"Missile Away!"

Vol. III, No. 3
FALL
1955
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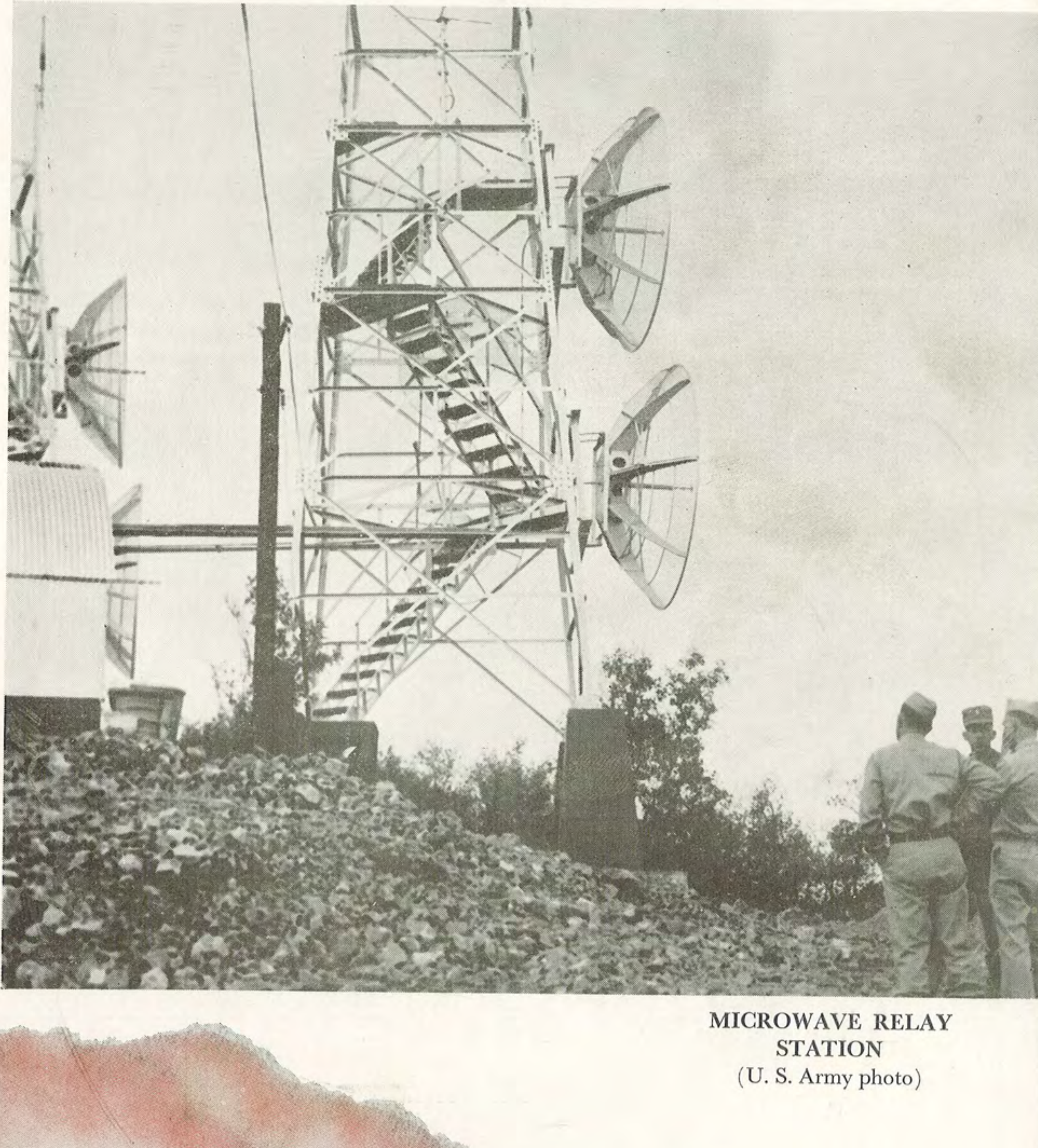
THE NEW MEXICO - WEST TEXAS SECTION
OF THE AMERICAN ROCKET SOCIETY



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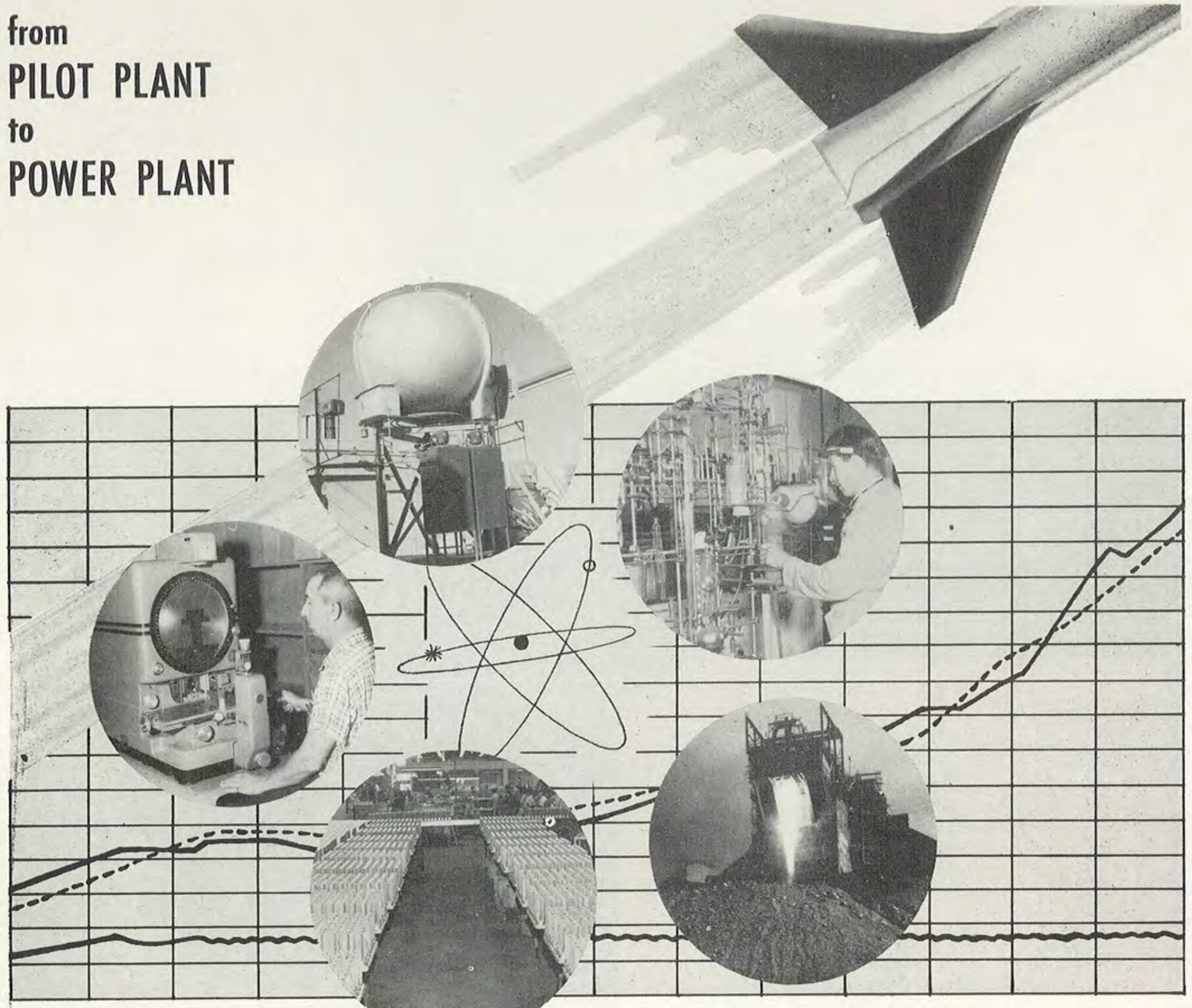

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CONTENTS

SPECIAL SUPPLEMENT (ARS members only): High altitude photograph from Viking 12, suitable for framing. Photo courtesy U. S. Navy.

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This picture was taken on infrared film from Viking 12 on Feb. 4, 1955 at 3:00 p. m. Looking toward the west, it shows the Gulf of California, Lower California and the Pacific Ocean with remarkable clarity. The horizon is nearly 1100 miles from the camera.

Editorial: "History's Stepchild"

FROM the first use of rockets in warfare during the Battle of Kai-fung-fu in 1232 A.D. when the Chinese sent the Mongols running, the rocket has played many roles. Usually, it was a firework, a beautiful pyrotechnic device capable of carrying a bundle of glowing star shells into the night sky for the pleasure of the holiday throng. From the very first, its use as a weapon was somewhat questioned; compared with artillery, it couldn't hit the broad side of a barn. Sir William Congreve and Count Pirquet tried to improve things, but the rifled cannon always won out.

Such was the case until a boy climbed up in the apple tree in the backyard of his home in Massachusetts near the end of the Nineteenth Century. While in this tree, he looked at the sky . . . and he knew what he wanted to do with his life. He wanted to send something higher into the sky than anything had ever gone.

He never forgot this dream. Beset by ridicule, technical problems, and setbacks, he developed a hard core about him to outsiders; he never discussed his work. But he was very meticulous in writing everything down. And it was this quiet man, so misunderstood by even his scientific colleagues, who founded the modern science of rocketry with nothing but a dream to start working on.

Nobody listened to him, except the Germans who were working on long-range rockets to replace the long-range artillery outlawed to them by the Treaty of Versailles. And at Peenemunde was another man who had looked at the sky.

These two men are among the long list of those, some living and some dead, who dared forge a new frontier. Goddard, Winkler, von Braun, Oberth, von Karman, Ziolkovsky, Pendray, Shesta, Wyld, the list is long indeed. They opened the doors for others to follow . . . and they took one of the longest chances in history.

They knew the rocket meant travel beyond the earth's atmosphere. But to develop it to the point of being able to have it do so meant money, man-hours, testing facilities, research laboratories . . . things far beyond the means of any man or small group. It would take the resources of nations and of the world.

Now our culture has some strange ways about it. If it cannot see the immediate practicality of a device, it will pass over it in favor of something which is practical. It passed the rocket by once in history. And it ignored its possible uses as a sounding vehicle. Perhaps it is unfair to blame it on our culture; the real reason may lie in the fact that a certain level of technological knowledge must be reached before something can become practical. So it was with Crooks' electron gun; some other people had to make some discoveries first before it could become a television tube.

But the rocket men in modern times succeeded in showing the culture that they had a wonderful method of carrying explosives to tremendous ranges. When the first V-2 landed on London in 1944, it changed the entire course of future warfare. Later, with other wars looming on the possible horizon of the future, the rocket men gave their talents to making weapons. They then had the money, the men, the facilities, the labs.

They built the weapons that they were called upon to produce. In a way, they knew they had to; our backwardness in basic human relations left them only with the alternative of being defenseless if they didn't. But no man likes the idea of having to deliver death to thousands.

The only thing which kept them going was the knowledge that swords may be beaten into plowshares. After all, mass production techniques were developed to supply standardized musket parts and ammunition. Atomic bombs also meant nuclear power reactors. Long range bombers were basic designs for long range transport planes. Tanks showed how to build massive earth-moving machinery. And the developments in guided missiles. . . .

The gamble paid off. Before we managed to get into a global war of extermination with long range rockets, the jackpot came along.

Goddard's dream has not been forgotten. Out of the sleek, needle-nosed rockets of war has come the knowledge and technology needed to lift a man-made object beyond the hazy rim of the world where it never shall return.

Nobody knows what emotions he will experience when he looks up and sees it there, knowing that men put it there. Such a thing has never before happened in all our experience. Pride, humility, elation . . . they will all run their course. As a quest for knowledge, it is perhaps the most audacious thing we have ever attempted.

It has come out of the wars, out of our petty squabbles, and out of our misunderstandings. Perhaps it will be proof of the worthwhile qualities of mankind.

But it will also be a vindication for misunderstood men everywhere who endure the greatest of all hardships in their quests for the impossible.

Our views are naturally biased. Each and every person on this earth will have to form his own conclusions, for the deed has a momentous legacy of the past, a momentary utility of the present, and an unknown effect upon the future.—G. H. S.

WSSCA.....

WHITE SANDS SIGNAL CORPS AGENCY

by
Wendell Haynes
White Sands Signal Corps Agency

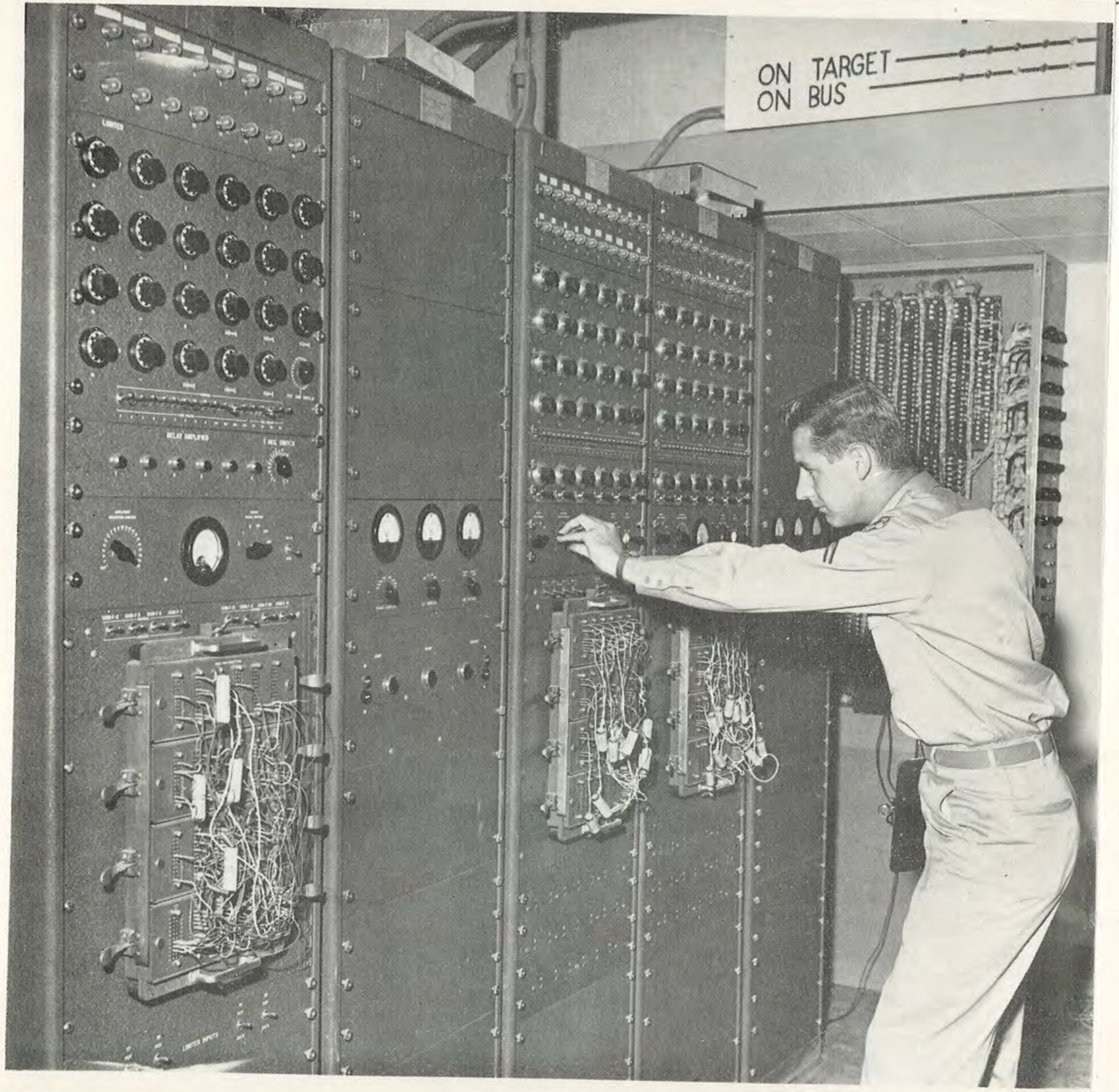
When a guided missile thunders into the skies at White Sands Proving Ground, the electronic eyes of radar follow it, news of its progress is passed over telephones and radio, cameras and other radars are remotely pointed at the missile. Those jobs, plus uncounted others, fall into the jurisdiction of the Signal Corps at WSPG. . . .

(U. S. Army photos)

"WHIS-kuh," the rather unique pronunciation used by Agency people for "WSSCA," initials of the White Sands Signal Corps Agency, serves, appropriately enough, as an oral symbol for a rather unique Signal Corps organization. That the Agency should be unique in many aspects is not surprising when you consider the unprecedented demands for instrumentation, communications, and other forms of signal support which have grown out of Department of Defense activities in the new field of rocket and guided missile research and development. To put it simply, two factors —space and time—have made tougher a tough enough mission at best. To get an idea of what is meant by this, first, consider as an operational site 4000 square miles of southern New Mexico's desert and mountains, an area larger than the States of Delaware and Rhode Island combined. Next, visualize over 400 instrumentation stations of various types widely scattered over this territory. Then consider that instrumentation data and communications services must be provided to any point within this area almost instantaneously, for the flight of a faster-than-sound missile requires only a few minutes at most. To sum up, overcoming the difficulties of too much space and not enough time constitutes a key phase of WSSCA's job at White Sands Proving Ground.

Since its activation in mid-1945, the Proving Ground has been under the overall control of the Ordnance Corps; however, from the outset, the complex technical and administrative problems involved in rocket and guided missile research and development have required the coordinated efforts of every branch of the military service, private industry, universities, and research institutions. The first Signal Corps personnel, a military and civilian radar team from the Signal Corps Engineering Laboratories (SCEL) at Fort Monmouth, arrived at the Proving Ground in the latter part of 1945. This team successfully tracked the first V-2 rocket fired in the United States. From the time of that initial operation, the scope and complexity of missile R&D activities steadily increased, a number of new types of more and more intricate missiles being introduced. Consequently, the scope and complexity of the Signal Corps' mission at the Proving Ground developed apace until by 1948, SCEL was conducting three major functions at WSPG. These were radar instrumentation, upper atmospheric research, and frequency coordination, the last named activity being established in that year to meet the problems posed by the large and increasing number of radio operations in the area. The resulting confusion made coordination of the use of radio frequencies and interference control imperative. Accordingly, through joint agreement of the Army, Navy, and Air Force, the Office of the Area Frequency Coordinator was established, the Frequency Coordinator to be appointed by joint approval of the three services. To date, all Frequency Coordinators have been Signal Corps Officers.

In January, 1949, the SCEL Field Station No. 1 was activated as a Class II activity, under the operational control of the Director of the Evans Signal Laboratory at Belmar, N. J. Thus was met the need for a local organization to conduct the increased scale of signal operations at the Proving Ground. However, as Proving Ground activities continued to grow during the next two years, it became clear that still more local autonomy was necessary to effectively support Proving Ground operations as well as to conduct or support independent Signal Corps research and development programs. Consequently, on July 1, 1952, the White Sands Signal Corps Agency was activated as a Class II activity, under the control of the Chief Signal Officer, under the command of Col. Earle F. Cook, who was succeeded in February, 1954, by Col. Elmer L. Littell. Colonel Littell



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The REAC computer racks at King I radar station, located at Holloman AFB, convert raw radar data to electrical voltages used to actuate plotting board arms.

At the extreme northern end of the WSPG range, almost 90 miles from the launching areas, stands Oscura Peak Station, located high on a mountain and overlooking the scar on the desert floor that marks our entry into the atomic age: Trinity Site.

was succeeded in March, 1955, by Col. Gerald Carlisle, the present commanding officer.

WSSCA's present mission, broadly phrased, is to provide communications and other electronic support to agencies or activities of the Department of Defense and to conduct or support primarily Signal Corps research and development programs. Since the formation of the Agency, signal functions have continued to increase in number, until today they include—besides radar instrumentation, wire and radio range communications, and frequency coordination—electronic warfare, meteorological and ionosphere services and research, a wide range of engineering services and research, signal maintenance and supply, photographic services, and administrative services.

Neither space nor security regulations would permit a detailed description of all these functions, so no attempt will be made to give each the emphasis it deserves. Instead, in what follows, the most will be said about the three, first named—and oldest—functions, as being representative of WSSCA operations at White Sands Proving Ground.

The development of the present radar instrumentation service offers a prime example of the expansion of signal functions at the Proving Ground. Today, in place of the half-dozen or so radar vans used by the original SCEL team, four modern, permanent radar control stations constitute a part of what is known as the "Chain Radar System." This system provides complete radar instrumentation coverage of the Integrated Range, so known because of its joint use by the Army, Navy, and Air Force. The Range—incidentally the same 4000 square mile area mentioned earlier—is oblong in shape, stretching almost 120 miles north and south. The four control stations are spaced out on an average of about thirty miles apart. From the roof of the northern-most station, which sits on top of a two-mile-high mountain, you can get a good bird's-eye view of the original A-bomb site.

Personnel at this isolated station will tell you that during thunderstorms the lightning bolts strike not from above but from below. (In fact, the station has been struck a number of times, but to date there have been no casualties). The men at the station will also tell you—and they aren't joking—that during construction days they used to pitch scrap lumber over the sheer, two-thousand-foot cliff at their doorstep, only to have the wind return it a few minutes later. By way of contrast, the southern-most station rests on a wide, flat plain at an elevation of only 4100 feet above sea level.

The Chain Radar System serves four major purposes: makes possible missile flight safety, provides a means of drone control, furnishes acquisition data for positioning optical tracking equipment, and provides trajectory data on missile flights. But first, very briefly, this is the way the chain system works. During missile flights the quality of the tracking of each of the chain stations is indicated by signal lights on the chain commander's console. By means of a simple switch, the commander can place in control of the system that station gathering the best quality of information. The station in control determines the position of the missile and automatically positions the radar sets at the other stations so as to track the missile in flight.

(next page, please)

As regards flight safety, two-pen plotting boards at each station display present missile position information in the ground and vertical planes during flight, provide in-flight velocity information along the X, Y, and Z axes, and predict the impact point. During missile flights, range safety personnel maintain close surveillance of the plotting boards to insure that flights are confined to safe areas of the range. Somewhat surprisingly, the range area seems none too large to the people engaged in these operations, the reason being that they think in terms relative to the great speed and long range of many of the missiles tested.

Plotting boards also play a vital part during the firing of missiles at pilotless aircraft, or drones. The purpose of these tests is usually not to hit the drone but to score a theoretical hit, or near miss. During the tests, the relative position of all aircraft flying over the Proving Ground must be accurately known. A typical operation involves one drone, two control director ships—commonly known as mother planes—and a missile. These are in the air simultaneously. Radar sets track each of the aircraft involved as well as the missile, and this information is presented on three plotting boards. Predetermined flight patterns are laid out on the plotting boards and are used to control the flights of the aircraft during operations. One radar set both tracks and controls the drone, causing it to conform to the prearranged pattern on the plotting board. After each firing, one of the mother planes is directed by radio from ground control to a position where it can take over radio control of the drone and land it, while the other mother plane stands by.

Position information for flight tracking equipment of various types, e.g., phototheodolites, which photograph the missile while in flight, is effected by a piece of equipment called a data converter which converts the missile's co-ordinate position in space to quantities that can be transmitted by electrical means. This electrical information—known as acquisition data—is then placed on a transmission bus by another item of equipment known as a data transmitter and receiver and is used for positioning equipment at distant sites to point toward the missile in flight.

Data on missile flights are provided by the chain system through the use of several methods. First, the radar plots from the plotting boards provide a permanent trajectory record which is available immediately after flight. Second, cursor scales on the radar sets which give azimuth and elevation readings are photographed throughout flight, along with time readings. A data display unit which gives range readings is also photographed. The photographic data thus obtained provides a considerably more accurate record of the missile's position in time and space than does the plotting board data. A third method of acquring trajectory data makes use of an automatic data recorder which receives range, azimuth, and elevation data from shaft-to-digital converters in the radar sets. This information is converted to binary decimal form, recorded on magnetic tape, and then transferred to teletype punched tape which is used to prepare IBM punched cards. By use of these cards the position and velocity components of the missile are computed and results tabulated by an IBM calculator.

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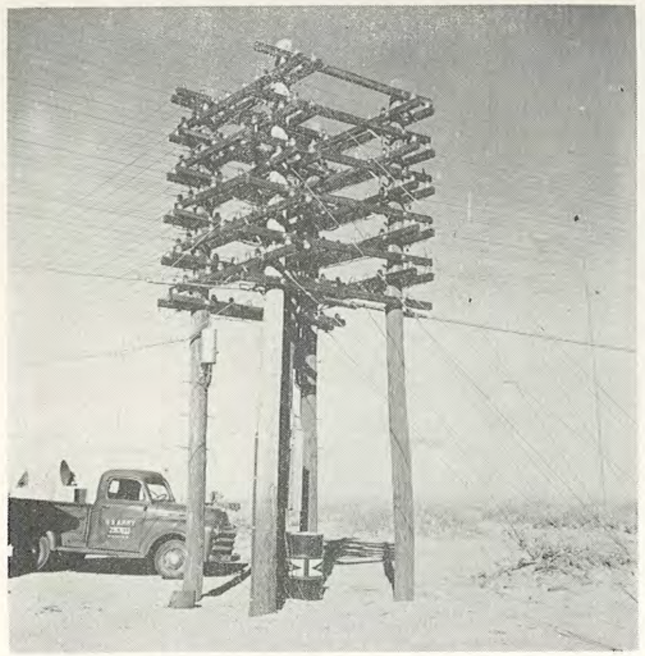
At the southernmost end of the range, C Station with its roof loaded with radar parabolas stands ready to track the initial part of a missile's flight when launched at this end of the range. Drone control is also handled from here, and the entire WSPG range is controlled from this focal point of operations.



An example of the complexity of wire lines maintained by the Signal Corps at WSPG, Pole 96 with its multiple cross-arms, slanting guy wires, and network of wires against the sky helps WSSCA perform its task of supplying communications to the 4000 square miles of rocket range.

Communications between the radar stations as well as between all other operational sites on the Integrated Range are a part of the Agency's wire and radio range communications function. Stated briefly, this responsibility involves the construction, installation, operation, and maintenance of outside and inside wire plant and radio communications facilities utilized in direct support of the Integrated Range Mission. Wire plant facilities include approximately 7700 circuit miles of open wire, 211 running miles of overhead and underground cable, and many more miles of field wire, not to mention such related items as central office equipment, switchboards, teleypewriters, and inter-communications equipment. Radio facilities include a 23 channel, four link, micro-wave system which provides communications between the radar control stations as well as far-flung instrumentation stations. Point-to-point and air-to-ground communications are also provided, utilizing HF, VHF, and UHF radio equipment. Circuits utilized range from voice transmission to carrier and other forms of multiplex systems for communication and data transmission in connection with missile firings.

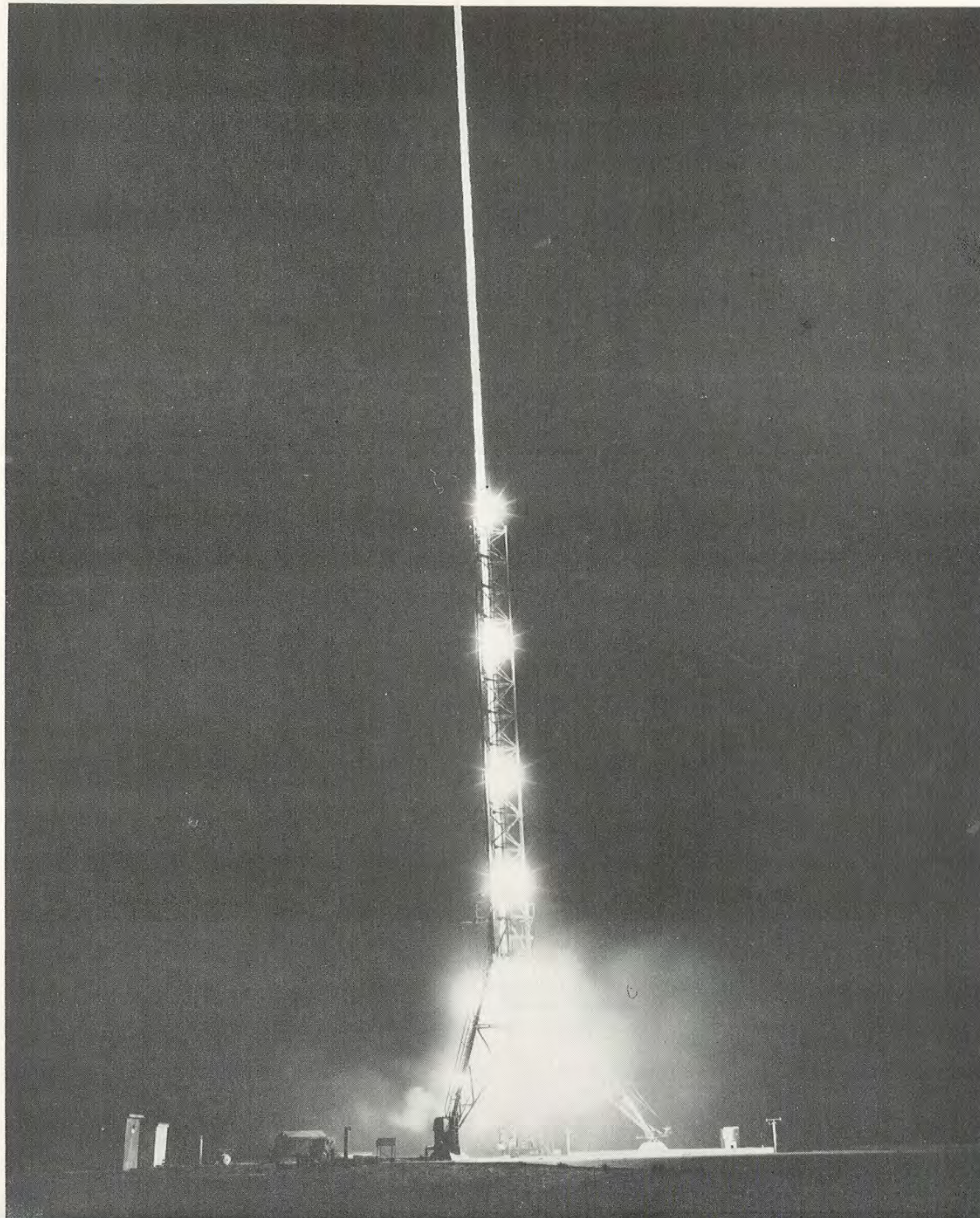
A little of the history of the Agency's frequency coordination function was mentioned previously. This function, the responsibility of the Area Frequency Coordinator, is to coordinate all frequency allocations and to minimize radio interference in electromagnetic emissions in the state of New Mexico and other U. S. territory within a 150 mile radius of White Sands Proving Ground. The Agency has established fixed, mobile, and aerial monitoring facilities on the Integrated Range and at Fort Bliss and Biggs Air Force Base, the latter two installations being located about fifty miles south of the Proving Ground. During the course of normal operations, monitoring is performed on frequencies from 2 to 18,000 megacycles. A continuing inspection of the entire spectrum is carried on to determine clear channels for equipment which is in, or will eventually be brought into, the area. Direction finding equipment and noise and field intensity measuring equipment are used to determine sources of interference, and susceptibility of electronic equipment to various types of interference is tested. These and many other operations in the field of frequency coordination are performed by Agency personnel. The problem of coordination is one of increasing significance and requires continual vigilance and foresight, backed by experience and technical "know-how." This is true for two reasons: missile activity is continually increasing, with consequent crowding of the frequency spectrum, and, too, more complex equipment is constantly being brought into the area.

To briefly mention other functions of the Agency, meteorological services and research include the testing of tactical types of wind measuring equipment developed by the Signal Corps and used in conjunction with missile operations, the study of the feasibility of large scale wind structure measurements, and studies of the use of acoustic equipment in detecting missile impacts. Ionosphere services and research are provided by an ionosphere station at the Proving Ground which supplies research data on radio wave propagation in conjunction with missile firings and also provides ionosphere data to augment that being obtained by other stations throughout the world. Engineering functions include the planning, coordinating, standardizing, and evaluating of operations, equipment, and facilities involved in the execution of Agency engineering projects. Signal maintenance shops provide maintenance, modification, and inspection of Signal Corps equipment throughout the Proving Ground. The Agency also supplies signal items to post organizations as well as its own units. Photographic services include the provision of public information and technical still photographs, documentary and historical motion pictures, and guidance and advice concerning the operation of missile flight data recording cameras. Military organizations under the control of the Agency include the 9577th TSU, the 9525th TSU, and the 169th Signal Co. (Const). The total civilian and military strength of the Agency exceeds 1000 personnel.

In conclusion, let us admit that we have touched upon but a few of the high points of the WSSCA story, a story which becomes dated even as it is being written, for events have moved—and are moving—with rocket-like rapidity in this desert center of a new field of science and engineering. Much ingenuity and hard work have gone into keeping the Signal Corps abreast of developments, and, no doubt, much more of these same qualities will be required to keep up the pace in the future. At any rate, whatever turn future developments take, you may be sure that the people of WSSCA will give their best to uphold the proud traditions of the Army Signal Corps. • • •

midnight shoot . . .

Night firing of Aerobee sounding rocket. (U. S. Army photo)



SO You Want to Track It With Radar ?

by

Lyle D. Bonney

W.S.S.C.A.

"Track it with radar!" is the usual answer you might get, but even these fabulous electronic eyes have their troubles . . . and they aren't all due to equipment, either!

THE basic aim in tracking by radar is to record enough information to accurately reconstruct the trajectory of the missile. Each missile operation by radar becomes a long chain of functions that must be carefully welded together. The beacon must be perfect. Each of the radar's many components must be operating precisely as it was designed. The operators must be quick and prudent. The data recording system must faithfully reproduce the radar's track by a film record, in which each frame represents a precise azimuth, elevation angle, or range reading during the flight of the rocket. The film must be carefully processed to bring out the fine detail required for accurate reading by the mathematicians who skillfully apply their knowledge. Supporting information is also recorded such as automatic gain control voltage, error voltage, switching seket's trajectory. This information is used during the information is recorded versus a flight time standard. This supporting information verifies, corrects, and substantially improves the reliability of the film data.

The primary link is the radar, with its hundred or so complex electronic circuits, which seeks out the moving rocket, tracks it, and establishes direction and range. By trigonometric operation this information fixes points in space which will be used to define the trajectory of the missile.

The next item in the series is the data recording system. The components are the azimuth and elevation cursor scales, range scope, the electronically operated cameras, and the timing unit for tying down the information presented to a certain elapsed time after take off.

Then there is the plotting board which is used as a moment to moment (real time) indication of the rocket's trajectory. This information is used during the operation primarily for flight safety, but later this plot will be used to augment the photographic data. The board furnishes a D.C. voltage to the radar, and by utilizing the range, elevation and azimuth potentiometers of the radar, information is returned to the board that will enable it to trace the missile flight.

In addition to the major items listed above tape recorders, radios, telephones, coders, and signal systems are required to instrument the flight. The radar, with all of its associated equipment, is woven together with miles of wire and cable. Several hundred vacuum tube circuits are required as well as scores of relays and switches, and a multitude of electronic components. All of this obviously adds to the maintenance requirements, and most certainly is a threat of failure stemming from any one of the systems used. The life expectancy of such items as vacuum tubes, resistors, capacitors, and similar electronic components drastically affects the reliability of the data gathering system.

Most of the unusual or disappointing happenings encountered in the instrumentation of the firing by radar can be attributed to inadequacies caused by equipment failure, operator misjudgement, natural phenomena and "goofs."

Some of these abnormalities have been near tragic, others comical, but all have caused moments of anxiety for the operating personnel.

Early one morning, shortly after dawn, a radar was being prepared for a tracking assignment on an important firing. A recheck of the collimation was being made—a check required to verify the alignment of the data recording system on the radar with the electrical axis of the radio beam. The reference target, at that time, was located on the gantry crane at the army blockhouse three miles north and at zero elevation to the radar. To the surprise and annoyance of the radar technician it was found, upon positioning the antenna on the target, that a positive elevation angle was indicated by the data recording equipment. This adjustment had been carefully made only a few hours previously. After several attempts to explain the error, closer observation through the telescope revealed that the gantry crane had taken on the appearance of a vertically stretched framework of steel girders. A desert mirage had created an extremely confusing illusion. The test became proper a few minutes later.

The radar instrumentation people are infrequently exposed to loss of life and limb. Being tagged by a rotating ten-foot parabola does happen, but a scrape with the detonation of two turns of prima cord in the tail of an Aerobee might be considered somewhat irregular. The missile had been equipped with a radar beacon, which transmits an answering pulse for each pulse received from the radar as an aid in tracking the rocket to greater distance. The installation of an external power supply was being made on the tower for the operation of the beacon during pre-firing checkouts. This was located near the nose of the rocket as it hung in the tower. The wind had been especially severe this winter night, even for New Mexico. The moving air and blowing dust had kept the Aerobee launching tower in a constant state of static charge. The technicians had found it more comfortable to jump between the bottom end of the launcher ladder and the ground, rather than to discharge it through their bodies. The task had just been completed, and telephone contact made with the blockhouse for an operational test, when a deafening roar and searing flash enveloped the tail of the missile. The radar people, after pulling their jangled nerves together, reached the ground almost simultaneously—rather remarkable considering the narrowness of the ladder. Later investigation revealed that the prima cord, which is used to blow the tail free from the body of the rocket on the terminal leg of the trajectory, had been detonated by squibs which were thought to have been made safe. The investigating group theorized that enough energy had been generated in the squib circuit by the static conditions to fire the cord.

Physical weaknesses of the operating personnel have also contributed to disorder at critical moments during a tracking operation. A split second's distraction of the optical tracker operator's attention can cause him to lose the missile from his telescope with a very slight chance of recovering it. This is especially true at a time when the missile is fading from view because of haze, clouds, or distance. During one firing, the count was down to X-2 minutes when it was brought to the attention of the station chief that one of the optical tracker operators had suddenly quit his instrument in undeterred haste. At X-35 seconds he returned to his post

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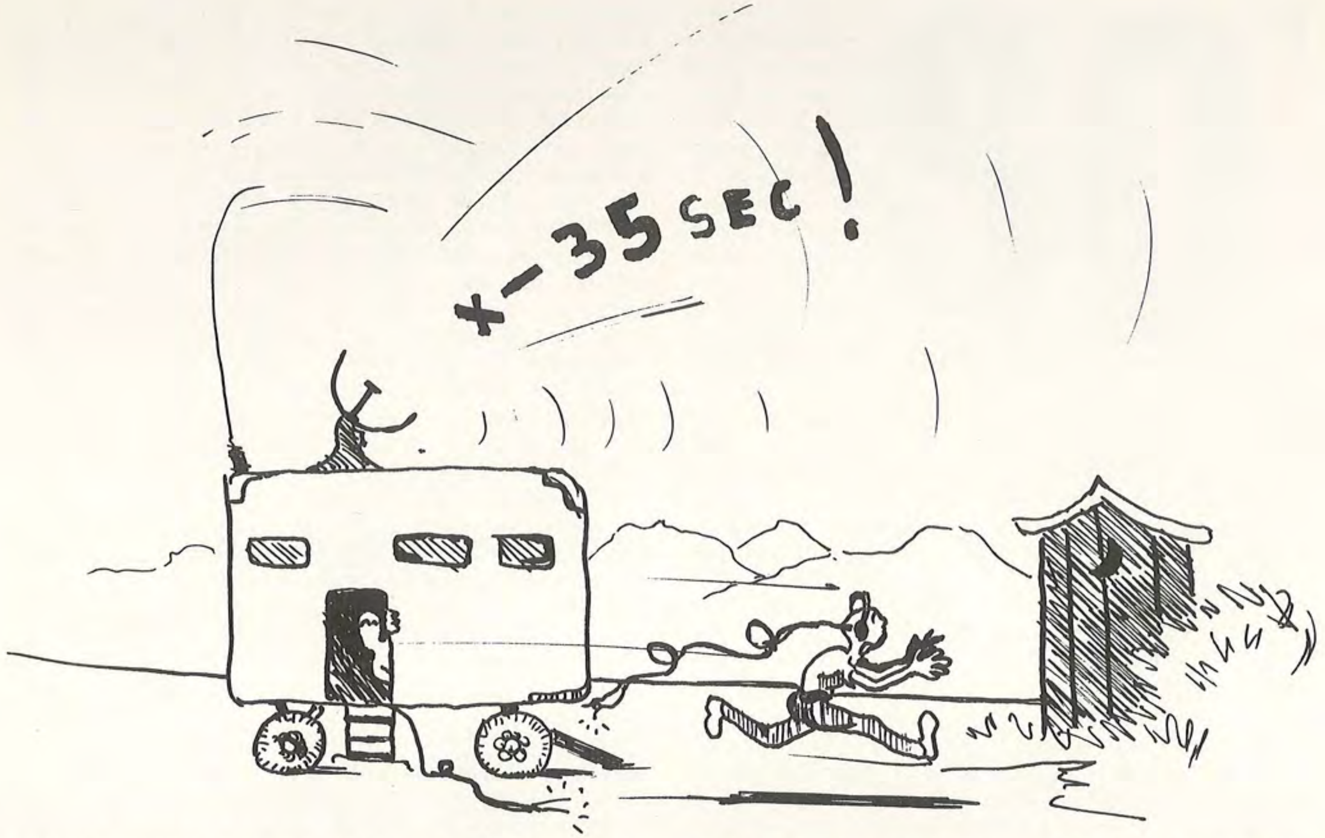


greatly relieved and tracked the missile from take off to impact. A sudden and pressing call of nature had to be answered.

There is a club among the radar tracking people to which few aspire membership, but very few are not members. This exclusive—or should we say inclusive—group makes the roll by blunder, neglect, or misjudgement. In addition to the routine preparation of the radar for service there are possibly two dozen separate operations that must be made by the radar operator during the comparatively short flight of a missile. Failure to accomplish any one of these manipulations can cause a complete loss of data. Such things as the spinner motor on, amplidynes on, transmitter high voltage set, automatic gain control in the automatic position, positioning data switch in remote, and many others are imperative. Putting the set into automatic track on the booster instead of the missile has nominated possibly more members than any other "goof." The sudden appearance of a strong signal that turns out to be the pip from a signal generator mistakenly left on has also tempted many an operator to go into automatic. Of course, the automatic tracking of a target on a misaligned gate results in no end of confusion to the plotting and flight safety people, since an error in range appears on the plotting board.

Trouble that develops remotely to the operating station also wreaks havoc on the radar system. A power failure at a critical time obviously puts the entire data gathering system out of action. On one operation the object being tracked by the radars flew into a power line supplying the station. As the target continued merrily along its way, the radars sat paralyzed with their attention fixed at the point of mishap.

Telephone and radio circuit failures can cause a complete loss of intelligence between the launching site, aircraft, or other operational areas and the radars, resulting in deficient data. Transportation failure to the instrumentation site has been known to delay the operation to such an extent that it was necessary to cancel the mission.

Probably the radar people who are subject to the greatest strain during the firing of a rocket are the members of the beacon section. These are the technicians who take the beacon, as it is received from the factory, and prepare it for near-perfect performance. Frequency, sensitivity, and power must be set for the mission at hand. They must charge the batteries and provide spares in case of an emergency. They spend long tedious hours making careful adjustments on the beacon. Many hours prior to shoot time, they must install their equipment in the rocket. This crew is subjected to the same adverse weather conditions, injury by falls, and other hardships endured by the firing crews. After the installation is completed and the radar site is contacted, a complete checkout with the radars is made. During the pre-launch count down they are constantly monitoring the beacon return, supply voltage, and current drain. In case of a beacon failure they can call a hold on the firing until the trouble is corrected or the beacon replaced. The external power supply is used as long as practical, then usually at X-3 minutes the internal batteries of the missile are used. If the signal observed by the radars is still satisfactory, the beacon will never return to the external batteries. However, in case of a firing hold for troubles in the missile, the beacon can be returned to external power until the hold is released. The beacon people are as thrifty with time spent on internal batteries as a miser with his money. The batteries' exact life is known, and if more than the allowed ground operating time is exceeded, the shoot must be held while the internal batteries are replaced with fresh ones.

X-2 seconds, minus one, fire! Now there is nothing more that can be done by the beacon technicians. Their long hours of exacting work have been traded for a few minutes operation after which nothing will be returned except a twisted and torn jumble of vacuum tubes, resistors and condensers that was once a beautiful piece of electronic equipment. Although its life span is short, much depends on the reliable operation of the beacon, not only because it is a source of tracking signal, but because it is often a means of intelligence between the missile and the radar.

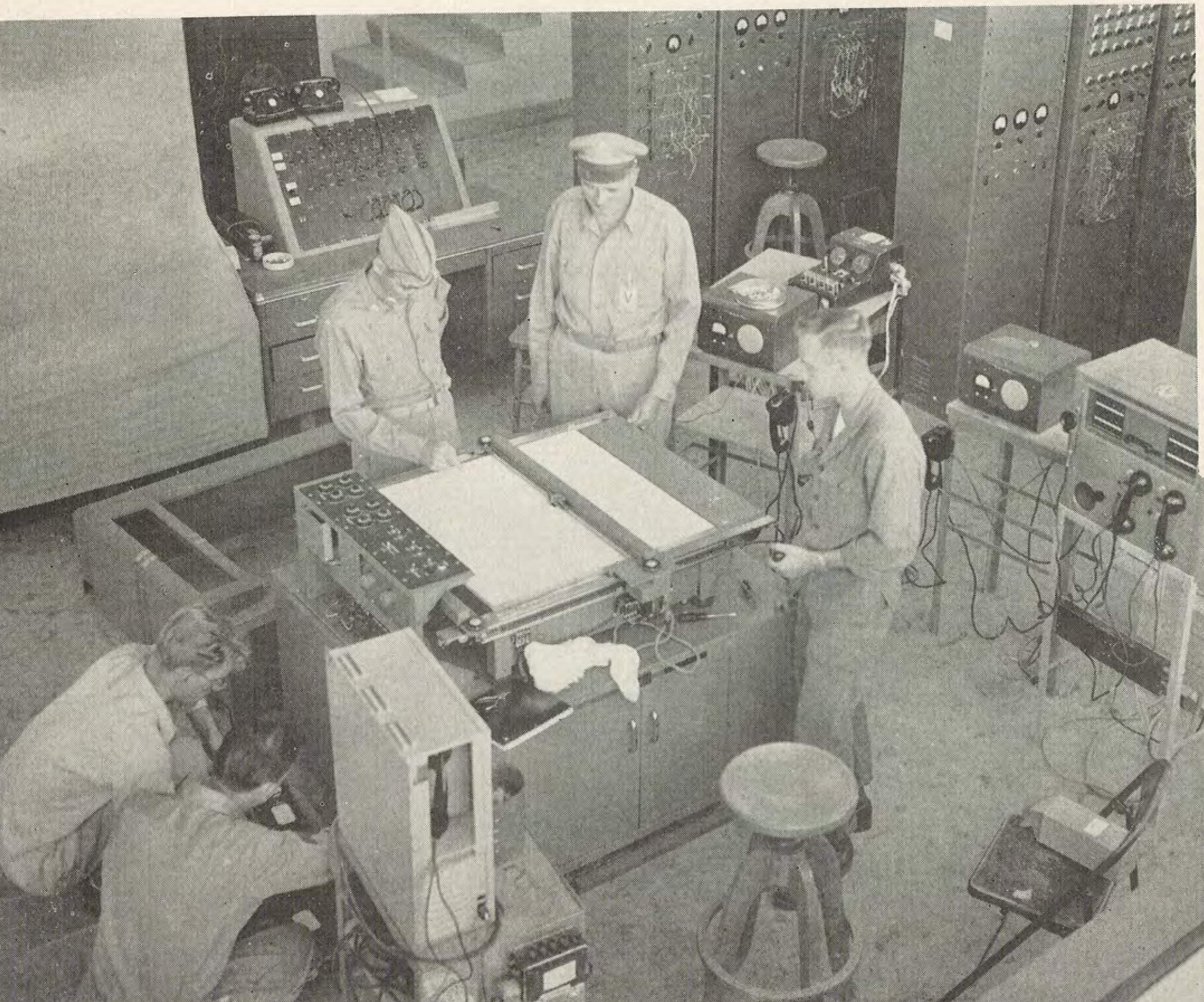
Considering the complexity of the system, the whims of nature, the moods of the operating personnel and the tandem relationship of one function to the other, the radar man is likely to approach his task with a prayer on his lips, a voltmeter in his hand, and a rabbit foot in his pocket. • • •

The Exclusive
Radar Goof Society

Sections	Membership Requirements
Booster Club	Lock on booster in automatic instead of missile. Wrong data will be plotted on safety board.
Block House Club	Lock on blockhouse instead of missle. Plotting board pen will never move while missile flies.
Spinner Club	Forget to turn on spinner motor and look shocked when radar refuses to track in automatic.
X Time Club	Request X-time after missile has not only taken off but impacted as well.
Parabola Club	Must have been knocked cold by walking into a radar dish at night while it is slewing.
High Voltage Club	Kick-off transmitter high voltage by accidentally resting elbow on H. V. button on console and shrieking "Beacon Off."

Parabolas and Plotting Boards

C Station Radars



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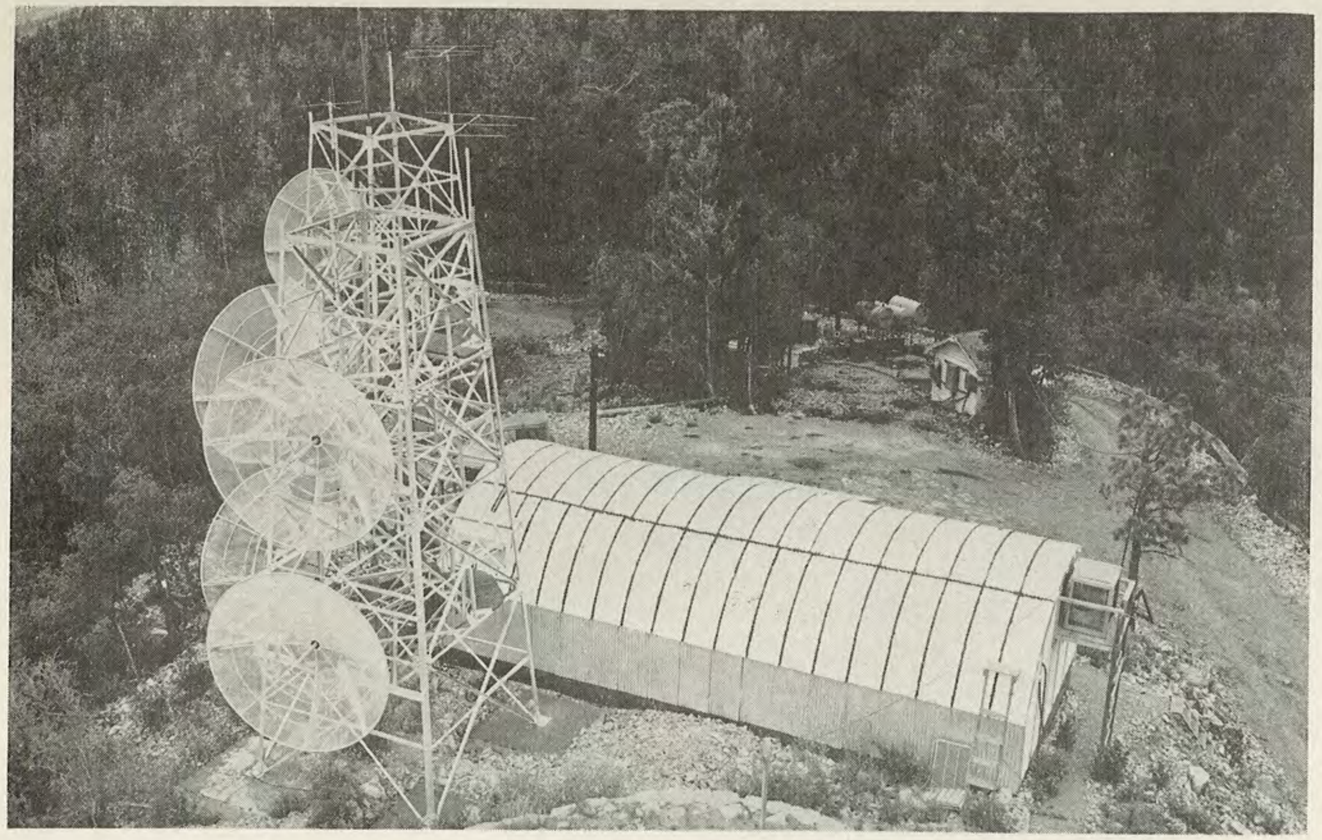
King I plotting room



Alamo Lookout Microwave Relay Station.

RADAR DATA FOR OPTICAL TRACKING

By PERRY L. WHITE
White Sands Signal Corps Agency

How the "chain radar system" supplies space position information to optical tracking instruments. Optical stations which are located beyond line of sight of launching areas or lose track of targets behind clouds can be pointed "on target" from radar data originating from a remote source.

VARIOUS groups at White Sands Proving Ground are constantly seeking practical means of improving and extending optical coverage of long-flying, supersonic missiles. Optical focal lengths have been increased, automatic tracking systems for optical instruments have been worked on, and radar acquisition data has been furnished to optical instrumentation sites. It is with the last named of these three approaches to the problem, that this article is concerned.

The heart of the acquisition system is the White Sands Signal Corps Agency's Chain radar system. This system has been in use at the proving ground for several years. It consists of four permanent radar control stations, located roughly 30 miles apart, from north to south, on the 120-mile-long missile testing range.

Assume that a missile is fired straight northward from a launching site near the southern range boundary. From the instant of take-off, the missile is tracked by "C" Station, the chain radar station nearest the launching site. "C" Station is now in command of the radar system. But as the missile speeds farther and farther uprange, control is passed from each station, in turn, to the next station to the north. Command is transferred the instant that it becomes apparent that another station is obtaining flight data superior to that being obtained by the controlling station.

The command station transmits missile space position data via a microwave link to the Alamo Lookout Radio Relay Station, atop a 9,288 ft. mountain. From the Relay Station, the data is microwaved to the other chain stations and radioed (VHF) to widely dispersed optical instrumentation sites. The chain stations receiving the data, apply parallax corrections, locate the target in space, and proceed to track.

Before transmission from a station in command of the system, all space position data is referenced to a common coordinate system. Thus all receiving stations, optical or radar, use only one set of parallax constants, regardless of which station is serving as the primary data source.

Each chain radar station is equipped with several radar sets. However, only one set can feed data to the chain at any given time. At a master chain station, the chain commander sits at a chain console during tracking operations. By means of information presented on the console, the commander can not only place any station in command of the chain system but can also select one particular radar set at that station as the data source for the entire system.

In this connection, a device for automatically selecting the command station and the best performing radar at that station has been considered desirable. To meet this need, the Signal Corps Engineering Laboratories have recently let a study contract to Cook Research Laboratories, Chicago, Ill., to investigate the feasibility of developing such a device. This presumably would be a small computer that could evaluate each radar's tracking performance, carefully weigh other factors, and select the radar producing the best chain data during any particular portion of a missile flight.

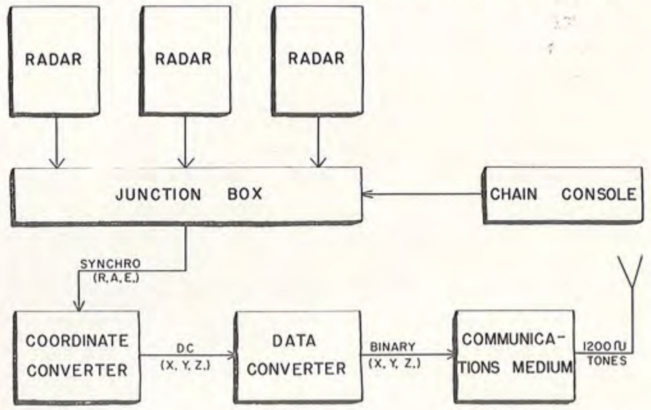
At the present time the chain commander chooses what appears to be the best performing radar by observing both a status board on the chain console made up of a multi-colored display of lights and the space position plot of the missile trajectory. The chosen radar feeds range, azimuth, and elevation data in the form of A.C. voltages to a synchro type analog computer. This computer, commonly referred to as an A.C. Coordinate Converter, transforms this polar data to the cartesian coordinates x, y, and z, applies parallax constants, and sets scale factors. Its output is three D.C. voltages, proportional to the x, y, and z coordinates of the missile's space position.

To digress briefly, the chain system is presently being extensively field tested to determine whether its accuracy and reliability can be increased significantly by replacing A.C. with D.C. type converters. Theoretically, the D.C. method, using radar sine-cosine and range potentiometers as the primary source of data, in place of A.C. synchros, will increase the accuracy, precision, and reliability of the chain data.

The output of the Coordinate Converter, i.e. the three D.C. voltages proportional to x, y, and z, are fed to the Data Converter. This instrument, a 16-digit analog-to-digital converter, transforms the D.C. voltages to binary numbers, applies parallax data as necessary, and feeds the binary numbers in the form of 1200 cycle tone bursts to the communications medium.

It should be interposed here that only the first 13 least significant digits are used for data transmission, a method providing a potential accuracy of .01% of maximum range. At present the three higher significant digits are not used. However, they could be used for data transmission and parallax purposes should it become necessary to extend the range.

BLOCK DIAGRAM— CHAIN RADAR SYSTEM TRANSMITTING STATION



From the chain station in command, the 1200 cycle tone bursts, representing the missile's position in the x, y, and z planes, are microwaved to the Radio Relay Station. The signals are then re-transmitted by either microwave or VHF radio links to all range stations using acquisition data. When necessary, the signals can be further relayed from the VHF receiver stations to more remote stations via telephone lines.

Present-day stations furnishing acquisition data to optical instruments, are equipped with a VHF communications receiver, an AN/TSQ-1 receiver, and a

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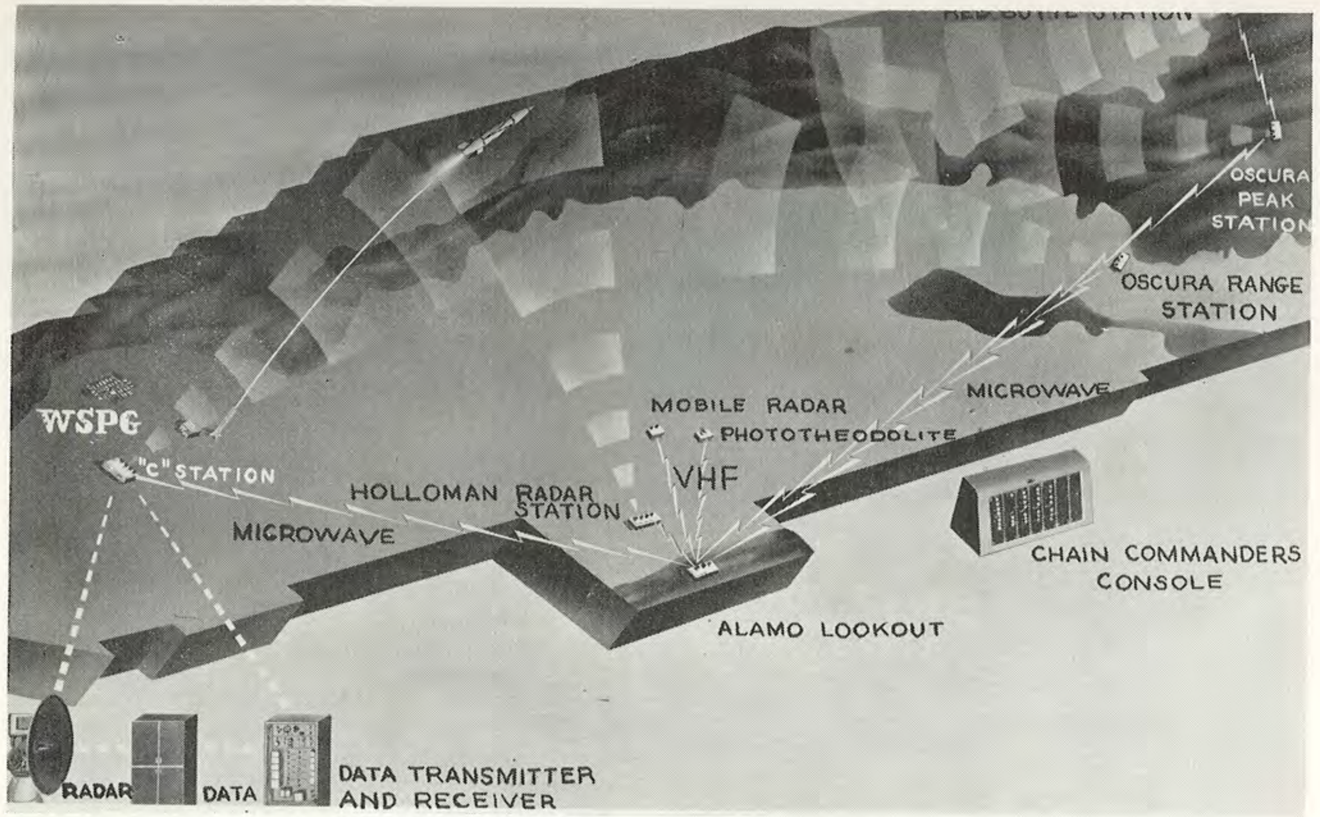


A schematic drawing of the principle of chain radar operation, showing the location of chain stations at WSPG, plus the microwave relay links. The chain commander can, by consulting his console, put any radar station in control of the chain to feed data all over the WSPG range.

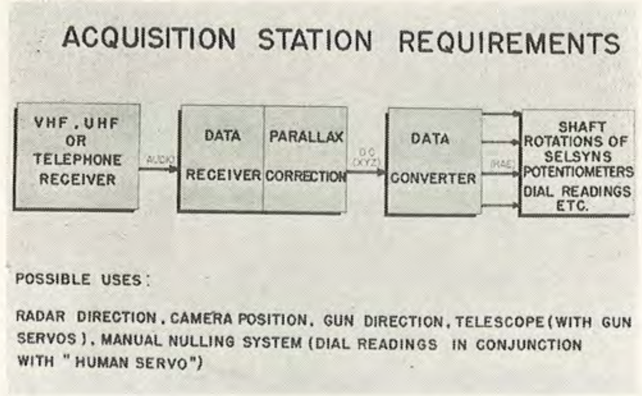
D.C., analog type, Coordinate Converter. The VHF receiver reproduces the original 1200 cycle tone burst at its output and feeds it to the TSQ-1 receiver. The TSQ-1, a binary-to-analog converter, which is equipped to handle 16 digits in the same manner as the transmitter, accepts the 1200 cycle tone burst, applies station parallax digitally, and produces three D.C. voltages proportional to the x, y, and z position of the missile with respect to the receiving station. These three voltages along with a D.C. reference voltage are then fed to the D.C. Coordinate Converter. The Coordinate Converter transforms the incoming data from cartesian to polar coordinates, applies proper scale factors, and produces the three necessary shaft rotations. Each shaft rotation is presented at the output in the form of a D.C. voltage and a synchro position.

Incidentally, this D.C. Coordinate Converter, developed at Evans Signal Laboratory, has not been conclusively field tested. However, its conversion accuracy appears to be within specifications requiring that the static angular standard deviation should not exceed 1 mil, and under dynamic conditions, should not exceed 2 mils at shaft speeds up to 6 rpm; that static range accuracy should be within 150 yards; and that velocity lag should not exceed 60 yards at velocities up to 20,000 yards per second. The Coordinate Converter also has facilities for adding parallax should it be used with instruments not containing this feature. However, at the proving ground, it is not normally used for parallaxing data.

Outputs of the D.C. Coordinate Converter are normally fed to two types of optical instruments: the IGOR (Intercept Ground Optical Recorder) and the Askania Cine-Theodolite. The IGOR is used to photograph the interception of an aerial target by an anti-aircraft missle. The Askania is used to photograph missiles throughout flight. Both instruments make use of telescopic lenses.

The IGOR cameras receive synchro data from the D.C. Coordinate Converter. To make this possible, cameras on the IGOR are modified to house two synchros which receive azimuth and elevation data respectively. Since circuits for both types of data are identical, only the operation of the azimuth circuit need be explained.

The stator of the azimuth synchro on the camera is wired in parallel with the stator of the output synchro at the converter. The rotor of the camera synchro is geared to the camera azimuth drive shaft. A resistance bridge containing a galvanometer is across the output of this rotor. This circuit is capable of detecting small differences in shaft rotation between the two synchro rotors. The galvanometer indicates the magnitude and direction of the error between the two shafts. Thus, the galvanometer readings indicate to the operators whether the IGOR is on target.



POSSIBLE USES:

RADAR DIRECTION, CAMERA POSITION, GUN DIRECTION, TELESCOPE (WITH GUN SERVOS), MANUAL NULLING SYSTEM (DIAL READINGS IN CONJUNCTION WITH "HUMAN SERVO")

The means used to feed acquisition data to Askania cine-theodolites is much the same as in the case of the IGOR, except that the synchros in the camera are replaced with linear potentiometers. Also, the Askania cameras receive D.C. voltage from the Coordinate Converter representing shaft rotation.

A systems evaluation program has recently been begun on the acquisition equipment described in this article. Sufficient data has not yet been gathered to justify conclusions as to over-all accuracy of the acquisition system. However, evidence that the system is serving its purpose very well does exist. The Optical Group of the Flight Determination Laboratory, White Sands Proving Ground, is continuing to make use of this system as an aid in optically instrumenting many types of missile programs.

Although this fact and other evidence indicate that the system is doing a very adequate job at White Sands Proving Ground, it is probable that additional work would be necessary to adapt it to longer range proving grounds. For example, range capability would have to be extended, and increased accuracy would be required. In addition, it would be desirable to devise servo driven optical instruments, thus eliminating the need for human operators, particularly in hazardous or isolated areas. • • •

A Signal Corps technician checks the recording instruments where a continuous record of chain operation is plotted, enabling engineers to assess the operation of the system.

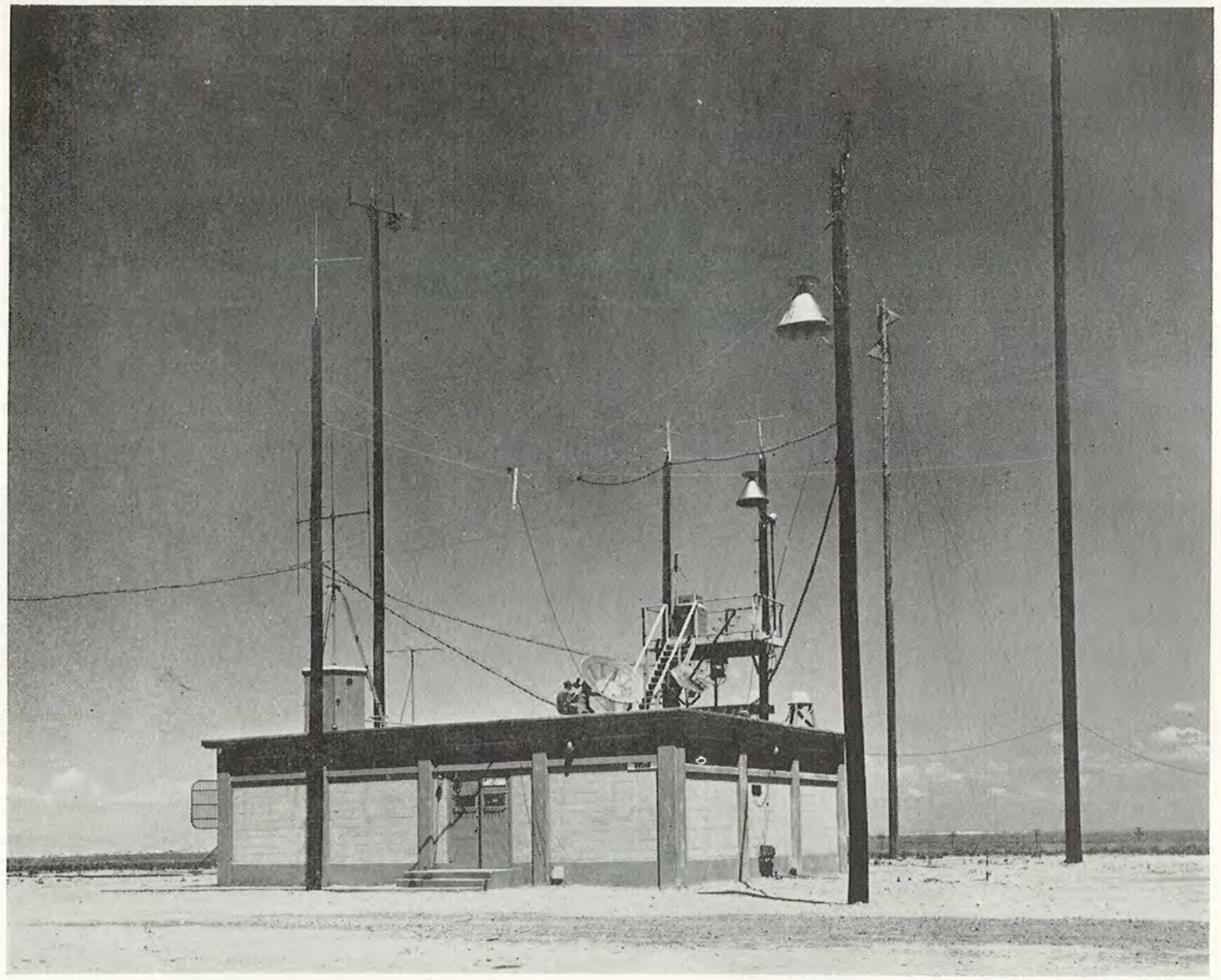
FREQUENCY COORDINATION

by

M. N. LUSTGARTEN

White Sands Signal Corps Agency

Chief, Frequency Co-ordination Division



Frequency Monitoring Building

Frequency coordination at White Sands Proving Ground not only includes activities similar to a medium scale Federal Communications Commission, but also includes technical analysis of equipment used in this area in order to aid in frequency assignments and solution of interference problems.

THE testing of guided missiles at the White Sands Proving Ground—Holloman Air Development Center Integrated Range, coupled with the large number of other military activities in the New Mexico—West Texas Area, has resulted in an unparalleled utilization of almost the entire usable radio frequency spectrum.

It is generally recognized that the list of uses is long . . . communications, navigational aids, missile guidance, radar tracking, telemetering, instrumentation initiation, velocity and range measuring devices, miss-distance systems, data transmission, television and many more; ECM activities and passive devices such as the radio telescope on Sacramento Peak serve to make the overall problem even more complex. It is not so generally recognized that the frequency spectrum is a limited entity and that much modern equipment is quite susceptible to interference, requiring careful coordination of all activities involved.

A system of coordination of joint military usage of the frequency spectrum has been in effect in the White Sands Proving Ground—Holloman Air Development Center—Fort Bliss Area for the past seven years. Recently, the Area Frequency Coordinator, a Signal Corps Officer appointed by the Chief Signal Officer with concurrence of the Navy and Air Force, has been given the additional responsibility for coordination of all military frequency usage in the State of New Mexico and all United States territory within 150 miles of Headquarters, White Sands Proving Ground. The Coordinator, who acts in the capacity of a technical advisor, is supported by the Frequency Coordination Division of the White Sands Signal Corps Agency.

Virtually every type of modulation, power range and antenna (airborne and ground base) that transmitter-receiver systems can utilize, does or will ultimately appear in the New Mexico-West Texas Area. Major installations include White Sands Proving Ground, Holloman Air Development Center, Fort Bliss, Biggs Air Force Base, Walker Air Force Base, Kirtland Air Force Base (Special Weapons Center and 34 Air Division) and Sandia Base. The United States Forestry Service maintains extensive communications nets throughout the area for the purpose of forest fire prevention. A large number of other government and non-government activities also make wide use of the frequency spectrum. The majority of frequencies used by the three military services in the area are allocated on a temporary, non-interference basis to non-government and government non-military services.

In order to ensure clear channel operation for all concerned, close coordination with the local Federal Communications Commission representative and continual liaison with major users of the spectrum is essential. Frequency usage is so extensive and so vitally connected to the guided missile program that it has been found necessary to schedule many of these operations, particularly radars and telemetering. Scheduling consists of geographical and time sharing of certain critical frequency bands or spot frequencies. Depending on antenna directivity, propagation conditions, and possible conflicting operations, the technique of sector blanking can also be employed. Wherever possible, minimum power and highly directional antennas are utilized, making assignment of identical frequencies to more than one operation feasible.

"Interference", a catchall word, has many connotations to operating and coordination personnel. A communications circuit may be "jammed" to such an extent that it is unusable. Such a condition may involve considerable loss of manhours, it may result in the delay or cancellation of a mission, it can even result in damage to property or loss of life. Interference to data transmission systems such as radar tracking, telemetering, or DOVAP, can destroy valuable data, resulting in a wasted missile test. Since the cost of certain missiles is of a high order, it can be readily understood that loss or deterioration of data is of considerable concern.

Control systems and range safety devices present a unique problem. Although certain systems are relatively invulnerable to interfering signals, others are not. Should a control system suffer interference, it is conceivable that the missile could assume a course which would cause it to impact outside the range boundaries. On one occasion in the past, before range safety became the science that it is today, a V-2 rocket crashed in Juarez, Mexico, causing little harm but considerable consternation. To prevent this sort of occurrence, extreme safety precautions are now taken. Missiles are tracked by radar and should they appear to be going off course, are destroyed by a radio or radar controlled device. Should interference occur, however, a missile's position could be lost and the project officer would have no other choice than to destroy the "bird". Fac-

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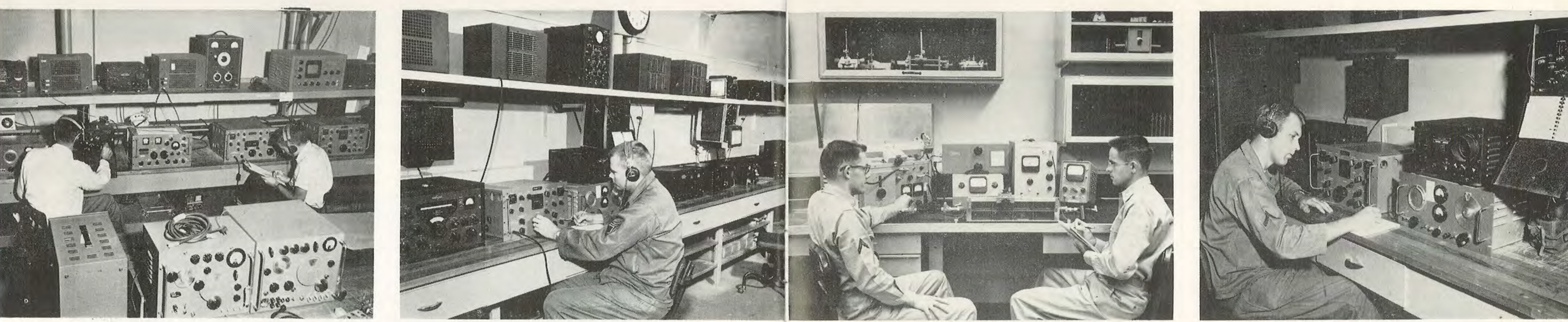
The original frequency coordination truck used at WSPG in 1949. Even though it looks like something out of Buck Rogers, the job of frequency coordination soon got too big to be handled by this small station.



Technicians with the frequency coordination unit maintain a constant watch over the entire electromagnetic spectrum utilized by radio, radar, and television for the entire state of New Mexico and all other U. S. territory within a radium of 150 miles. All frequencies to be used during a firing are scheduled and cleared for use during the time of preparation and flight; any interference might be disasterous, so the frequency coordination men are empowered to control the emission of radio signals. They use this power, too. If telemetry on a missile is encountering interference, they located the source of disturbance and order it shut off, regardless.

tors of cost, manpower, safety and relative scarcity of certain devices all demand that "interference" be held to a minimum. Yet, all missions must be given adequate "on-the-air" time. This, in brief, is the Area Frequency Coordinator's mission.

Complete records of all local frequency assignments are maintaned. Close liaison with all activities is essential. It is not at all unusual to ride through the "boondocks" and find a radar that was not there the day before. Liaison, paper work and scheduling, however, are not sufficient to ensure interference-free operation for all concerned. Monitoring is an important factor in the coordination process. Continuous routine monitoring is conducted to discover "holes" in the spectrum. Since propagation conditions are continually changing, many clear channels are suddenly discovered to be useless, necessitating quick changes of allocations. Scheduled frequencies are also monitored closely to observe whether unauthorized transmissions are present. Quite frequently, transmissions are noted in "silence" bands whose source must be located and eliminated quickly. Such sources may arise outside the area, in which case satisfactory coordination must be effected. Either the interfering signal must be silenced or a change to a suitable assigned frequency must be made. Local sources of interference are readily located by Direction Finding equipment. Occasionally, local area activities radiate spurious or harmonic signals, necessitating correction or modification of the equipment involved. Receivers may have relatively poor rejection characteristics, the overall selectivity may be too broad, IF isolation may be poor. Monitoring personnel can assist operating agencies in solving problems arising as a result of equipment defects.

Monitoring facilities located at White Sands Proving Ground, Holloman Air Development Center, the Fort Bliss-Biggs Air Force Base Area and the Albuquerque Area include fixed, semi-fixed, mobile and aerial units. The fixed station building, with approximately 500 square feet of floor space, houses receiving equipment which covers the frequency spectrum from 100 Kc —12,000 Mc, panoramic adapters and spectrum analyzers which give the observer a clear picture of the spectrum usage of a particular signal, field intensity meters which give quantitative signal strength measurements, pulse analysis equipment capable of giving pulse width, rate and spacing of pulse groups, recording equipment and a wide variety of test equipment including frequency meters, signal generators, etc. Recordings of field intensity and frequency shift, with appropriate time marks, of ground and airborne transmitter emissions, are made when required. This equipment must necessarily be of the highest quality available since it must be capable of matching the performance of the best equipment utilized in the field.

The primary problem of fixed monitoring is the selection of antennas. Ideally, the monitoring station should be equipped with high gain directional antennas capable of locating a specific signal of any type polarization at any frequency. It should also be possible to see, simultaneously, a large number of signals spread over a wide frequency range. Since it is a basic engineering concept that the gain-bandwidth product be constant, high gain and wide bandwidth cannot be simultaneously realized. Consequently, certain compromises must be made. Low gain, wide band antennas such as discones, hats and stubs are utilized as well as higher gain dipole arrays and yagis cut for specific frequencies or bands. A helix antenna is available which is capable of providing 6-8 db gain over the band 210-240 Mc, utilized by telemetering operations in the area. This antenna is quite directional and can be used for Direction Finding purposes or for providing field intensity measurements of missile telemetry radiation. In the radar bands, use of "dish" reflectors with provisions for adjustable inserts, (dipoles, crossed dipoles, helices, etc.) or horns provide sufficient directivity for the majority of cases that arise.

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Flexibility of antenna installations is, however, essential. During the course of an operation, it is frequently necessary to improvise a new antenna, or switch connections between antennas and different receiver heads. Careful and continual checks of antenna performance must be made. Patterns and VSWR measurements are made periodically as antenna connections easily become dirty or corroded resulting in unreliable monitoring results.

Semi-fixed stations are 5-ton trailers which can be established as fixed sites when required. Guided missile operations frequently select relatively inaccessible locations for launching to simulate tactical conditions. A fixed monitoring site usually cannot be chosen so that it can observe all possible significant signals or signal sources.

A mobile station, a ¾ ton modified ambulance type

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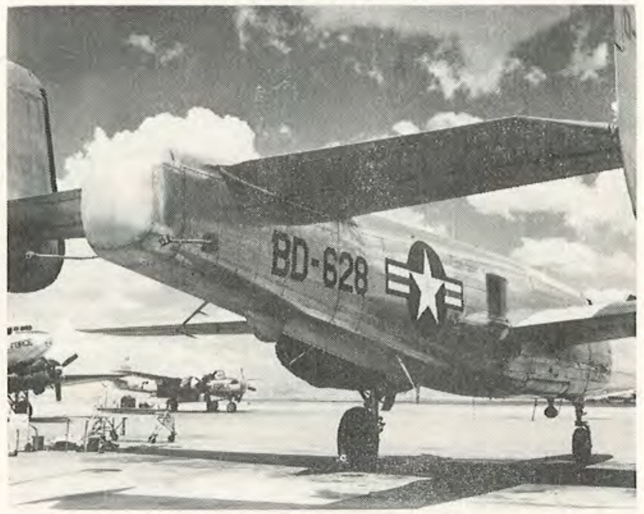

Frequency coordination men use this modified B-25 aircraft to search out the source of interference. Its innards are literally crammed with monitoring equipment.

FREQUENCY COORDINATION

(continued from page 25)

vehicle, is also extensively employed. When interference is reported, fixed monitoring may indicate that the interfering signal is emanating from a particular area in which many equipments are located. A small vehicle, equipped with appropriate receiving and field intensity equipment, is required to track down the source. On many occasions, operating agencies are not aware that certain of their equipment is actually radiating.

Another difficulty that often arises is a report of interference which cannot be observed by the monitoring team. It is then necessary to investigate the receiving site reporting the interference. This may be an instrumentation station, a missile launcher, or a hangar in which a missile is being checked. Odd situations frequently occur, such as unwanted oscillations or improperly shielded power leads which cause the operator to suspect an interfering signal when the difficulty lies within the equipment itself. Careful investigation will usually clear up these problems. It has been the experience of frequency monitoring personnel that inexperienced operators have a tendency to resort to complaints of interference when difficulties arise. Consequently, careful evaluation of all interference reports must be made.

Another function of the mobile station is to isolate power line troubles. Considerable radio frequency noise emanates from power lines or power transformers which are improperly maintained. Poor electrical grounds, dirty or corroded connections, and high voltage arcing can cause noise levels of the order of 30—100 microvolts/meter throughout the HF band (3—30 Mc) and well into the VHF band (30—300 Mc).

Aerial monitoring is also essential. Guided missiles, reaching extremely high altitudes, can "see" signals which cannot be observed on the ground. Since certain missile guidance systems may be susceptible to interference, aerial monitoring at altitudes above 30,000 feet is extremely important.

A further requirement for effective frequency coordination is a laboratory unit capable of providing frequency and power calibration services, (a primary frequency standard is available), calibration of monitoring field equipment, performing a wide variety of measurements such as antenna patterns, or attenuation and VSWR of microwave components, and performing system evaluations to determine spectrum utilization and interference susceptibility characteristics of critical equipment in the area. This last function is essential to determine the particular clear channel requirements of a specific system, (considering the types of other equipment in the area which are capable of causing interference), terrain features, antenna characteristics, and performance of receiving equipment when simultaneous "control" and "interference" signals of varying intensity and frequency are introduced. This evaluation is occasionally a complex problem, but certain rule of thumb approximations can usually be made to secure a "system bandwidth" figure which will insure clear channel usage in almost all cases that arise.

A typical problem, employing all of the resources at the disposal of the Frequency Coordination Division, arose as a result of what appeared to be a routine case of interference. Small drone aircraft utilizing commercial TV bands reported serious "interference" conditions. The aircraft, which are equipped with parachutes, consistently "popped chutes" after they had been in the air for a few minutes.

Mobile and aerial monitoring teams were dispatched and the control frequencies monitored. No interfering signals were observed but the "interference" continued. To solve the problem, a complete investigation of the system transmitter, receiver, antennas, batteries, calibration and maintenance techniques was conducted. In the laboratory, simultaneous insertion of "control" and "interference" signals of varying amplitude and frequency provided a sound basis for necessary guard channels between transmitters at adjacent and distant locations. Transmitter and receiver stability was also considered.

Investigation of field alignment techniques indicated that peak transmitter power, maximum receiver sensitivity and optimum antenna performance were not being attained. Perhaps the most serious deficiency was

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"Not very tasty, are they?"

FREQUENCY COORDINATION

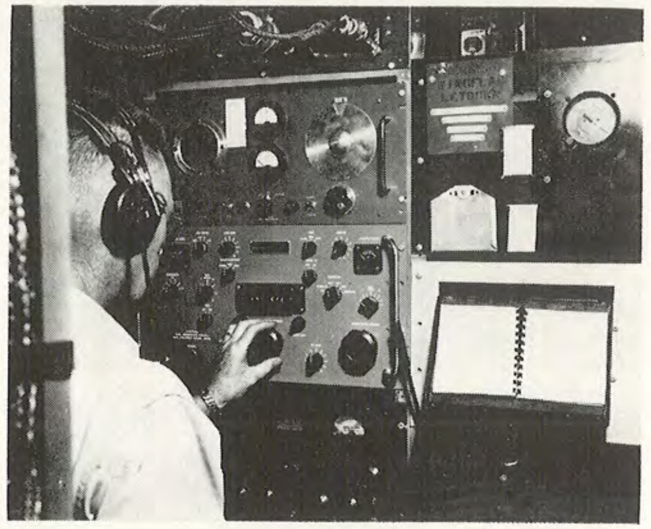
(continued from page 27)

inadequate battery testing. A large number of "interference" cases were shown to have been caused by reduced battery voltage.

To prevent recurrence of the problem, the following actions were taken. An allocation table was drawn up, coordination with local Federal Communications Commission personnel was effected, securing authorization for use of the frequencies. Crystals were procured on an emergency basis. Field personnel were instructed in equipment adjustment and alignment and action was taken to procure necessary test equipment required to perform effective field operation. As a result of these measures, operational difficulties were reduced to a minimum.

As can be seen, coordination of the frequency spectrum is a complex problem. Apart from actual cases of interference on adjacent channels, originating locally or from distant points (one control system received serious interference from a transmission originating in New Hampshire), many situations arise due to limitations of transmitting and receiving equipment involved. Stability of transmitters or receivers, harmonic and spurious emission, spurious responses, and other equipment characteristics may be factors in causing or experiencing interference conditions.

A thorough knowledge of all equipment in the area, a continual surveillance of spectrum usage and operating conditions, complete cooperation of all concerned . . . all these, with capable monitoring, laboratory and liaison teams are necessary to ensure what is fast becoming a rarity in this part of the world—a completely interference-free frequency band. • • •



Frequency monitoring equipment in the B-25 aircraft.

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Chicago Standard
Clarostat Mfg. Co.
Erie Resistor Co.
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Eitel and McCullough Co.
Electronic Tube Corp.
Federal Telephone and Radio Co.
General Cement Mfg. Co.
Greenlee Tool Co.
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Harvey Hubbell, Inc.
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Krylon Co.
Marion Instrument Co.
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Pyramid Electric Co.
Precise Development Co.
Philmore Corp.
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MISfires . . .

A Rocket Man's Dictionary of Bureaucratese

Inasmuch as rocket people will undoubtedly run up against such things as office procedures, administration, and a lot of other junk that piles up in an "IN" basket, we think it may be of some help to define the somewhat ambiguous terminology used in this tremendously broad field of bureaucratism into which a lot of rocketmen have found themselves thrust. **Non illigitimus carborundum.**

PART TWO

CONSULTANT (or expert)—Any ordinary guy more than 50 miles from home.

TO IMPLEMENT A PROGRAM—Hire more people and expand the office.

A MEETING—A mass mulling by master minds.

TO NEGOTIATE—To seek a meeting of minds without a knocking together of heads.

RE-ORIENTATION—Getting used to working again.

RELIABLE SOURCE—The guy you just met.

INFORMED SOURCE—The guy who told the guy you just met.

UNIMPEACHABLE SOURCE—The guy who started the rumor originally.

WE ARE MAKING A SURVEY—We need more time to think of an answer.

NOTE AND INITIAL—Let's spread the responsibility for this.

SEE ME, OR LET'S DISCUSS—Come down to my office, I'm lonesome.

LET'S GET TOGETHER ON THIS—I'm assuming you're as confused as I am.

GIVE US THE BENEFIT OF YOUR PRESENT THINKING—We'll listen to wat you have to say as long as it doesn't interfere with what we have already decided to do.

WILL ADVISE YOU IN DUE COURSE—If we figure it out, we'll let you know.

TO GIVE SOMEONE THE PICTURE—A long, confused and inaccurate statement to a new comer.

SPEARHEAD THE ISSUE—To expand one page to fifteen pages.

THE ISSUE IS CLOSED—I'm tired of the whole affair.

ACTIVITY LEVEL—The level at which all activity ceases.

(next page, please)

"5 . . . 4 . . . 3 . . . 2 . . . 1 . . . Hold! Holding!"

A ROCKET MAN'S DICTIONARY . . .

COMMITTEE—A group of the unfit, appointed by the unwilling, to do the unnecessary.

INCENTIVE PROGRAM—The most complicated arrangement that can be devised to keep the employee from having any interest whatever in improving the status quo.

SHOP—Affectionate term used by administrators to suggest that the group they head produces something.

STAFF ASSIGNMENT—Standard operating procedure to reduce effectiveness of those successfully performing productive work.

SYNTHESIS—A compounding of detailed bewilderment into a vast and comfortable confusion which offends no one.

TASK FORCE—Three employees assigned to prepare a complete statement of bureau-level policy and given a four-day deadline.

ENGINEERING TYPES

— by Wagoner —

SCIENCE WITHOUT PHILOSOPHY IS BUT A MASS OF UNRELATED FACTS ——

ANONYMOUSE

Rare Birds of the American Southwest

Compiled by
R. K. AUDOBURNE

SAGE SCOOTER (Apoidea Aeria)

Field Marks: Long and slender, the overall length varies from 20 feet to over 23 feet with a body thickness of about 15 inches. Coloring is plain, usually all white with an occasional all red, or red nose and tail combination seen. The tail consists of three plane surfaces located symetrically at the rear of the body.

Similar Species: Lesser Man-O-War Bird (See description in **Missile Away!** Fall 1954)

Range: Although very common in Southern New Mexico this bird has been seen at such out-of-the-way places as the Gulf of Alaska and the equatorial region of the Pacific Ocean. There are indications that this species adapts quite readily to a wide range of climatic conditions and that the number of birds outside of New Mexico will increase rapidly in the next few years. It is expected that the bird will thrive even in such a rigorous climate as that at Ft. Churchill, Canada.

Comments: A very high flying bird for its size, it can reach altitudes between 70 and 100 miles. These high flights result partially from the assistance provided by a booster in getting away from the ground with a fast start. The flight characteristics are strongly dependent on low altitude winds since the bird cannot move its tail fins during flight. This means that it must have the proper heading before leaving the ground.

The bird has been invaluable to bird watchers interested in the conditions that exist in the upper atmosphere. This small fellow has even been known to do such things as cough up a balloon near the top of its flight, keep part of its nose continually pointed directly at the sun in spite of the motion of the rest of its body or give monkeys and mice rides high in the sky.

The bird is generally very reliable but has been known to drop its booster, or even return itself, to the ground in the vicinity of dismayed bird watchers—just one of the risks of watching rare birds.

Other Names: Townsend's Wobbler, AOB, Desert Scooter.

POST-SHOOT CONFERENCE

THE president of our Holloman-Alamogordo Region, Lt. Col. John P. Stapp, USAF (MC), has again made the news. The September 12, 1955 issue of **Time** magazine featured Col. Stapp on the cover, as well as a long article on his life and his aeromedical research. In addition, Stapp now holds the coveted Air Force Cheney Award for valor and self-sacrifice. Our hats are off to you, Colonel Stapp! It is a pleasure to note that there are still men around who are willing to take risks, particularly for knowledge.

* * *

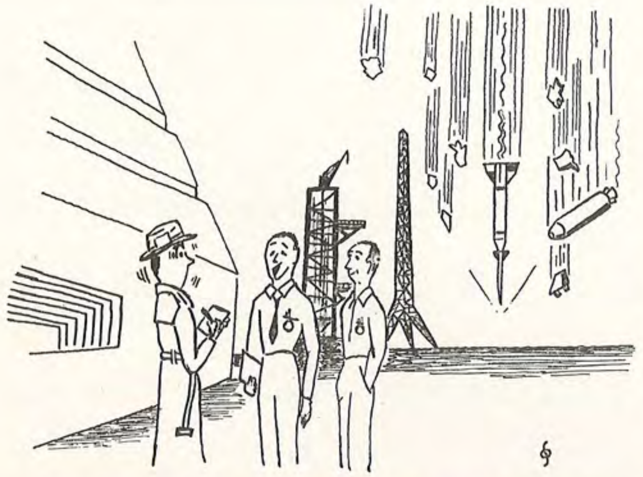
Operation Bacchus proceeds, but no further news except that Don Moore has been appointed Project Officer with a competent staff under him.

* * *

Past-president Frank L. Koen, Jr., now with Ramo-Wooldridge in Los Angeles, delegated his authority as NM-WT Section member of the ARS National Nominating Committee to the Section's Board of Directors, who promptly acted in the matter of selecting a slate of candidates for consideration by the Committee at the September meeting in Los Angeles.

* * *

George L. Meredith, member of the NM-WT Section Board of Directors, journeyed to Los Angeles to present a paper written jointly with Don I. Thompson. The paper dealt with "Missile Flight Safety Considerations at White Sands Proving Ground." Good for you, gentlemen!



"Yes, we just launched the first made-made earth satellite vehicle!"

This is the first issue of "**Missile Away!**" put together with the "task group" concept. Dudley Cottler of WSSCA at White Sands consented to be the guinea pig for this first experiment which is something new in the way of editorial policy. Dudley and his group tackled the momentous assignment of coming up with the editorial contents of the magazine, plus photographs. (The regular staff handled the regular departments such as this) It looks like it has worked. And it certainly saved wear and tear on the regular staff. But we are wondering how Dudley and his crew feel now. Don't worry, boys; you won't have to do it again for a long time!

* * *

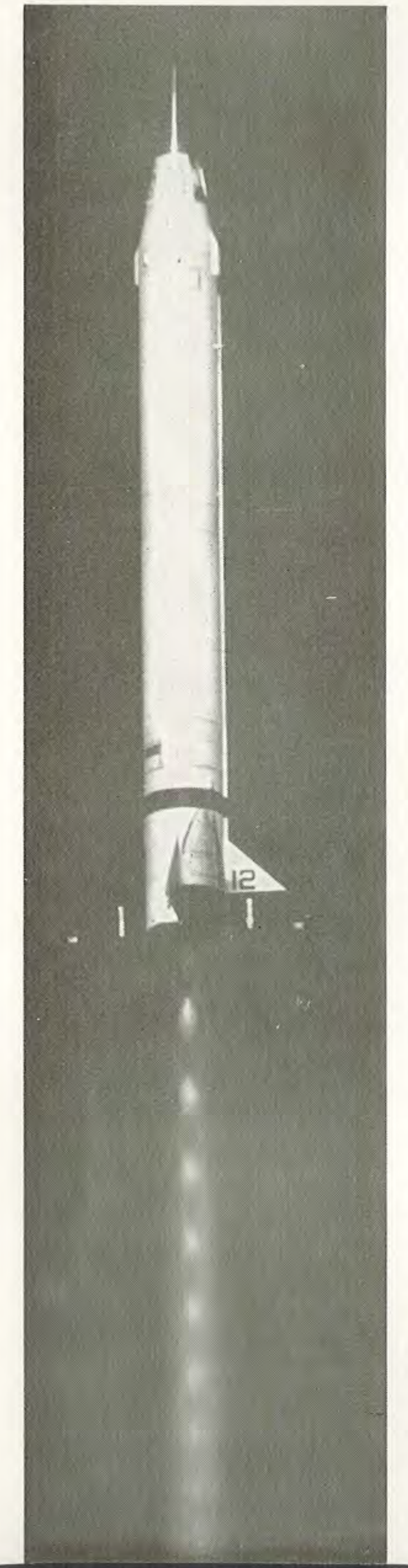
We wish to congratulate the Southern California Section on the quality and content of their printed program for the National Fall Meeting. It is an excellent, first-class job. Maybe we will have a program for the Annual ARS Meeting like it. And maybe "Missile **Away!**" is due to have another sectional publication as a brother-in-arms. It looks like the SoCal boys have it in them.

Covering a million and a quarter square miles, this Naval Research Laboratory aerial view of the continental United States is believed to be the largest earth area ever photographed from one spot at one time. It is a painstaking composite of 310 separate prints of 16-millimeter movie film, taken over White Sands Proving Ground, New Mexico, from a height of 100 miles by a camera mounted in an Aerobee sounding rocket.

Covering a 2800-mile horizon, the photograph sweeps from Omaha, Nebraska on the left to the lower Gulf of California on the right. The camera's eye traversed nine states and—incredible though it may seem—all of Texas too. But the curvature shown is deceptive—it is not the earth's but the rocket's own horizon.

The coverage possesses another unusual feature—the first photograph of an entire hurricane. A thousand miles in diameter, the monster is centered over Del Rio, Texas. Weather officials, quick to recognize the potentialities of this type of observation, plan to use Aerobees in a variety of forecasting programs.

"Beyond the satellite, the future can be only dimly perceived. One thing can be said. As long as men have the curiousity and the courage, the exploration of space will continue to at least the farthest reaches of the solar system."—Milton W. Rosen, The Viking Rocket Story, **page 235.**



Coming from the Rocket Capital of the World at White Sands Proving Ground, "Missile Away!" is proud to publish the works of the men who are foremost in their fields, the men who have been in the forefront of American rocket development.

Those of us with the New Mexico-West Texas Section of the American Rocket Society chose the above quotation from Milton Rosen as the representation of our feelings about the ultimate use of the rocket, the new prime mover.

The rocket alone is not our goal; nor is the conquest of space. Already, rocket-powered guided missiles stand ready to defend our cities. Rocket-assists are being used on commercial airliners.

Advances in propellant chemistry, combusion, instrumentation, and servomechanisms are already being felt by the man in the street as derivaties of the devices of rocketry find their uses in the everyday world.

"Missile Away!", far from being written for the select few of rocketry, is our contribution. Within its pages has appeared—and will appear—the heartbeat of rocketry, the hard-won history, the humor, the thoughts, and the story of the men who are living the audacious dream of Goddard, Oberth, Winkler, Wyld, and all men who have looked at the stars and wondered.

The success of this magazine's philosophy is evidenced by the fact that few back issues are available. But the future ones can be yours if you are not already receiving "Missile Away!"

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