Signal Corps Centennial

By Harold A. Zahl

IN June 1960, the US Army Signal Corps celebrated its 100th birthday. In looking back a century, it is apparent that the combat record of this proud Corps and the research so closely interwoven with the force its wartime endeavors brought to bear in conflict, is, in part at least, a story of physics as it unfolded during the past four generations of our Nation's history.

Our centenarians will remember that it was General Albert J. Myer who during the Civil War started research pointed toward a new horizon in communications. That it was General William B. Hazen who first set up a laboratory for meteorological research which led to a military weather service which in 1890 was separated from the Army and established as the US Weather Bureau in the Department of Agriculture.

It was Signal Officer Greely, who in the First International Polar Year led a scientific expedition of twenty-five men into the Arctic in the year 1881 and returned in 1884 with only five other survivors. But the six brought with them the best scientific records of arctic phenomena history had ever known. The data formed an unbroken series of hourly meteorological, tidal, mag-

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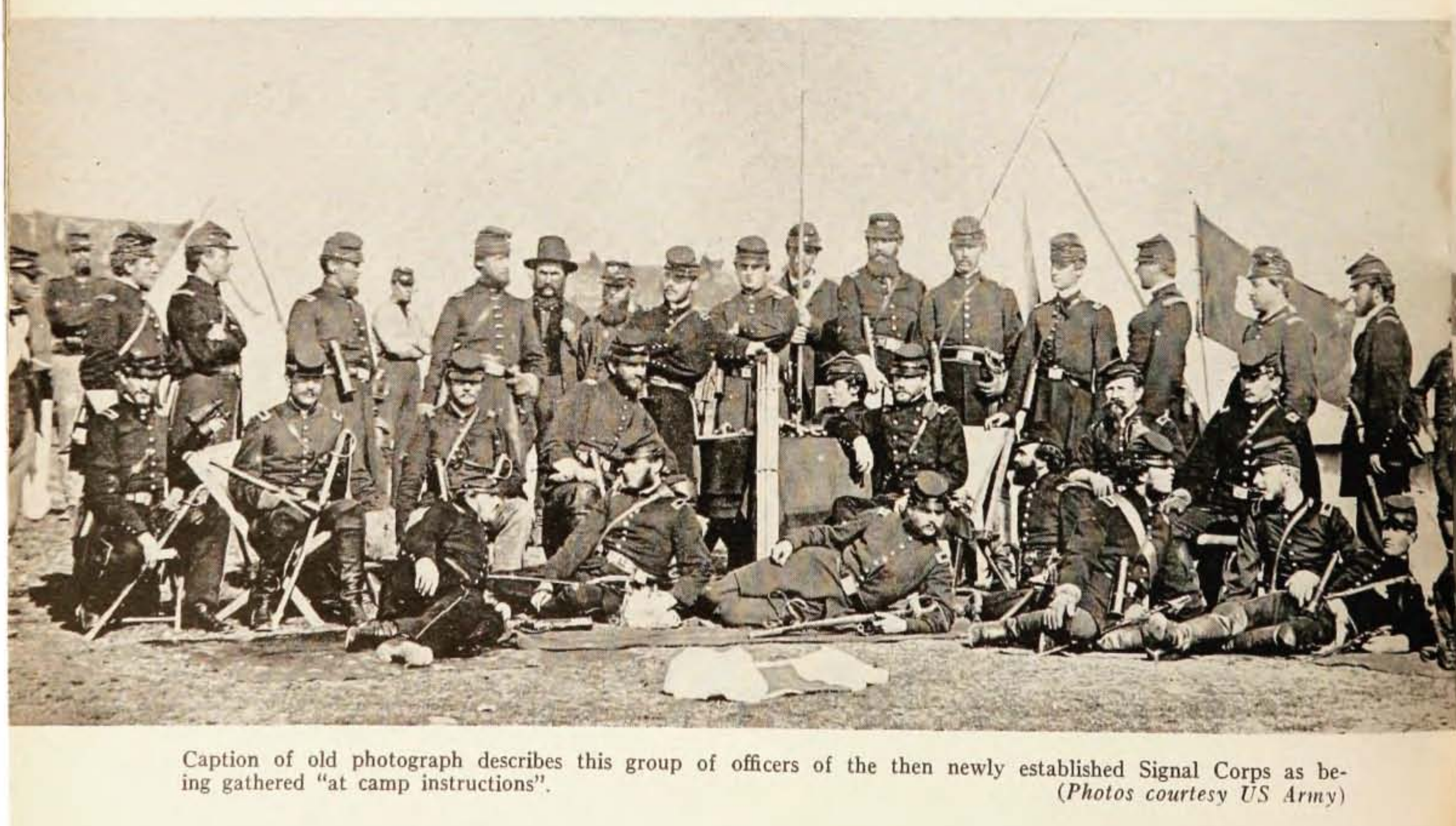


Caption of old photograph describes this group of officers of the then newly established Signal Corps as being gathered "at camp instructions". (*Photos courtesy US Army*)

en. Albert J. Myer | Gen. William B. Hazen | Gen. Adolphus W. Greely | Gen. George O. Squier | Civilian R. A. Millikan

netic, and pendulum observations covering a period of two full years.

It was soldier-scientist General G. O. Squier with physicist R. A. Millikan, who in World War I pushed forward the fields of physics, aeronautics, communications-electronics, and aerial combat so effectively that the Corps' aviation effort soon grew into the organization of a separate Army Air Corps. During this period radio was so new and unappreciated, and wire communications used so much, that history even records a line commander reporting back by radio that he was "entirely out of communications".

Manila, Fort Malate. Signaling for reserves to advance after retreat of the Spanish—August 13, 1896.

While the voice of radio became louder and louder as the war closed, the impact of this new form of war communications was felt more in the immediately following peace since the civilian-operated broadcast industry, beginning in the early Twenties, surely inherited the equivalent of ten years of peace-time research; even as did television when World War II ended.

In the early Thirties, Signal Officer William R. Blair wondered why not use pulse-echo techniques for detecting small reflecting objects in space—airplanes for example? This, with his associates, he did (as did US Navy personnel independently)—but it was not until 1958, following one of the most exhaustive patent searches in history, that the US Patent Office awarded Colonel Blair the basic patent for radar for work done in the Signal Corps Laboratory prior to World War II.

One could even say that the Corps introduced the "Space Age", when in 1946, Lt. Colonel John H. DeWitt and his associates announced the first successful radar contact with the moon; while almost simultaneously, the US Army Ordnance Corps acted on a Signal Corps request for the first of the Nation's guided missile research family—the meteorological rocket known as the "Wac Corporal".

While all these are historic accomplishments, the story of physics in the Signal Corps goes beyond and much deeper. The full story of progress in the broad fields of communications and surveillance, which are the Corps' major technological responsibilities, encompasses almost the entire field of the physical sciences. But the core is physics and from physics spring electronics and the invention, development, production, and issue of superior equipments to our troops.

Based, in part, upon the superb demonstration by the National Research Defense Committee of science's power in World War II, the Corps' postwar technological objectives were clear. It was understood by most everyone, that in the nuclear age, to be effective in future military emergencies, one must not only follow scientific accomplishments—one should be a part of

Field telegraph equipment in 1898 was carried in mule-drawn Signal Corps battery wagons.

them, for time will be all-important in any future global conflict. This required a strong internal potential within the Corps capable of going into partnership with civilian scientists and scientific endeavors throughout the nation, and the rest of the free world. To the latter end and at the close of World War II hostilities, as the various laboratories of the NDRC were undergoing dissolution, the Signal Corps, in conjunction with Navy and USAF representatives, evolved the then quite radical concept of improved defense through direct dollar support of basic research in our Nation's educational institutions. The very first of these postwar research experiments was a Signal Corps project under Professor Rabi of Columbia University, soon joined in support by the Office of Naval Research and later by the USAF. In 1946 also, the concept of Joint-Service support for basic research was introduced by the Signal Corps and under Professor J. Stratton, the Research Laboratory of Electronics at the Massachusetts Institute of Technology came into being. This pattern was soon expanded to include work at Harvard, Columbia, Princeton, Michigan, Illinois, Texas, Stanford, Polytechnic Institute of Brooklyn, and others, with all Services sharing the mundane task of contract administration. Most of this effort still continues, albeit many other elements of Government in later years have now joined in support of basic research on a scale far greater than the Signal Corps or any other one service by itself would ever have been able to achieve—but the pattern was set early.

We are proud of the results of our research contracts with educational institutions, joint-service or separately supported—for example, the experiments of Lamb for improving man's understanding of the hydrogen atom; the experiments of Kusch on highly precise measurements of the magnetic moment of the electron; the work of Ramsey, Zacharias, Strandberg, and Dicke on adding fundamental knowledge to the field of atomic resonance frequency and time control; experiments by Townes which led to the maser; Bloembergen's work toward the solid-state maser; Longacre for research leading to "side-looking" radars;—and overseas, we take pride in our partial support of Warnecke's work which led to the discovery of the carcinotron pointing the way to high-power voltage tunable oscillators.

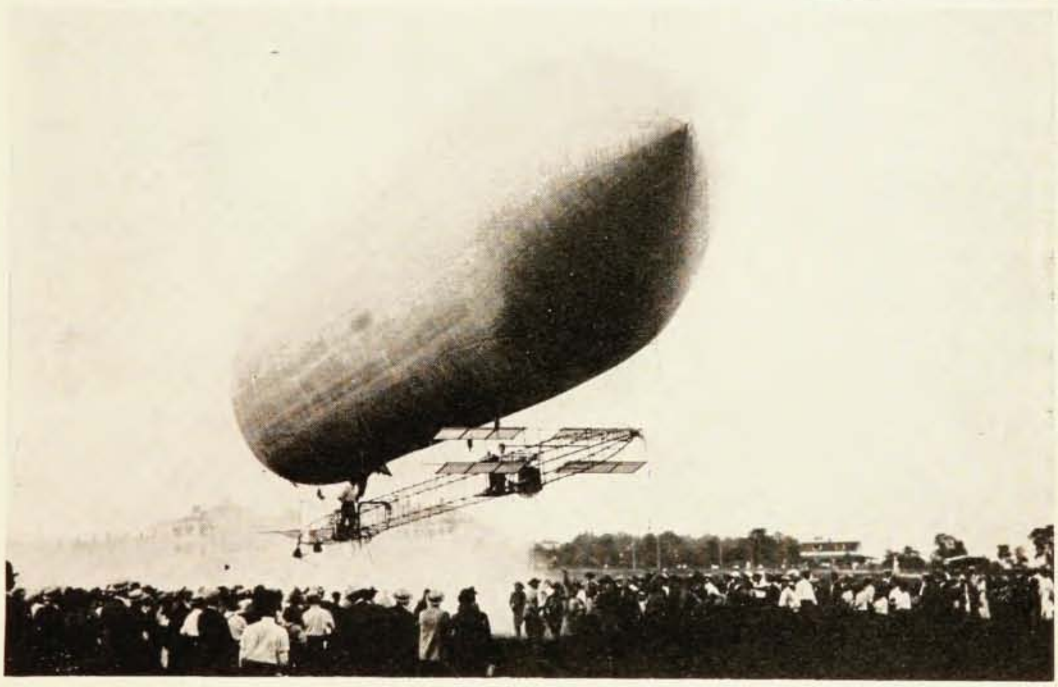
The above listing could go on almost endlessly and would name many other physicists who have made important findings. What is frequently not too well understood, however, is that in making truly noteworthy contributions to pure science, incidental by-products may become of extreme importance over and above the specific reasons for the original research. For example, the technology required and developed for the Nobel prize-winning measurements of Lamb and Kusch was the same technology which simultaneously provided the breakthrough for millimeter radar to move forward into the area of potential applications; the gas maser gave a new dimension to frequency control, the solid-state maser and the parametric diode provided previously impossible sensitivity in devices reaching for signals coming from man-made vehicles traveling millions of miles away into the cosmic unknown.

In keeping with Department of the Army policy, the Corps maintains a superb laboratory facility [1] at Fort Monmouth, New Jersey, where a total staff of 3000 people (many engaged in physics research) set the pace for the Corps' R&D effort which is currently also supported by 150 research contracts (half industry, half educational institutions) spread throughout the nation and augmented further by support in Western Europe through the Army's European Research Office. The interest in our internal effort, and in the R&D contracts we support and monitor, can in part be measured by the fact that in the past year over 70 000 visitors came to our Laboratory. This does not include overflow crowds for which we were forced to establish convention facilities in Atlantic City when the North Jersey shore could no longer handle the numerous attendees.

As a small but important spark in the Nation's explosive reaction to the Sputnik incident, ten percent of our most senior scientists were placed in an environment almost unique in military organization when our Institute for Exploratory Research [2] was formed. Within the framework of this new structure, we are conducting many experiments having both direct and indirect bearing on long-range aspects of our development program. For example, in radio work and in conjunction with the USAF and ONR we are studying re-

[1] H. A. Zahl and F. B. Moses, "New Signal Corps Laboratory", Physics Today 7, 12 (April 1954).
[2] H. A. Zahl and E. M. Reilley, "Exploratory Research", Physics Today 11, 20 (August 1958).

Signal Corps balloon ascension on April 17, 1908 at Gas House Field, Washington, D. C.

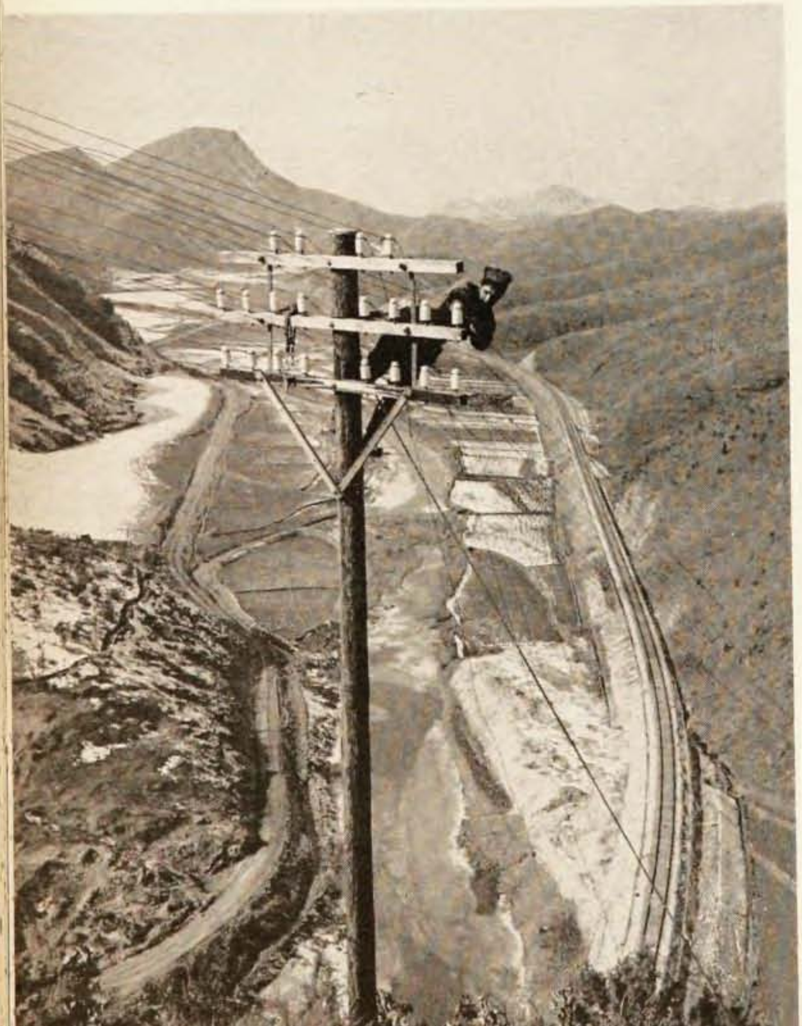


The first Army dirigible is launched at Fort Myer, Va., in the summer of 1908.

In May 1918, pigeons are prepared for carrying dispatches at 42nd Division Headquarters in St. Pol, France.

During the siege of Corregidor in April 1942, the Signal Corps personnel shared Lateral No. 12 of Melinta Tunnel with members of the Army's Finance Office staff.

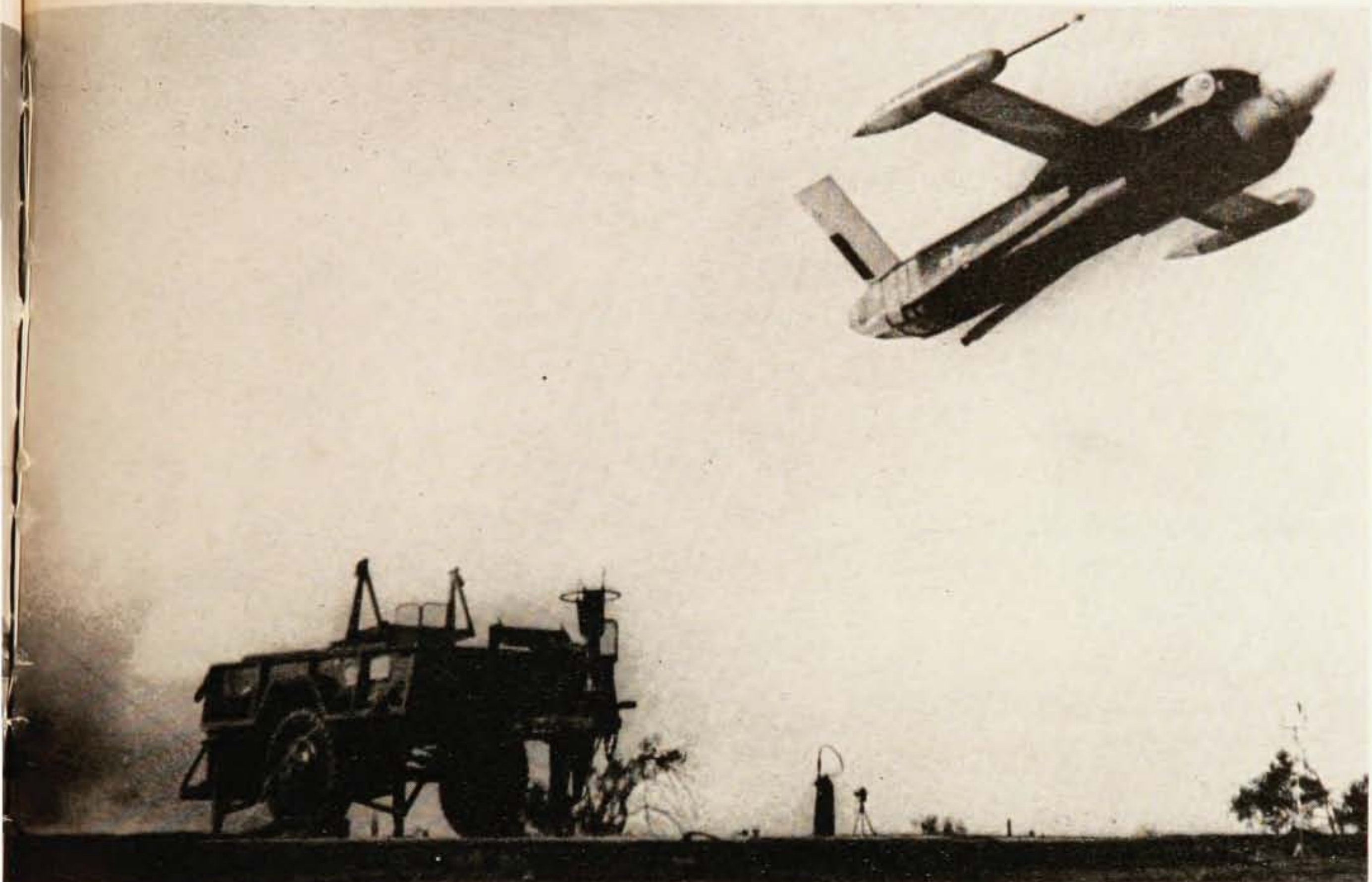
Below, corporal from 4th Signal Battalion perches precariously on line pole in Korea in January 1951.



Diana, the 50-foot radar antenna at the Signal Corps Engineering Laboratories, Fort Monmouth, was constructed for use in tracking artificial earth satellites.

flection phenomena as a function of frequency from artificial ionospheres produced by the creation of chemical clouds high in the atmosphere at the upper range limits of carrier rockets; a 100 000 joule condenser discharge is used to produce dense plasma which enables the simulation of ionospheric hydromagnetic phenomena so we may learn more of communications problems associated with missiles and satellites operating in a nuclear environment; and in using recent premoratorium ARGUS high-altitude nuclear bursts, our scientists discovered two new ductlike mechanisms for propagation of hydromagnetic waves—waves which appear to be generated when the atomic blast completely annihilates the magnetic field at that point and when the magnetic balance is re-established, spread out like ripples in a magnetic pond. We have work going on investigating properties of materials very close to absolute zero; and in high-pressure research, in looking for exotic substances as yet unknown to man, as a first step, we have been successful in synthesizing one of nature's invariants—crystallized cubic carbon.

These things and many more, in the internal language of our Laboratory, we call "Exploratory Research"; and in our research contracts, 25 percent of all monies



The first photo (April 1959) of successful flight test of remote-controlled combat surveillance drone SD-2, which was designed and built for US Army Signal Corps by Rheem Manufacturing Co.

available for contracts go into similar basic effort, the remainder being oriented in a more applied direction and frequently with some security classification.

It being our birthday, in boastful modesty (and in hope for accolades) the Signal Corps is proud of its many original achievements over the past century. As more recent unclassified examples: in the spectacular field of outer space, we are pleased that the solar cells we placed in the IGY Vanguard I satellite, even after two and a half years of continuous operation and almost 10 000 trips around the world, still provide power for as yet unattenuated radio signals which are regularly intercepted in our Astro-Observation Center; the first voice communication from outer space came from the Army Signal Corps—ARPA Project SCORE when on December 18, 1958, the President of the United States broadcast Christmas greetings to the world and beyond. On April 1, 1960, the NASA TIROS satellite, produced under the technical direction of the Army Signal Corps, started sending sensational pictures of global cloud cover back to earth. The almost 25 000 pictures received in a dramatic 90 days of uninterrupted operation, will contribute immeasurably to our understanding of atmospheric phenomena; what makes weather, how to use it more effectively militarily, how to predict it, and going further—how to take advantage of this knowledge for increasing safety in air travel and to provide more warning for civilian populations of violent atmospheric disturbances such as tornadoes, cyclones, etc. And later, TIROS-type data, coupled with the findings of our Project CIRRUS (which several years ago sensationally demonstrated certain possible controls over weather when conditions were right), enable us to visualize significant contributions toward a more equitable distribution of the earth's rainfall and snow.

Starting the Signal Corps' second hundred years—first, of combat alertness and strength, and second, of applying all facets of science toward the technological improvement of the needs of defense, it is apparent that physics yesterday has done well by the Signal Corps. What remains for the future is a challenge to the Corps, to assist in allowing science all the dimensions needed for healthy growth, so that physics tomorrow will not only quickly reflect itself in the struggle of keeping a civilian economy strong and globally attractive, but maintain a defense posture which dares not be challenged.