almost five years ago.

5. It was found that all serious damage resulting from the explosion was confined to the area immediately adjacent to the point of the explosion and within the battery boundaries. No injuries were inflicted on personnel outside the battery area, and damage outside the battery was limited. Debris from the explosion was found at some distance from the battery, but there are no reports of damage resulting from it.
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6. Immediately after the explosion occurred, the Army promptly sent teams to Middletown to assist in processing all claims for damages to property resulting from the explosion.

7. The battery remained operative in spite of the explosion. It can take its place in the defense of the New York City area at any time. Army Engineers are rapidly repairing the damage and will return the site to its original condition in a short time.
MEMORANDUM

TO:    Donald F. O'Donnell
FROM:  Thomas G. Egan
SUBJECT:  NIKE Explosion

On May 29, 1958, the writer visited the Middletown, New Jersey, launching site of the Nike Ajax guided missiles. A briefing was held during the morning which was attended by Brig. General Charles B. Duff, who is in charge of the air defense of the New York area, Lieutenant Robert Daly, Commanding Officer of B Battery, 526th Air Defense Battalion, Colonel Lloyd and Colonel Droudy (phonetics) both of Duff's staff, Colonel William Johnson of the Army Liaison, and Colonel Francis Newcomer, an expert on Mikes and on the staff of O.D.C.S.O.F.S. at the Pentagon. The launching area was toured during the briefing. (See the Washington Post, May 23, 1958, article for a photograph of the area.)

The launching area is composed of three sections: The assembly shop, which is a low concrete building; the revetment area, which is approximately 50 yards northwest of the assembly shop (directions used are for the purpose of clarity and may not be accurate); and launching sections of which there are three. The launching sections are located approximately 75 yards west of the assembly shop and extend west approximately another 100 yards. The three sections are referred to as sections a, b, and c with "a" section being nearest the assembly shop. Each is about 30 yards long and six yards wide. On each of the sections is located a launcher. The launcher is on a rack which is about three feet high and is connected by parallel rails on which the Mikes may be placed prior to being put on the launcher. The Mikes are usually placed in an underground pit which is connected to the launching section. The Mikes are brought from the pit to the surface on an elevator and mechanically placed on the section rail.

The over-all area of the launching section is approximately the size of three football fields. The area is completely surrounded by a six foot hurricane fence. The area outside the launching section is a wooded area with no apparent dwellings in close range. This outside area is private property or public domain.

During the initial briefing, Duff brought out the point that there is a theory of "inadvertent sabotage." He explained that it would be possible for a person with a high-powered rifle to shoot from outside the launching area into the booster of the Mike which would cause it to launch and then the heat from the burning booster could cause other Mikes above the ground to explode or possibly launch. However, General Duff was not prepared to pin the cause of the accident as the cause of the accident has not been determined.  

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and may never be determined. A Board of Inquiry is presently conducting an investigation in an attempt to ascertain the cause. This Board is composed of Colonel Robert Hain, Major Robert Taylor, and Captain John Hunt. It is hoped that a final report will be forthcoming within a week's time.

First Lieutenant Robert F. Daly, 068-495, provided the information which follows in this memorandum. E Battery, 526th Air Defense Battalion, has a complement of some 100 enlisted men and five officers.

The Mikes arrived at the battalion in metal containers. None of the components are attached at the time of arrival. The parts are taken to the assembly shop at which time the Mike is put together and the skin attachments (fins) are attached. The Mike is then hydraulically and electrically checked. It is then removed to the revetted area and joined to the booster.

The booster contains MJ fuel which is a high-grade kerosene. This fuel is highly inflammable. Red fuming nitric acid, which is the oxidizer for the missile, is also added at this time. During this period of fueling, there is always a possibility of fire. The nitric acid can be very injurious to personnel and consequently protective garments are worn, protective showers are maintained in the area, and other safety measures are taken. When the Mike, which is 21 feet in length, leaves the revetted area, the three warheads, fore, mid and aft, are in place, and the booster is attached. The arming device which controls the explosion of the Mike at high altitudes is in place, and the primer cord which causes the Mike to set off the booster is also attached. However, the primer cord which hooks up to a five-section socket is not connected. The Mike is then removed to the pit area and placed in storage. The hookup of the primer cord only takes place when the battery is prepared to fire the missile in anger.

The battalion had had orders to change the arming device on all its Mikes. The reason for this was that in order to get to the present arming device the two forward warheads had to be removed. With the new arming device, they could be adjusted without removing the warheads. The battalion had set a time table for changing the arming devices at the rate of four Mikes a day. On Thursday, May 22, 1958, they had changed four of the Mikes. On the day of the explosion they had completed three more changes and were working on the fourth. The Mike upon which the Army was working had already had one-half of the new arming device attached and holes were drilled for the other half of the arming devices to be attached. This is a fact as this particular missile has been recovered. It is to be noted that this missile upon which the Army was working was believed to be the missile that had exploded. In Daly's opinion, it was almost impossible for the missile to explode. As he expressed it, each of the men, both civilian and military, working on the missile were schooled, trained technicians who could not be guilty of any skylarking. They all also had at least a year and a half's experience on working on Mikes. He stated that only a stupid blunder on the part of one of the men could have caused the Mike on which they were working to explode.
Position of Nikes Above Ground at the Time of the Explosion

In Section C there were three Nikes above ground one of which was on the elevator. One of these three was already equipped with the new arming device, it having been attached the day before. The fourth Nike had been removed below ground as the drill was over. There was no damage to any of the Nikes in Section C.

In Section B there were four Nikes above ground, one of which was on the elevator. Of these four Nikes, the one closest to "A" Section launched and buried itself in a hill some 100 yards away from the rack. The Nike immediately next to this launching Nike was hit with shrapnel from the exploding Nike and it had a hole in the forward warhead and another hole that went completely through the skin of the missile. The Nike on the elevator and immediately on the left of the Nike just mentioned received a hole in its mid warhead, and another piece of shrapnel went completely through the rear warhead cover. The other Nike in B Section was undamaged.

In Section A there were seven missiles above ground and working from left to right will be referred to as No. 1 through No. 7. No. 1 was on the launching rack; No. 2 was on the elevator; Number 3 was on the launcher rack; No. 4 was on the rack without the launcher (this is the missile upon which the men were working); No. 5 was on the rack next to No. 4; and No. 6 and No. 7 were on the rack but were not on a launcher. Numbers 5, 6, and 7 had received the new arming devices that day and the work upon them was completed.

Number 1 missile launched. It is believed that this missile was partially elevated. It is also believed that this missile as it launched struck a hill some 100 yards away with the two forward warheads burying themselves in the hill and the booster and aft warhead continuing on flight as it broke off from the forward section of the missile. The booster was found within a short distance of the place of impact and the aft warhead was found about 3-1/2 miles away from the launching site. Missile No. 2 exploded; missile No. 3 launched; missile No. 4, which only had one warhead, exploded. Missile No. 5 is believed to have launched because the rail upon which it was resting was not blown completely. It was pointed out that the missiles that definitely exploded destroyed the rails upon which they had been placed.

Missiles No. 6 and No. 7 definitely exploded.

Personnel at Time of Explosion

At Section B there were three men above ground and none below ground: PFC Martin J. Wenzel, Specialist 3rd, Hubert A. DeWitt, who were participating in the drill, and the third man, Eldridge Newell, Specialist 3rd. Newell had been working at Section A on missile No. 4 and had taken the old arming devices and the old primer cord and walked from Section A to
Section C and stored this material in the pit of Section C. He came above ground just at the time of the explosion. He has stated to Daly and others that just prior to the explosion he heard a "crack." He has not given any other description of the noise that he heard as to direction or intensity. At Section B there were no men above ground but two men were underground: Specialist 3rd James E. Flatte and Pfc Lewis P. Fillipone.

At Section A where the explosion took place there were 11 men above ground. Three civilians and three GI's were working on the modification of missile No. 4. There were two civilians working on launcher No. 3, installing a hydraulic erecting cylinder. There were three GI's working on the Section procedure drill. Of these 11 men, 10 were killed by the explosion and one was seriously wounded. The wounded man was Joseph A. Follino, a civilian ordnance expert. Follino at the time of the explosion had crouched to the ground a split second prior to the explosion and was thus protected by a three foot base rail which separated him from the NIKE. The explosion apparently was one that blew itself directly off rather than spreading itself parallel to the area. Follino was thrown about 20 feet from his position and then he got to his feet and ran to the hurricane fence. He was removed to a Fort Monmouth hospital in a critical condition. He has been interviewed by the Army Board of Inquiry. Underground at Section A was Sergeant Joseph McKenize and Pfc. Joseph Abbott, who suffered a case of shock.

In the assembly shop were Commanding Officer Daly, Warrant Officer Seiger, who was injured, Sergeant First Class Richard A. Becton, and Pfc. Frank Tufo. The explosion sucked the windows out of this building. At the sound of the first explosion, Daly ran for the door. As he ran for the door there was a second explosion, taking place within five seconds of the first explosion. When he got outdoors there was all sorts of debris flying and he did recall seeing a booster burning. He gave orders for the other Nikes above ground to be lowered into the pits immediately. He would not have had the two damaged Nikes on Section B lowered into the pits if he had known they had been struck by shrapnel. These two missiles have been examined by Army detonating experts and it has been ascertained that they are now in a safe condition.

Approximately five minutes before the accident, First Lieutenant Thomas H. Casey, the platoon leader, had left the area after having made an inspection of it.
Section C

= Launcher

Section B

= Launcher on elevator

Section A

O = missile

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EXPLODED NIKE'S TRIGGER FOUND

Middletown, N.J. A.P. - Ordnance technicians probing the Nike explosion which took ten lives Thursday have reported finding the triggering device which was being installed when the missile blew up. They said the mechanism was never attached and was found on the ground. This disclosure was made yesterday as a team of experts worked through the weekend to determine the cause of the blast. Army authorities have speculated that something went wrong as the device was being placed in one of the Nike Ajax missiles. One of the tall slim devices posed on its launching rack detonated touching off the almost simultaneous explosion of seven other missiles. Six soldiers and four civilians were killed. Nearly one-half million dollars damage was done to the battery site, one of the many ringing the metropolitan New York area.
Nike Blast Survivor Queried by Probers

Three Army probers seeking the cause of last Thursday's Nike Ajax explosions in Middletown Township, N. J., in which 10 perished and three were injured, yesterday visited a badly hurt survivor in Fort Monmouth Hospital to learn if he could shed light on the tragedy.

The patient was Joseph A. Follno, 28, of 20 Cedar Ave., Stapleton, S.I., a civilian ordnance expert working on a Nike in the installation of B Battery, 526th Air Defense Battalion, when the rocket exploded and touched off explosions in seven other miles.

By yesterday he was well enough to talk. What he told Col. Robert Hain, Maj. Robert Taylor and Capt. John Hunt, however, was not disclosed.

Capt. Grant Lasher, public information officer for the 52d Anti-Aircraft Artillery Brigade, of which the 526th Battalion is a unit, said a public report will be made after all the data picked up in the probe has been digested and security violations have been screened out.

Brig. Gen. Charles B. Duff, commanding general of the 52d AAA Brigade, and Lasher met last night in Middletown Township Hall with the Chapel Hill Civic Association, a local civic group, to discuss the accident.

The association called the meeting to get assurance that increased precautions will be taken in the future.
Army Halts Nike Work After Blast

Inspectors Begin On-Spot Probe of Jersey Explosion

The Army announced yesterday a Nation-wide suspension of modification work on Nike-Ajax missiles. It said an explosion at the Middletown, N. J., Nike base Thursday which killed 10 persons apparently occurred while modification work was under way.

The Army said modification work had been completed on "hundreds" of missiles in other parts of the country "without incident." But it decided to suspend the work "throughout the Army."

It said the suspension was ordered by the Army ordnance missile command at Redstone Arsenal, Huntsville, Ala. It will remain in effect until the cause of the New Jersey explosion has been determined.

Inspection at Scene

The Army did not say what the modification was but a report from Ft. Niagara, N. Y., referred to it as installation of a new trigger.

[Meanwhile, in Ft. Devens, Mass., a spokesman for an Army anti-aircraft brigade said there would have been no explosion if the warheads had been removed from each missile before the installation work, the Associated Press reported.

[Each of the missiles that exploded was armed with three warheads.]

A team of Army inspectors opened an on-the-spot investigation of the disaster at the New Jersey base which had been termed as "safe as a gas station." Army inspectors rated the base as "superior" in overall safety only three days before the explosion.

Some 30 key American cities, industrial areas, and military bases are defended from air attack by Nike installations.

Besides the eight missiles, the explosions destroyed two Army pickup trucks and a civilian automobile. It said launchers and launching equipment suffered extensive damage.

The Army said that outside the Nike site area the damage appeared to have been limited to broken windows and other minor breakage. It said one warhead was reported to have been found about three miles from the installation.

Acting Army Secretary Hugh M. Milton II said the "fuller investigation" was under way to determine the cause of the explosions and to insure against such disasters in the future.

Rep. James C. Auchincloss (R-N. J.) said the Army had assured him it would help residents of Middletown Township to prepare their claims for compensation for any damage they may have suffered in the explosion.

Two other New Jersey law-makers, Reps. Gordon Canfield and William B. Widnall, both Republicans, demanded "an immediate and exhaustive investigation" of the explosion to determine whether all possible safety precautions were being taken at such bases.

They said they were assured by Rep. Frank C. Osmers (R-N. J.), a member of the House Armed Services Committee, that committee investigators would review "all the facts involved."

The Army meanwhile released the names of 10 men dead or missing in the explosion.


Civilians: Charles Romano, 38, New York; Lee A. Parker, 46, Atlantic Highlands, N. J.; Joseph Brokas, 33, New York; and Joseph Arcieri, 38, New York."
Halt Nike Ajax Work
As Blast Is Probed

By Henry Machirella and Sidney Kline

Jolted by the explosion of eight supposedly accident-proof Nike Ajax guided missiles, with consequent death to 10 persons and injuries to three, the

Army yesterday suspended modification work on the rockets throughout the nation.

Modification, completed without incident on hundreds of missiles, will not be resumed until the cause of Thursday's blast, on a launching site in Middletown Township, N. J., 45 miles from New York City, has been established, the Army said.

Yesterday, scores of military and civilian experts toured the scene of the disaster to learn why it had occurred.

On Thursday, authorities disclosed that the explosions took place while ordnance men were installing a supposedly improved trigger device on one of the Nikes. Whether the blast resulted from mechanical or from human failure still was to be determined.

Yesterday's suspension of modification work affected Nike installations protecting 30 major cities and military bases from coast to coast, and was ordered by the Ordnance Missile Command at Redstone Arsenal, Huntsville, Ala.

Probers poured into Middletown Township yesterday from Huntsville, Army Ordnance headquarters in Washington, and from the plants of Douglas Aircraft, Western Electric and Bell Laboratories. Those firms make the Nike and auxiliary equipment.

Brig. Gen. Charles B. Duff, who is in charge of Nike installations throughout the United States, said: "This battery," he added, "could deliver fire against enemy aircraft in the event of an attack."

In addition to ordnance men, the Army sent claims specialists from the Corps of Engineers. They opened a headquarters in the township hall and inspected property damage in the vicinity. The claims men were authorized to make settlements up to $1,000. Congressional legislation is required for larger amounts.

Lasher denied that the missile site had been deactivated, because of the accident. All Nike Ajaxes at the installation, he disclosed, had been moved to storage quarters below ground, covered by reinforced concrete. But the missiles could be moved to their launching pads in a matter of seconds in an emergency.

Army officials said the missiles were protected by a steel and concrete wall around the launching pads. No one was injured in their explosion.

The Army will not make any public statements until the explosion probe is completed, but Maj. Gen. Patrick L. Klein, Air Defense Battalion, whose equipment exploded, is part of the probe.

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**For Them, the Nikes Struck Close to Home**

Disbelief that their men were dead, bitter, inconsoatable sorrow because their men were dead, yesterday wracked the families of the six soldiers and four civilian ordnance workers killed in Thursday's Nike explosion in Middletown Township, N. J.

These were the servicemen who perished: Sgt. Jerome W. Mould, left home for work at 5 A. M. Thursday, he didn't awaken his wife. "I never said good-by to him," she said. "I'll never seen him again."

Parker's wife, Jessie, 42, spoke tearfully at her home, 93 East Highland Ave., Atlantic Highlands.

"We were so happy, were looking forward to so many things," she said. "We were going out on May 30 with our daughter, Jean Lee, to celebrate her 21st birthday. Lee was excited about a trip to New York, the season's first Broadway show."


These were the civilians: Joseph Arciere, 35, of 217-21 99th Ave., Queens Village, Queens; Joseph Brokas, 35, of 95 Jewett Ave., St. George, S. I.; Charles Arciere, 38, of 217-21 99th Ave., Queens Village, Queens; and Pvt. Nicklos J. Composino, 21, of Lyndhurst, Ohio.

2 Other Children

There are two other children, Patricia Ann, 15, and Pamela, 12, Parker's father, Joseph, 72, of 45 Fourth Ave., Atlantic Highlands, and his wife, Catherine, heard the blast which took their son's life.

The elder Parker retired from the Army in 1949 as a lieutenant after serving in the two world wars. He was an enlisted man in France in the first one, and served in the States because of age in the second.

"Even as a boy," the veteran said somberly, "I was interested in the War."

The military tried hard to placate civilians in the vicinity. Brig. Gen. Charles B. Duff, commanding general of the 50d AAA Brigade, and Lt. Col. Leonard Brody, commander of the 60th Signal Unit, have been scheduled for this summer.

"I believe this base is here to stay," Blaisdell told, newsmen. "Millions of dollars have been spent on it."

The five-member Middletown Township committee met in emergency session yesterday afternoon and voted unanimously to withhold any formal protest to the government until the area was safe.

Map locates sites of some of the Army's Nike guided missile installations (stars) which form a protective ring around the metropolitan area.

**Halt Nike Ajax Work as Blast Is Probed**

(Continued from page 3)

radius of the launching site. At least one civilian auto in the area was destroyed.

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of a local civic organization. "This is a scary thing to live with," said Erker. "We know the base is important. But all of us would like to know the answer to two questions. How did it happen? Why? We could probably sleep better then."
NIKE

Continued From First Page


CIVILIANS, Lee Parker, 46, Atlantic Highland, N. J.; Joseph Breake, 35, Staten Island, N. Y.; Charles Ronano, 38, Staten Island, N. Y.; Joseph Arciere, 36, Queens Village, N. Y.

Two in Pit Survive

Two servicemen in a 20-foot deep pit under a missile's launching pad miraculously survived the holocaust.

Staff Sgt. Joseph W. McKenzie, 33, a launcher section chief from Framingham, Mass., stepped from the pit unharmed. His partner, Pfc. Joseph Ab- bött, 24, of Grindstone, Pa., was treated for shock and hysteria.

The missiles, known as the Ajax type, exploded at about 12:20 p.m., while a team of experts was working on them. They were to be replaced next year by Hercules missiles capable of carrying atomic warheads.

Each of the Ajax missiles carried three conventional warheads of explosives and shrapnel. Most of the explosive de- vices were accounted for, but some had still not been located today.

Gen. Charles B. Duff of the Army Defense command said ogamance experts had found that all of the eight missiles had left the launching area, flying various distances.

A 12-foot section of one missile landed in a backyard three-fourths of a mile away.

Investigations from this base went over the ground inch by inch, but it may never be known what set off the first rocket.

Investigators Flown to Site

The Army flew in three in- spectors from the office of the chief of ordnance in Wash- ington to investigate the explosion.

Other investigators are fly- ing in from Redstone Arsenal in Alabama and from various other key defense points.

The Douglas Aircraft Corp. and Bell Laboratories, which devised the equipment, are also sending experts to the scene.

The accident, the first of its kind since the Nike system became an integral part of America's air defense, was ex- pected to trigger public ex- cursions.

Residents of this area had protested in vain against erection of the installation 18 months ago. The Army, how- ever, had given the public to understand that no such acci- dent was possible and that the missiles would only be fired in case of war.

Gen. Duff emphasized that the Nike "is an operationally safe weapon," and said the explosion was "something very new and unusual." Windows were shattered and doors blown in a mile or more from the explosion scene. One woman was blown out of a chair in the living room of her home.

Fund Shortage Being Probed

At Maryland U.

BALTIMORE, May 23 (AP)—The State Controller's office said today it is studying a possible shortage of funds in the University of Maryland's treas- ury.

Joseph O.C. McCusker, chief deputy controller, said the uni- versity's auditing department is examining the records.

Mr. McCusker refused to comment on reports that $18,000 was the amount involved.

A spokesman in the State auditor's office confirmed an audit of the university's books had been undertaken.

Atom Mispah

With Hercules

Is Discounted

By L. EDGAR PRINA
Star Staff Writer

The Army gave assurances today that the chances of an accidental nuclear explosion of one of its new atomic-tipped Nike Hercules missiles are "virtually non-existent."

The big Hercules weapon is joining the air defenses of the Washington-Baltimore area in a complex new and industrial complex next month. It will augment the ring of 20 Nike Ajax bases, such as those at Lorton, Va., and Fort Meade, Md.

Among other Nike sites in the Washington-Baltimore area are those at Fairfax, Kenmore and Fort Meade, Va., and Olney, Mattawoman, Upper Marlboro and Navarre, Md.

In reply to a question follow- ing the explosion of eight Nike Ajax missiles at a New Jersey launching site yesterday, the Army said:

"Elaborate precautions have been taken in the design and handling of Nike Hercules to minimize harmful effects resulting from accidents whether on the ground or in the air."

"Atomic weapons tests con- ducted by the Atomic Energy Commission have confirmed that the possibility of any nuclear explosion occurring as a result of an accident involving either impact or fire is virtually non-existent."

TNT Warhead Involved

The Ajax type missile, in- volved in the blast which killed 16 persons and injured three others, is a non-nuclear version of the Nike Ajax (TNT) warhead.

The much longer-ranged Hercules type rocket is built with either a nuclear or conventional explo- sive.

Last February, in reply to public expressions of concern over hazards involved in moving nuclear weapons, the AEC and Defense Department issued a joint statement asserting that the possibility of an accidental atomic explosion while trans- porting or storing such weapons is "so remote as to be negli- gible."

The Army gave somewhat similar assurances on its Ajax missiles about three years ago when they first became part of the Nation's air defense system. It said then that the guided missile installations were "safe as safe devices.

Elaborate safety measures are built into the Nike sites and the crewmen are specially trained. Explosives and volatile fuels that propel the rockets are stored underground.

The explosion of the Nikes in New Jersey, the first such acci- dent of its kind apparently took place in a new device.
7 Die, 3 Vanish in 8-Nike Blast

Mystery Explosion
45 Mi. From N. Y.

By Maggie Bartel and Sidney Kline

Eight mighty Nike Ajax missiles exploded at 1:20 P.M. yesterday at a launching site in a New Jersey air defense installation 45 miles from New York City—the first such accident in this country. Seven men were burned to death by liquid fuel. Three vanished, presumably blown to bits. Three injured were taken to Fort Monmouth Hospital. Warheads and missile fragments crashed over an area of many square miles.

Scene of the blasts was in Middletown Township, between Keyport and Red Bank, manned by Battery 526th Air Defense Battalion—one of an undisclosed number of similar institutions ringing the metropolitan area to guard against sneak attack.

Five civilian ordnance experts from Miller Field, S. L., and a group of soldiers were installing an improved arming device in a missile when it blew up. This touched off what the military called "sympathetic" explosions in seven others of the 33-foot-long rockets, each equipped with three warheads, every warhead containing 50 pounds of non-atomic, inert explosives.

Seven of the missiles, each horizontal on a launcher of its own, shattered. Missile fragments and at least one warhead...

Witnesses Describe Blast:
'The World Was Going Up'

By Henry Machirella and Arthur Mulligan

Fear. Terror. Wonder. Disbelief. Those were the emotions experienced by civilians living in the neighborhood of the air defense installation in Middletown Township, N. J., where the eight Nike Ajax rockets exploded tragically yesterday.

"I thought the whole world was...

(Arrow view from NEWS plane by George Matson, Bill Warner, pilot)
Meyers, who lives across Sleepy Hollow Road from the military center. Unhurt but startled, Meyers was in the kitchen of his home when the blasts occurred.

Henry Lutz Jr., a truck driver, was closer. He was hauling dirt fill on the base at the time of the explosion—and the concussion hurled him out of the cab of his vehicle.

"Everybody Was Running"

"That was from the first blast," Lutz said later. "I got up from the ground. There was this second and bigger explosion. Everybody was running. I started running too. Some buildings were shattered, I knew that some men must have been killed. It was awful."

Mrs. Theresa Wainwright of Atlantic Highlands, N.J., was working in the cellar of Adam T. Schilidge's Tanglewood Farm, three quarters of a mile from the scene.

"I was frightened almost to death," she said. "The first blast broke a window in the basement and knocked a lot of my flower pots to the floor. As I started upstairs there was a second blast."

Storm Door Shattered

"At first I thought there had been an explosion in the house. When I got upstairs I saw that the storm door to the dining room had been shattered. Then I saw a lot of smoke at the missile base."

Mrs. Erika Lazorchek was shopping in a supermarket a mile from the base.

"The blasts rattled all the windows," she said. "We were terrified. I ran home, and everything was all right there, thank Heaven. I have three children. At first we in the supermarket thought an atom bomb had gone off."

Mrs. John Fisler, who lives a mile from the base, was entering her car. An instant later she saw a fragment of one of the missiles zoom in front of her car and bury itself in the back yard of her neighbor, Walter Paine.

Mrs. Henry W. Abrams Jr., 59, of Leonardo, was knocked from her feet in her home.

"I thought it was someone breaking the sound barrier," she said. "I opened the door and asked what had happened. A man across the street said it was an explosion in the missile base."

"He told me he had seen a big flame shoot up in the air, and then a second flame went up." The flames were seen by many nearby, and the roars were heard for 10 miles around. Scores of householders reported windows broken.

Mr. and Mrs. John M. West, whose farmhouse on Mountain Hill Road is 1,000 feet from the north end of the missile base, flew for distances of more than three miles. The eighth missile plowed into a revetment 50 yards ahead, gouging a hole 12 feet wide and five feet deep into the earth.

Killed by Liquid Fuel

Liquid rocket fuel poured over seven men near the pit in which the missiles had been burning them to death. Flames burned two trucks, an auto and a few buildings nearby. The rails on which the missiles lay were crumpled into twisted, fiery metal.

Three of the men who had been working on the rearming project vanished. Apparently they disintegrated.

Concussion blew out windows for miles around. Two terrifying explosions, the first blast and the "sympathetic" blast which followed, were heard 20 miles away. Flames flared briefly.

"I was putting the tools away," he said later. "I heard an explosion. I looked up toward the elevator (on which missiles are"

(Continued on page 6, col. 1)
Raised to the launching site, the cables were all in flames, falling into the magazine and starting a fire. I got the hell out of there.

I went through a steel door into the missile room, where panel operator Abbott (Pfc. Joseph A. Abbott Jr., 24, of Grindstone, Pa.) was. The boosters were going off all about us. There were two big explosions, Abbott and I waited it out. When the explosions stopped, I ran to the panel room next door, "I ran to the missiles back down into the pits."

Suffers Shock
Abbott later was taken to Fort Monmouth Hospital in a state of shock.

Lt. Robert F. Daly, 36, a West Pointer who commanded Battery B, was in the missile assembly building 200 feet from the launching site at the time of the explosion.

"The windows of the building were sucked out," he said. "I yelled, "Cover me," and that was all about us. I began to run. I turned to run, and I was struck. Everything was blowing up in the area. The panels were not leaving the ground."

Yelled to Others
"I yelled and directed other personnel to evacuate the missile assembly sites to lower five other missiles by elevator into their 20-foot deep pits."

His action presumably prevented further "sympathetic" explosions.

About 100 men were at the installation at the time of the blasts. All the casualties except Sieg were in the immediate vicinity of the explosion.

One missile reportedly hurtled into lower New York Bay, a few miles away. Fragments of the destroyed rockets buried themselves in nearby woods and in houses.

Commanding general of the 5th Artillery Brigade, protecting the metropolitan area, flew to the scene to take charge of the investigation. He praised those on the scene for the manner in which they had met the emergency. Approximately 100 men are at the installation.

The general said yesterday's explosion was the first incident of its kind in the history of U.S. guided missile installations.

"We believe there is no possibility of danger of explosion in the area at this time, although it is hard to say for sure," Duff said last night. "I am not ruling out any possibilities, but as far as the public is concerned I do not believe there is any further danger."

A search continued through the night for warheads not accounted for. One of them had landed near East Road in a residential section of Belford, three miles from the scene of the accident. Since its explosion was inert, it did not blast on landing. The object, painted green, weighed 100 pounds, was nearly two feet long, 10 inches wide and looked like a small beer keg.

"Safe as a Gas Station"
"We don't know what happened," the general conceded. The warheads, he said, all were armed to the extent that they would fire if all safety devices were removed. But, he stressed, no safety devices had been removed from any of them.

Duff's comments re-affirmed Army statements made back in 1945, when Nike installations first were activated.

One Army assurance to the public went this way: "It (the installation) is as safe as a gas station and as important to the security of the community as the police and fire departments. The warhead is constructed to explode only in flight."

"It has a self-destructive feature so that it will not crash and explode. Safety precautions are taken for storage of explosives and volatile fuels. Assembled missiles are stored underground. Fueling areas are surrounded by high earthen revetments."

As Joseph A. Folino, 28, of 30 Grove Ave., Port Richmond, S. I., Pvt. Joseph A. Abbott Jr., 24, of Grindstone, Pa., and Chief Warrant Officer Herbert Sieg, 27, of 471 Church St., Belford, N. J., Folino was in serious condition, identities of yesterday's dead were withheld pending notification of kin.

North Jersey has been the scene of other great explosions.

On July 30, 1916, German saboteurs touched off the Black Tom munitions explosion in Jersey City, which killed six persons and caused $40 million damage.

On Oct. 5, 1918, about 100 persons were killed in an explosion at the Gillespie Loading Co. plant in Morgan.

On July 10, 1926, an explosion in the Picatinny Arsenal at Lakehurst, N. J., caused nearly $100 million damage.

On Sept. 12, 1940, a blast at the Hercules Powder Co. plant in Kenvil killed 51 and injured more than 100.

On the 19, 1950, munitions being transferred from freight cars in South Amboy exploded, killing 31.

From back door Mrs. West saw soldiers picking up pieces of the missile in the field.

Two miles from their home, said Mrs. West, the J. Howard Elmi 111 fertilizer factory was struck by a piece of a missile.

1,500 Soldiers in Panic

Nearly two miles away, as the blast shook the base, at the Middletown High School, 1,500 students were panicked when a chunk of metal landed near the school.

Jimmy Higgins, 16, of Shore Blvd., Keansburg, N. J., said his math class had just started when "all of a sudden we heard a great big explosion and everything shook... the whole building shook."

"The teacher," said Jimmy, "jumped to the door as if he were going to run. Everybody was screaming and some of the girls were crying. I don't know what it was. I went under my desk."

Jimmy said a big piece of metal landed near the school and soldiers came and took it away.
9 Are Killed in Blast at Nike Base

Shattered launching equipment covers the ground at the Nike launching base at Middletown, N.J., after a series of explosions of Ajax missiles yesterday.

NIKE—From Page 1

Fore steaming into New York Bay.

Middletown Township covers an area of 38 square miles with a population of about 35,000 people.

General Duff contended that the missiles were not fired. "This was an explosion," he said.

No one outside the base was injured.

First Lt. Robert F. Daly, 30, of Flint, Mich., commander of the base, said members of the 536 Battalion, which mans the installation, had braved the flames and the second explosion to remove other missiles to safety below ground.

Daly, who was in the missile assembly building, about 200 feet from the launching pads, when the first explosion occurred, said: "The windows were socked out of the building and debris began flying in all directions. As I ran out of the building toward the launchers, I saw everything in the area blowing up or burning."

He said he yelled for some of the other men in the area to begin placing the missiles on two other launching pads.

The Army said one of the missiles went off at about 1:20 p.m. while a crew of five civilian technicians and six Army personnel was installing a new type of arming mechanism to insure greater accuracy.

Four minutes later, seven other missiles on the launching pad blew up at once with an earth-shaking roar that could be heard 30 miles away. Windows were shattered within a one-mile radius.

Army de­molition crews scooped the countryside for the 24 warheads; that were sent hurting over the area.


Duff told newsmen he did "not rule out any possibility of an explosion" from some of the missing TNT warheads. But, he added, "as far as the general public is concerned there is no probability of any injury from the warheads."

The warheads can be detonated only by blasting caps, the Army said.

Middletown Township Mayor Frank Blaisdell, angry over the explosion, complained to General Duff: "The Army is assuming no responsibility like this would ever happen. Now we have missiles flying all over the place, landing on schools, in the streets and on our houses. The Army assured me that these things were not armed and never would be fired unless there was an enemy attack. Our concern is, is it going to happen again?"

What added to the concern was the fact that the Middletown base is close to the ammunition depot at Leonardo, N.J., where U.S. Navy vessels must unload their shells because it is in New Jersey Hit by 24 Warheads

1 Man Missing, 3 Hurt in Blast Of Ajax Weapons

By Jack Lotto

MIDDLETOWN, N. J., May 22 (INS)—Eight powerful Ajax missiles exploded at a New Jersey Nike launching base today, killing nine men, injuring three and showering 24 live but non-atomic warheads over a wide area. A tenth man was missing and presumed dead.

The Army said one of the missiles went off at about 1:20 p.m. while a crew of five civilian technicians and six Army personnel was installing a new type of arming mechanism to insure greater accuracy.

Four minutes later, seven other missiles on the launching pad blew up at once with an earth-shaking roar that could be heard 30 miles away. Windows were shattered within a one-mile radius.

24 Warheads Sought

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MEMORANDUM

TO: Donald F. O'Donnell
FROM: Tom Egan
SUBJECT: The Nike Explosion, Middletown, New Jersey

On May 26, 1958, a conference was held in reference to the captioned subject. Present at the conference at the Pentagon were the Honorable Hugh M. Milton, General Penn, Army Liaison, Colonel H. M. Spangler, Colonel F. K. Newcomer, Major R. F. Thomure of C.D.C.S.O.F.S., and the writer.

The Secretary was advised that the Subcommittee had two basic questions involving the explosion which were: (1) what caused the accident, and (2) what steps will be taken to prevent future accidents of this sort. The Secretary advised that this is the same basic approach that the Army has taken and at this time has not come to a determination.

Milton has treated this accident as two separate areas, that is, the base itself as one area and all damage and effects to the civilian property outside of the base. This latter area, Milton could handle immediately from a public relations point of view. Claims Specialists from the Corps of Engineers were immediately dispatched to the area to contact civilians and to ascertain what damages, if any, they had as a result of the explosion. These specialists conducted a door-to-door type of canvass in attempts to settle all claims immediately. A member of this team was stationed at the Governor's Mansion so that any complaints coming into the Governor's office could be handled immediately. The results so far from this portion of the investigation indicate that there was between $3 and $5 thousand worth of damages to civilian property in the form of broken windows and cracked walls.

More important than the claims adjustment was the safety precautions taken. The public was warned through the medium of radio and newspapers to report to the Army any objects which appeared to be of a foreign nature in the neighborhood. The public was warned not to touch any of the objects so located. A thorough search of the area was made by Army detonation teams. As a result of the above steps, one warhead was located about two miles from the camp, and a State Policeman located a small object about a foot long which was a detonator, but harmless in itself. Milton has been in telephonic contact with Governor Mayner of New Jersey and Frank Blaisdell, the Mayor of Middletown Township, New Jersey.
As to the more important portion of the investigation, the Army dispatched several teams of specialists in the fields of ordnance and safety with the intention of making the area safe. A Board of Inquiry has also been set up in an attempt to ascertain the cause of the accident. As of this date, their investigation is incomplete although they are working night and day. It was estimated that a final report should be forthcoming within one week to 10 days. Milton has stopped work on all NIKE projects until a determination of the explosion has been reached. Milton stated that the newspaper articles contain the true story as it is known at this time. He, personally, has checked to be sure that the newspaper articles contain accurate information. He stated that the articles contain his full knowledge as of this time.

It was pointed out to the Secretary that several civilian organizations have been conducting technical investigations of the explosion. The report will include the opinions of the civilian experts who will be interviewed during the Army's inquiry. It was also pointed out that the civilians' opinions may disagree with those of the Army and such reports would probably be made to the civilian companies. The following companies are known to be conducting an investigation: Douglas Aircraft, Western Electric, and Bell Laboratories.

Dick Davis of the Washington office of Douglas Aircraft Public Relations, phone Nat. 8-0474, advised on May 26, 1955, that he would have to contact Douglas's office at San Monica, California, in order to determine from whom the Subcommittee may request a report made to the company from its technical experts.

Mr. Richman of Western Electric, telephone NAT 8-5577, advised that Western Electric is the prime contractor for the Middleton Base and that Bell Laboratories is the subcontractor for Western Electric. He advised that any technical knowledge concerning the Bell equipment would have to be supplied by Bell Laboratories. He supplied the following name as the person whom the Subcommittee should contact in requesting a copy of the company's report concerning the explosion: Mr. W. C. Timus, Vice President, Bell Telephone Laboratories, Whippany, New Jersey.

Lewis Ulman, an attorney for A.T. & T., located at 1001 Connecticut Avenue, N. W., Washington, D. C., who was substituting for Phil Taylor, who is the regular Public Relations man for A. T. & T. in Washington, advised as follows:

Phil Thayer, Assistant Director of the North Carolina Laboratories, Burlington, North Carolina, is at Middleton, New Jersey, at present serving as a technical consultant to the Army. He is serving in this position at the request of the Army. It was stated that Thayer, serving in his position as expert witness, would probably not make a report to his company.
P. H. Timus, Vice President of Bell Laboratories, telephonically advised on May 27, 1953, that immediately after the accident at Middleton, experts from Bell Laboratories were dispatched to the scene of the accident to serve in an advisory capacity to the Army. It developed that the accident concerned warheads which were of Army design and, consequently, the Bell experts were not needed. The Bell Laboratories, which is the subcontractor for Westinghouse, was responsible for the guidance equipment which was not involved in the explosion. The company did not receive a report from its experts inasmuch as they did not participate in the investigation, although there would be an informal verbal report made on generalities.

Thayer of the Bell Laboratories in North Carolina did appear at a town meeting on May 26, 1953, with Major General Duff. The purpose of the meeting was to assure the townspeople that the area was safe.

Douglas Aircraft also had dispatched experts to the scene of the accident inasmuch as they were responsible for the design of the missile, but it is believed by Timus that Douglas' services were not required for the same reason that Bell's services were not required; that is, it was the warheads that exploded and the warheads are of Army design.

Phillip Thayer, office address, 204 Graham-Hopedale Road, Burlington, North Carolina, telephone, Canal 7-3671, ext. 436, was telephonically contacted on May 27, 1953. Thayer participated in the town meeting at Middletown at the request of General Duff. The purpose of Thayer's appearance was to discuss the mechanics that prevent premature detonation of the Mlkes. The Army had requested that Thayer not express an opinion of the accident during the meeting.

Duff advised the local residents that the Army could not at this time discuss the details of the investigation. When the Army completes its investigation, the Secretary of the Army will furnish full details to Governor Mayner and Mayor Blaisdell.

Thayer's statements as to the assistance provided the Army by Bell was substantially the same as those of Timus. He did not express an opinion as to the cause of the accident at this time as he said all the technicians would have opinions but only those who actually dug into the facts would be in a position to make any concrete determinations. He felt that the Army technical personnel conducting the investigation were doing an exceptionally thorough job but no matter how thorough an investigation is conducted, it is going to be extremely difficult to come to a definite conclusion. He felt that the Army was doing a thorough job and that there was no need for a nontechnical person to make any inquiries into the cause of the accident. He advised that the investigation was one of a very highly technical nature. Thayer will return to his North Carolina office on May 29, 1953, and will be only too glad to cooperate with the Subcommittee in any way.

Dick Davis, Public Relations for the Douglas Aircraft Company, telephonically advised on May 28, 1953, that he had contacted the San Monica office of Douglas, and he was advised that the Douglas people did not participate in any formal investigation at Middletown. The Douglas Company did have some of their service people in the area available to assist the Army if they so requested. However, no such request was made.

- 3 -
ONLY the surface-to-air guided missile stands between near-supersonic, megaton-loaded enemy bombers and missiles and vital installations and cities of our nation. Antiaircraft guns are not effective at the tremendous altitudes required to intercept modern air assault weapons.

The Army has recently been assigned increased responsibility for air defense by longer ranges and broader coverage for its antiair missiles. These weapons are directed toward the destruction of aircraft of all types, ballistic missiles, and air-supported missiles—anything traveling through space that imperils the continental United States or hinders land combat operations of the U.S. Army or its allies. The need for such missile systems was anticipated more than twelve years ago when research on Nike Ajax began. Its creation resulted in the only operational land-based air-defense system capable of meeting the present air threat.

The surface-to-air program has developed to include all types of targets and more new missiles. In the course of testing, these systems have destroyed while in flight every type of drone, missile, and aircraft that they have been permitted to engage.

The most critical future problem is the defense against the ballistic missile plunging down out of space at a speed in excess of ten thousand miles an hour. The basic Nike system concept and implementation provide a logical, well-balanced step toward the solution of the destruction of this threat. The purpose of this article is to cover this antimissile problem as well as some of the basic principles of operation of the Army's antiair missiles.

Missions and organization

The Army in executing its antiair function provides surface-to-air missile (SAM) units for the air defense of the continental United States and of U.S. overseas bases and forces. The SAM requirements include land-based antiair missiles for defense against high, medium- or low-altitude aircraft, drones, and ballistic missiles. Surface-to-air missiles should also have a surface-to-surface role when feasible.

The U.S. Army Air Defense Command is the component which, along with the Air Force and the Navy, forms the Continental Air Defense Command (CONAD). Under CONAD the Army is responsible for point air defense by missiles fired from the ground at targets in the air not more than a hundred miles away. The Air Force is responsible for manned interceptors, area defense, and missile ranges over a hundred miles, the Navy for the sea approaches.

Point defense includes those geographical areas, cities, and vital installations that can be defended by missile units which receive their guidance information from radars located near the launching site. It should also include the responsibility of a ground commander for the air protection of his forces.

Within this roles-and-missions framework, the Army has developed and placed into operation the Nike Ajax missile system designed to combat the medium- and high-altitude bomber in existence today. It is the first weapon in artillery history capable of reaching out to ranges far beyond those of conventional guns to counter a maneuvering target. It is a mobile system to be used either in fixed defense or with the field army.

Nike Hercules is capable of delivering an atomic warhead in air defense. It will be employed primarily to attack and render ineffective with a single warhead a formation of enemy aircraft. It is bigger, faster, has more range, and is more accurate than Ajax. However, both missiles are compatible in a universal Nike defense and will be used side by side on operational sites around the country.

Three other missiles have been announced recently as joining the Army's surface-to-air family. Hawk will afford additional antiair protection. Land-based Talos comes under the jurisdiction of the Army if it is employed by CONAD. The Talos system is similar to Nike Hercules in capability. Finally, Nike Zeus is being studied.

Structure of firing units

The organizations that fire Nike Ajax and Nike Hercules are based on conventional antiaircraft artillery battalion structure. There are normally four firing batteries and a headquarters and headquarters battery. The battalions on site in fixed defense are formed into groups or brigades, that come under regional antiaircraft commands which in turn are directed by the U.S. Army Air Defense Command. In overseas areas, the air defense of the communications zone and the combat zone will normally require clear-cut command lines and distinct separate organizational structure based on battalions, groups and brigades. The field army commander must possess complete authority for the air defense of the combat zone.

The antiair missile battery commander must have sufficient warning of an impending attack to allow his firing elements to be properly prepared. Some of the electronic equipment must be warmed up and given a brief check for proper operation. Full crews must be assembled on the equipment. The responsibility for early warning in the United States belongs to CONAD agencies such as the Semi-Automatic Ground Environment (SAGE) system that reaches out with the long-range radars of the Distant Early Warning (DEW) line and sends this detection information to antiaircraft operations center (AAOC) where the Missile Master is located. The Missile Master is a complete system for coordinating and directing a large number of missile firing batteries. It ties
together elements of antiair defense from target detection to destruction in order to achieve maximum effectiveness. Information is collected from the SAGE system and other agencies on the location and identity of aircraft or air-supported missiles, presented on electronic screens, and distributed to the firing batteries—all electronically and within fractions of a second. Each battery receives a continuous flow of fresh data on all targets within the defense areas; the battery commander can then make the proper selection of a target to be attacked.

Rocket principles

Most of the antiair missiles are essentially two-stage rockets. The first stage consists of a booster rocket that propels the second or main stage at tremendous speeds through the lower atmosphere until a high altitude is reached. Then the booster rocket motor burns out, the booster drops off, and the main stage or sustainer motor takes over to add more speed to the missile. By combining two rocket stages, more speed is developed with a relatively small missile that must be able to take the large g forces developed by maneuvering at supersonic speeds. In addition, full advantage is taken of high altitudes where the sustainer motor will give better performance.

These two-stage rockets utilize both solid and liquid propellant rocket motors. The burning of the propellant—composed of a fuel and an oxidizer—produces high-temperature, high-pressure gases that are ducted through a nozzle and produce an action force which has as its reaction the force called thrust. In Nike Ajax, for example, the booster is a solid propellant rocket of large thrust, and the sustainer motor is a liquid propellant rocket using JP-4 and nitric acid as the fuel and oxidizer.

In contrast to the ballistic missiles, the antiair missiles do not require control of the time of burning of the rocket motors. The maximum amount of energy is needed every time to get the missile through the heavier atmosphere as quickly as possible and drive it toward the target. Both the booster motor and the sustainer motor are allowed to use all of the propellant or burn out. The missile then coasts at supersonic speeds to intercept the target. Of course, each separate missile has a maximum range where it no longer has sufficient speed to cope with a maneuvering target. This point is well established and may determine the maximum range capability of the particular system.

Guidance systems

Any guidance system for antiair missiles must develop attitude and path error signals. An autopilot in the missile detects pitch, roll and yaw displacements which are attitude errors. If a missile has a displacement from the correct path to the target, then a path error exists. This path error is detected by the tracker of the guidance system. The tracker provides the information for the correct path and then an electronic computer determines the corrections which are sent to the missile. The aerodynamic forces developed by the resulting movement of the control surfaces or steering fins cause the missile, when in the heavier atmosphere, to move in attitude and path to correct its position. Outside the atmosphere, control can be maintained by air jets from the missile which force it back on the correct path. Significant forces acting on the missile during its maneuvering trajectory are gravity, thrust, and aerodynamic forces.

Predicting the intercept point is a method of missile "navigation" specifying the path to a kill point based on the target-missile closing velocities, the target velocity, and the missile velocity. The missile is directed to a point on the target's predicted course so that it will arrive there at the same time as the target. Since the point will not be fixed if the target maneuvers, a computer continuously determines a new predicted point for the kill and directs the missile toward each new point in turn.

The first of the three basic types of guidance that will be covered is command guidance. This type normally employs one radar to track the target while another tracks the missile. The data from these two radars are fed to a computer which corrects the missile's path and transmits commands to the controls in the missile. In this case, the tracker for the system is a radar. Command guidance is used by the Nike Ajax and Nike Hercules systems.

The next type of guidance is the beam rider. Two radar beams are normally used, one to track the target and one to guide the missile. The missile automatically centers itself in its radar beam as the other beam follows the target. A computer determines the movement of the missile beam so that the missile will intercept the target.

The last kind of guidance system is homing. This is the form of guidance where a device in the missile reacts to some distinguishing characteristic of the target such as radar reflectivity of the surfaces of the target.
electronic emissions, or heat emission. A target seeker in the missile is receptive to the kind of energy emitted or reflected from the target. A computer in the missile takes data from the seeker and sends appropriate commands to the steering fins for an intercept.

Nike Ajax

The Nike Ajax guided missile system consists of a two-stage rocket, three radars, an electronic computer, and the necessary control and communications equipment.

The missile itself—actually the second stage of a booster-missile combination—is a liquid propellant rocket about twenty-one feet long, one foot in diameter, and weighing more than half a ton. It consists of a warhead, steering fins, guidance section, propellant tanks for the JP-4 and the nitric acid, an air tank that provides high-pressure air to force the propellants into the rocket motor, stabilizing fins with small movable parts for roll control, and the rocket motor.

The missile is launched at the near vertical by the solid propellant booster. The booster drops off in a few seconds after which the missile's rocket motor begins operation. Then the missile goes through a steep turn to an on-course trajectory. After the motor burns out, the missile coasts supersonically to the target. The over-all trajectory is such as to maintain a speed and maneuverability advantage over the target throughout the engagement. The missile is under the control of its guidance system from the end of boost until intercept.

The radars and the computer form the basic components of the ground guidance equipment for the Nike Ajax command guidance system. One radar is for acquisition of targets designated by the Missile Master, the second tracks the missile, the third tracks the target. Information from the last two radars is fed to the computer concerning the position and velocity of both the target and the missile. Signals are then sent to the fins to move them in the correct direction and amount for a target kill. Any evasive action by the target is detected by the target-tracking radar and this information is sent to the computer. The computer reevaluates the trajectory of the missile to meet the change of direction, and steering signals are sent to the missile to correct its course. All this occurs in thousandths of a second in a complex electronic system.

Nike Ajax batteries are dispersed around the defended locality in a roughly elliptical pattern and at such a distance from one another that all the air space at maximum range can be reached by at least one battery. At closer ranges, six to eight batteries will cover the air space.

Launching area

To reduce the real-estate requirements of the batteries in the United States, an underground storage system called a box is used with a combination elevator-and-launcher supplemented by three aboveground, adjacent or satellite launchers. The launching area contains from three to six boxes, a missile assembly site, and a fueling area. The control area is made up of the three radars, control vans which include the computer, and generators. Troop housing is located within these areas. Safety provisions call for a minimum of forty-three acres for the launch-
Close-up of the Nike Hercules two-stage rocket on the launcher

ning area and eight acres for the control area. The operational requirement of the radars calls for a minimum of three thousand feet between the radars and the launchers.

In order to gain an insight into how a Nike Ajax battalion would function during an actual enemy attack, suppose we become observers as the 28th AAA (Missile) Battalion, stationed in Seattle, Washington, swings into action. (The 28th is the crack outfit that won the first Army-wide competition ever held for antiair guided missile units. During the firing competition, held at the Army's Red Canyon Range Camp in New Mexico, one of the firing units of Battery D scored 2,800 points out of 3,000 to set the record. The Battery has fired seventeen missiles without a single miss.)

Here's what would happen. First reports from the long-range radars on the DEW line indicate a flight of unidentified aircraft coming across the Arctic wastes. As the flight proceeds toward the Seattle area, the battery's control officer of firing unit D-2 follows the action closely. He is responsible for the execution of this fire mission for his fire unit, and he alone makes the final decision to fire. Fresh information on the progress of the flight is continuously fed into his control van.

**Battle Stations!**

When he is told that an attack is imminent, he orders **Battle Stations!** and his troops move rapidly into action. In the control area full crews man the radar and computing equipment and run through operational checks. The launcher crews raise the previously prepared missiles and boosters to the ground level on the elevators of the underground launchers. These missiles have had propulsion and guidance components tested, the propellants loaded, and the warheads installed. The three satellite launchers with each underground launcher have missiles and boosters placed on them, and final tests and checks are completed.

Still the enemy flight is out of range of everything but the long booms of the acquisition radar. As the target pip appears on the radar scope, the command is flashed from the operations center: **ENGAGE!** The launching crew scrambles into the underground firing pit and the missiles are erected to their firing positions.

Tension mounts as the time draws near for the battery's control officer to make his decision as to when to fire. Hesitation or confusion might let the target get in too close. The battery control officer subconsciously tries to recall his three-for-three record at Red Canyon and just how he and his crews did it. The battery is placed under its final Red alert status and the missile-tracking radar slews and locks on the first missile to be fired.

**FIRE!**

As the designated target in the flight approaches the maximum range of the Nike Ajax, the fire control officer pushes the firing button with a determined jab. The two-stage rocket roars off the launcher, hurtling at over a thousand miles an hour up to intercept altitude. In a few seconds the booster burns out and drops off in a gentle arc toward a booster disposal area where it can impact without damage to property or population. The rocket in the missile takes over and adds more speed to the Nike Ajax.

All eyes in the control van are on the plotting board pens, representing the missile and the target, as they approach each other. Everything is carried on automatically now; the operators merely monitor the equipment. They can't think or react this fast. As the pens come together from opposite directions, a cheer goes up in the van, for a hit has been scored. The battery's control officer grins at his assistant and then prepares to launch a second missile at another target in the formation. This scene is repeated in the many control vans in other battalions around the Seattle area as the Missile Master searches the sky for new targets.

This completes a brief observation of an actual attack on a defended area protected by Nike Ajax. The battalions on site around the country are on a twenty-four-hour alert status frequently
punctuated by practice runs on Air Force jet aircraft or, in some cases, by warnings of unidentified planes that so far have always provided their identity before the last possible moment.

**Nike Hercules**

The Nike Hercules system consists of a two-stage rocket, a booster-missile combination, and the same three radars, computer, and control and communications equipment of Nike Ajax modified into a Nike universal system. These equipment modifications will add to the effectiveness of Nike Ajax; at the same time, such an approach provides Nike Hercules with the use of the same test and maintenance equipment.

The missile is longer, heavier, and more than double the diameter of Nike Ajax. It incorporates a newly developed solid propellant type of sustainer motor that will simplify storage and checkout operations. This trend toward solid propellants for rockets may be applied to many future Army missiles. The booster is larger to accommodate the missile and is made up of a cluster of four of the solid propellant Nike Ajax boosters. It is an all-weather, air-transportable combination.

The scheme of operation of Nike Hercules is again identical to Nike Ajax with some of the newest advances in electronics incorporated into the longer-range radars and the more efficient computer. These advances include simplified monitoring and maintenance of the system by the soldier-operators. The total effect is to provide a missile with more maneuverability at extreme ranges and altitudes and higher velocity to attack the most advanced type of aircraft and air-supported missiles.

Nike Hercules provides a nuclear air defense which is the most effective defense against a mass raid attack. Its warhead will be employed at altitudes where the effect of blast, heat, and radiation on the ground would be negligible. As stored on site and loaded into the missiles, the atomic warheads emit no harmful radiation. However, the problems of troop training to handle these warheads will have to be solved.

**The Hawk**

The development of a versatile air defense missile system designed to reinforce the low-altitude capability of our air defenses produced the Hawk. This solid propellant missile carries a lethal warhead and is capable of destroying attackers flying at even the lowest altitudes at ranges insuring effective protection of defended areas. It will complement the defense against high-level air attack provided by the Nike.

Hawk is approximately sixteen feet long and fourteen inches in diameter. The system is capable of operating both in the continental United States air defense complex at fixed installations and with fast moving combat troops of the field army. It may be transported on the highway, using a minimum of vehicles, by helicopter, and by aircraft. Hawk in its mobile role also will be adopted by the U. S. Marine Corps.

Site selection actions for the employment of the Hawk have been started in the New York City and Washington-Baltimore areas. While the land requirement for each individual site is relatively small, positioning of the site is comparatively rigid. Only the absolute minimum of land necessary to emplace, operate, and administer the weapon system and to afford safety protection is to be acquired. Each battery will require approximately forty acres for emplacement. To reduce land holding requirements to a minimum and in the interests of safety, underground storage of the missiles is planned.

The Hawk system uses guidance techniques which are unusually successful in hunting down and destroying the attacker. Radars of unique design are highly effective in detecting and tracking the low flyers in the blind zone of conventional radars.

Raytheon Manufacturing Company of Massachusetts is the prime contractor under Army Ordnance for the development of the entire weapon system, with Northrop Aircraft of California as the major sub-contractor. A production contract for the Hawk has been awarded to Raytheon.

Talos is a Navy-developed missile system that will come under the juris-
The antinuclear arms race continues to escalate as nations develop and deploy advanced weapons systems. The complex interplay of technology, strategy, and politics in the realm of missile defense is highlighted in this excerpt from a military document. The text discusses the threat posed by new missile systems and the ongoing research and development efforts to counter these threats. It outlines the challenges and considerations involved in developing effective antimissile systems, emphasizing the need for rapid response times and accurate detection capabilities. The document also highlights the importance of integrating new technologies and strategies to maintain military superiority in a rapidly evolving geopolitical landscape.