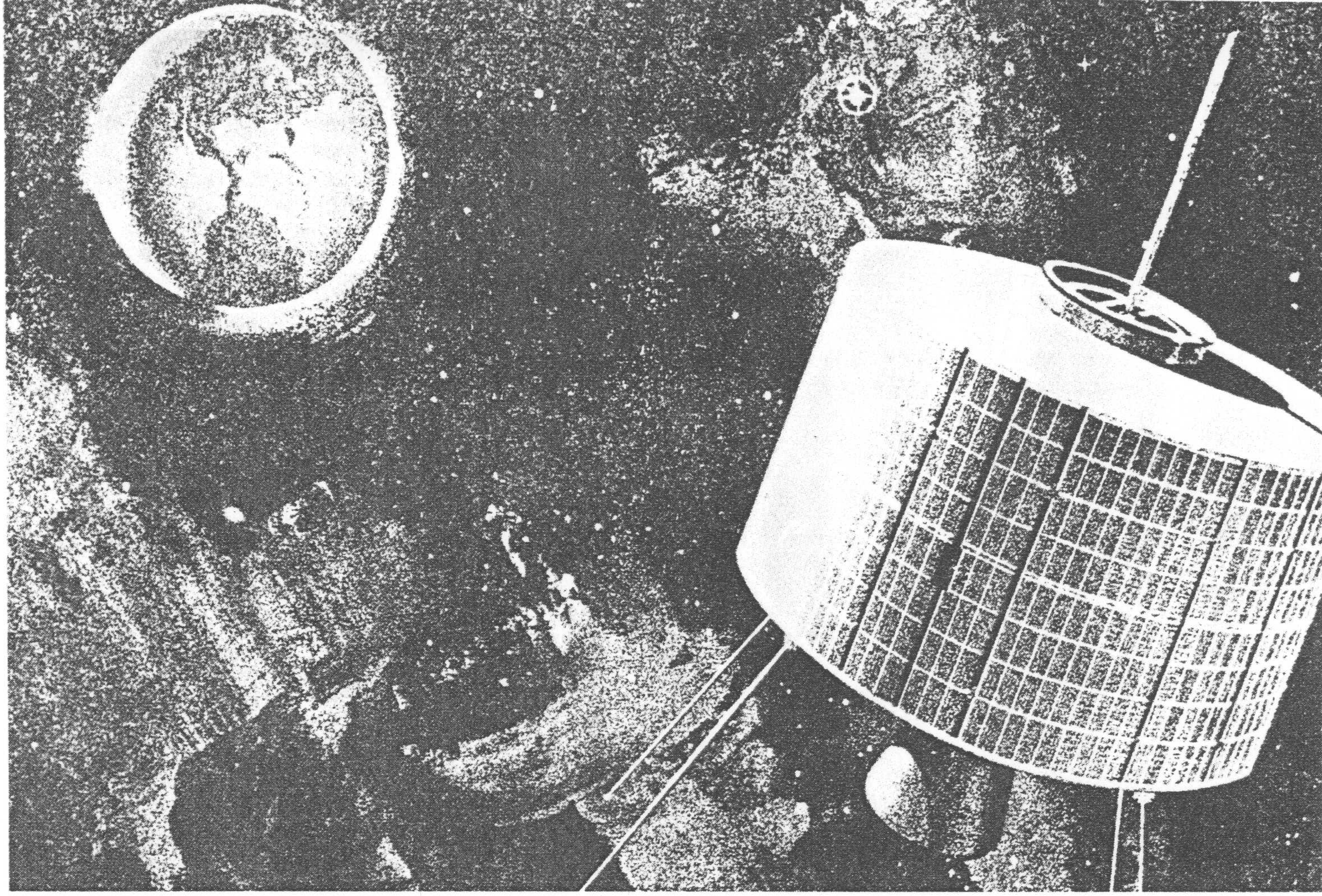


A Signal Corps Space Odyssey:
Part I - Prelude to SCORE

"In this century, I have bounced sensitive whispers off the moon, and guided manmade moons in orbit around our earth.
For the first time ever, I have cupped my ears and listened to satellites. My far reaching voice can now reach across the vast expanse of space. I can guide rockets and missiles ...
I can do that and more. I am the Signal Corps..." — *I AM THE SIGNAL CORPS*
by Samuel A. Barnes

by Dr. Hans K. Ziegler

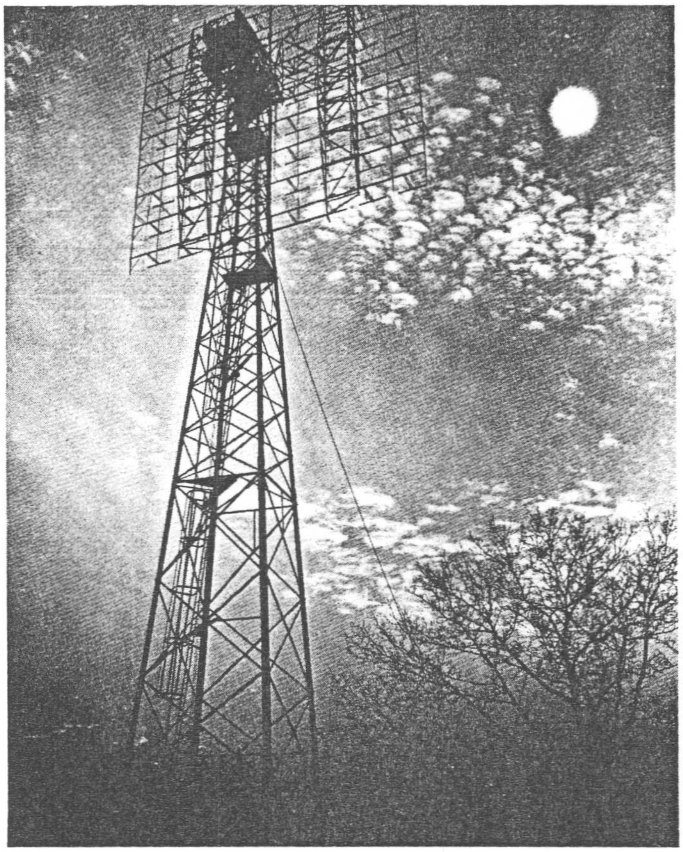
Until a quarter of a century ago, the term "Satellite," in its primary definition, pertained to a small secondary planet revolving around a larger one, such as the Moon around the Earth.

No "man-made" satellites did exist and reference to such contrivances could be found only in science fiction stories of space ventures or, later on, in visionary predictions of future technological conquests.

But in 1957 the first man-made satellite was suddenly circling the earth and it inaugurated the fascinating era of scientific exploration and practical utilization of space. Since then more than 2000 satellites have been placed into orbit by a dozen countries with the US and the USSR providing the lion's share and at least 1000 are still whirling around the earth with their payloads in functioning order. Using the services of satellites for global communications of every thinkable mode — weather forecasting and many other civilian and military goals — has by now become a matter of daily routine which we take for granted. For the presently growing-up generation of Signal Corps personnel, most of whom were born into this space age, all this represents merely the state of the art at the outset of their careers — the starting point from which, no doubt, more marvels of technological evolution will develop during their spans of life.

To fully comprehend the sentiments and excitement which ring from the recollections of General H. McD. Brown,* the Commander of the Fort Monmouth Signal

**TAC will publish Gen. Brown's recollections in the Winter issue.*



This "bedspring" antenna, long since replaced by more modern equipment, proved space communications possible when, in January of 1946, it bounced a pulse off the moon and received a return signal. Signal Corps scientists at Fort Monmouth were entirely responsible for Project Diana and the first moon radar contact.

R&D Laboratory (SRDL) at the time they proudly produced the world's first communications satellite, "SCORE," and to appreciate the successes as well as the frustrations, it will be useful to review the major historical events which preceded the memorable Signal Corps milestone achievements.

To start at the very beginning, it was Sir Isaac Newton who originated in 1686 the principle of what it would take to place an object such as a satellite into orbit around the earth. Not only did he give birth to the basic idea, but through his discovery of the fundamental physical laws of motion, specifically his third law on action and reaction, which represents the theoretical base for rocket propulsion, he even laid the groundwork for later practical solutions. But it took mankind some 270 years, to approach the required magnitude of mechanical thrusts.

The use of primitive rockets for warfare or simply for fireworks has been known at least as far back as the 13th century, with indications that the Chinese may have been the first to develop them. In America, our "Star Spangled Banner" reminds us of the "rockets' red glare" during the British attack on Fort McHenry near Baltimore in 1814.

More sophisticated developments of rockets did not begin until 70 years ago. It was the American physicist Robert H. Goddard who, from 1912 to 1941, conducted with almost heroic patience a program of experimentation to produce prototypes for "reaching extreme altitudes." Also, significant efforts were under way in other countries. Foremost were those of the German Hermann Oberth and the Russian Konstantin Tsiolkovsky. Their work concentrated, however, on theoretical aspects and serious experimental work did not start in Europe until the thirties.

THE V-2 THREAT

At the dawn of WWII, our country and parts of Europe possessed considerable theoretical and experimental know-how in rocket propulsion concepts. But no one used and advanced it more effectively during the war than the Germans. Their effort started in deep secrecy in 1930 and culminated under the stewardship of Dr. Werner von Braun and his team in 1944 with the production and tactical employment of the notorious V-2 weapon.

The progress achieved with the V-2 development was swiftly utilized and expanded by the US when in Dec. 1945 the entire von Braun team together with a substantial arsenal of captured V-2 hardware was transplanted to the Army Ordnance Corps' facilities, first to Fort Bliss, Texas and its closeby White Sands Proving Ground, and later (1949) to the Redstone Arsenal in Huntsville, Alabama.

At the end of WWII, the interest in rocket and missile development headed in two directions. Although it was recognized that long term future defense needs would call for their use as global weapons delivery vehicles, a more immediate requirement seemed to exist for their use as high altitude sounding rockets — the purpose for which Goddard had actually started his efforts. They were to obtain badly lacking information and data on the physical characteristics and the geophysical interrelations of the upper atmosphere above balloon altitudes. Both the military and the civilian scientific community were keenly interested: the former to explore the future missile operational environment and the latter to advance the understanding of the geophysical processes of our earth.

The US Navy, which entertained at that time a major upper atmosphere research activity, had particularly strong desires and was on the verge of initiating appropriate developments when in 1946 the re-activated V-2 rockets became available and offered a more than adequate initial research tool. Over the next five years, a total of 66 of these rockets, most of them successful, were fired from White Sands and other test sites. They served a wide range of military and civilian interests which were coordinated by an "Upper Atmosphere Research Panel" composed of representatives from both sides. These V-2 sounding rockets carried advanced sensors and associated telemetry and included biological experiments with live animals, high altitude photography, the concept of parachute recovery and electronic aspects of control. The Signal Corps through a newly established Missile Support Agency at White Sands and SRDL at Fort Monmouth played from the beginning a significant role in rocket and missile electronics and instrumentation.

Within this program, the concept of staging two rockets — a smaller WAC-CORPORAL on top of a big V-2 — was tested for the first time. In project Bumper, an unprecedented altitude of 250 miles was reached in February 1949.

When stability requirements for sensing instrumentation exceeded the intrinsic abilities of V-2s, the

Navy initiated new sounding rocket developments, one of which led to its Viking which was derived in great part from the V-2. It was first successfully launched to 51.5 miles in May 1949 and is considered to represent the largest and most ambitious sounding rocket within the arsenal subsequently developed by other sponsors.

In the meantime, the three military services started to refocus their efforts on their long range goal: to produce powerful delivery vehicles for weapons. The Army entered the Redstone/Jupiter missile development; the Air Force, since 1947 a separate service and no longer an integral part of the Army, after considerable early vacillations, embarked on a program which resulted in the Atlas. The Navy, with its uniquely different shipboard requirements, started later with the efforts leading to the Polaris.

While the rocketeers at White Sands and elsewhere were busy probing the atmosphere with physical instruments, the electronics scientists and engineers of the Signal Corps at Fort Monmouth succeeded in penetrating the atmospheric envelope of the earth and reaching the moon by electronic means. Although it is not unfeasible that spurious radio signals previously observed at various locations could have presented reflections of radio waves from earth accidentally striking the moon, the Fort Monmouth experiment was a deliberate and theoretically precalculated plan to engage the moon as a reflector for radio signals.

PROJECT DIANA

This project, Diana, was a full success and has been often hailed as the actual overture to the Space Age. On 10 January 1946 the first pulsed signals at a frequency of 111.5 MH and 3 KW peak power were reliably returned by the moon. The significance of this experiment was more than a scientific stunt. It attested to the fact that radio waves of proper frequency could be transmitted through the entire atmosphere in both directions with little attenuation, thus making it feasible to establish and maintain radio contact with objects in space.

Ever since information on the alarming progress of German rocket technology during WWII had reached these shores, it became evident that levels of power thrusts were rapidly approaching launching capabilities for man-made satellites. Consequently, starting about 1943 satellites and spaceprobes became the realistic subjects of inquiries, studies, plans, pronouncements and recommendations, both secretly and openly, by military and civilian government agencies, academic institutions, industry, individual scientists and their national and international scientific organizations and the news media. Most of this originated in the US, but voices from the USSR were gradually becoming more intense. Significantly, in the first report (29 December 1949) of the newly established Department of Defense (DoD), Secretary James Forrestal stated that "the US has been engaged in research on an earth satellite." Little attention seemed to have been given to this evolution by the general public for almost a decade.

Most remarkable was the fact that satellites were no longer considered mere luxury contrivances to satisfy space ventures of science fiction fancy; rather, they assumed realistic and significant scientific and practical importance. With sounding rockets providing hardly more than a few minutes of data during each flight and permitting only limited instrumentation, satellites would offer immensely better opportunities for continuous data monitoring and for a better understanding of geophysical phenomena, for both civilian and military interests.

For the long range potential it was already well recognized that invaluable practical civilian and military benefits in global communications, weather forecasting and optical and electronic surveillance could be expected.

But it was also obvious that besides technology and a favorable balance between benefits and investments, some important political and psychological factors required consideration.

It was feared that the creation of an earth-circling satellite as a unilateral enterprise of one nation alone might have an undesirable oppressive effect on other nations in the world, even cause conflicts with religious beliefs in some cases (as had the first unilateral use of nuclear weapons). Every effort was to be made to enter the space age with peaceful goals and programs and to avoid the impression that it would signal space as the future battlefield and the start of a related weapons race. The US was strongly professing tne nonexistence of any space race, even for scientific accomplishments. We were, no doubt, quite confident that we would reach the finish line first anyway.

Despite all this, it was clear that space would gradually and eventually assume military importance. Already the successful launch of a satellite itself implied a clear message to any other nation which cared to decipher it: a nation which was able to place a satellite accurately into a predetermined orbit would eventually be able to develop the technology necessary to deliver weapons anywhere on the globe.

By the early fifties, the idea of satellites had gained many proponents in the US and serious efforts were started to find an all-around suitable framework for such an enterprise. With the assistance of the National Science Foundation (NSF), an agency for civilian research under the National Academy of Science (NAS) — itself newly established in 1950 — such framework was soon generated.

IGY 1958/59

In 1882, in a First International Polar Year, a precedent of international cooperation on studying the physics of the earth by scientists from various nations, at that time mostly in the north polar region, had been set. A decision was made by the group to repeat such cooperation every 50 years during a period of intense solar activity and in 1932 a Second International Polar year was conducted.

Now in 1950, NAS approached the International Council of Scientific Unions, under whose auspices those cooperative programs were carried out, to shorten the interval from 50 to 25 years and proposed to schedule the next event for 1957/58, which would be again a period of intense solar activity. As a strong argument for such action, the unprecedented progress in technology during the past 20 years, including the spin-offs from WWII, were considered to offer never before available tools for data acquisition itself and the expansion of data collection to wider global coverage. The US proposal was gladly accepted and to reflect the greater scope of endeavor an International Geophysical Year (IGY) was scheduled for 1958/59.

As preparations for the IGY proceeded in a sequence of international conferences in various countries, the US gradually introduced information on the evolving potential for launching satellites and their unique capabilities as tools for geophysical research. As a result, in a crucial meeting in Rome, Italy on 4 October 1954, a resolution to recommend the use of satellites during the IGY was adopted by the international body. The USSR, which only recently had announced IGY participation, had no comment and remained for the time being mum on the subject.

Thus, contrary to common belief that an IGY was routinely coming along for 1957/58 and coincidentally presented a splendid opportunity to introduce satellites in a peaceful international demonstration of scientific applications, it was just the other way around. The US successfully bent the ear of the international groups and cleverly staged an IGY 25 years ahead of schedule, specifically toward this goal.

Within this framework, major funding for IGY satellite projects had to come from NSF although it was fully recognized that their execution and operation would be impossible without the direct participation and support of the military services. A US committee of the IGY worked out preliminary plans and endorsed them through NSF to NAS and further on to President Eisenhower, who considered them favorably.

By early summer 1955, the time had come to select a project plan which would offer an all-around satisfactory solution. In 1954 there were still indications that the three services — or at least the Army and the Navy — might team up to a joint satellite project proposal, but subsequently all services decided to compete separately.

The Air Force was not very forceful and specific in its bid and wanted to be selected only if Army or Navy plans were not satisfactory. The use of an Atlas rocket was proposed: it was under development and it could offer payloads of at least 150 pounds and later probably more than 1000 pounds.

The Army, based on its previously conceived Orbiter plan, suggested the expansion of the well-proven capabilities of the Redstone missile concept, initially offering payloads of at least five pounds, but most likely more.

The Navy proposed to start a completely new rocket development which would be derived from its successful Viking sounding rocket, with payload expectations in the 40 pound range.

The time span required for proposed developments was a crucial factor since launchings had to be accomplished within the IGY, 1957/58. In this respect the Army, with existing hardware, offered the lowest risk; the Air Force approach, based on ongoing missile developments, was not quite safe; and the Navy's completely new start entailed the highest schedule risk.

VANGUARD

In July 1955, a special committee, consisting of recognized experts from academia and industry, was established at the level of the assistant secretary of defense to select the most desirable plan considering all technological, economical, political and psychological factors.

While this committee was pondering over the proposals, pressure mounted on President Eisenhower to announce publicly the US intention to launch satellites during the IGY since a similar announcement from the USSR seemed imminent. The President obliged and on 29 July 1955 the nation and the world were stunned by the revelation that space endeavors had become a reality. This was none too soon since the USSR followed with a similar announcement within a few days.

Now the pressure was on the DoD committee, which finally reached its verdict on 9 September 1955. The choice was the Navy proposal and the project was given the name Vanguard. The decision was by no means unanimous and it was later speculated that the Army plan would have been adopted had not one important committee member been absent due to sickness during the final voting. Aside from technical considerations, the committee felt that the utilization of a launching vehicle, which would be an offspring of a scientific sounding rocket rather than of a military missile, was a most appropriate way to introduce satellite concepts for peaceful scientific purposes during an international enterprise. The Russians had no scruples along these lines and immediately pressed their most powerful military rocket developments into their satellite program — and consequently beat us to the punch. Moreover, the reasoning of the committee was not quite logical since both the Viking and the Redstone had utilized the basic design of the V-2 military rocket.

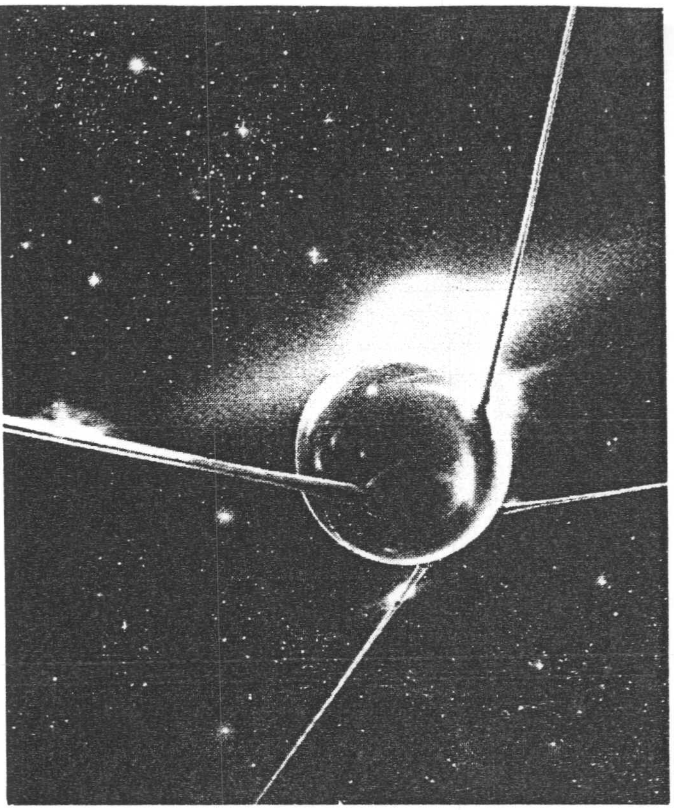
In retrospect, the committee's decision, although, no doubt, the result of an honest pursuit to offer the US the best solution, was a tragic mistake. Both the rejected Army and Air Force concepts resulted in successful satellite launchings long before the Vanguard program finally managed to place one of the planned IGY payloads, at least physically, into orbit.

SRDL INVOLVEMENT

The official involvement of the Signal Research and Development Laboratory at Fort Monmouth, N.J. started in June 1955. In a secret letter, dated 15 June, the Chief Signal Officer, Lt. Gen. J. O'Connell, directed that all activities of the Labs commence a crash effort to produce proposals in support of the IGY satellite program, covering all pertinent aspects of scientific instrumentation, telemetry, tracking, associated electronic componentry and ground support. Proposals for future satellite utilization beyond the limited scope of the IGY program were also requested.

An enthusiastic group of selected outstanding scientists and engineers, working long hours, produced the response. Based on the past ten years of close involvement with similar aspects of the sounding rocket program at the White Sands activities, it seemed easy to expand the concepts now to satellites. As a result, under the codename Lunchbox, a secret set of proposals (three Volumes, 327 pages) was submitted to the chief signal officer on 9 September. Responding to all aspects of his directive, they included already strong arguments for long range utilization of satellites as communications relays, both in the passive reflector and active repeater modes, for weather forecasting and for electronic intelligence gathering.

Ironically, the completion date of 9 September 1955 of our Lunchbox report coincided with the date of the DoD committee's verdict to reject the Army's Orbiter proposal. We knew, of course, of the Orbiter and had hoped that the Ordnance Corps' von Braun team would be the winner and our already existing close relationship would lead us to a key role in satellite electronics. Needless to say, we were dismayed. But from Washington came word that there still



Painting by Fred L. Wolff

The successful orbiting of the 184.3 pound Sputnik 1 launched man — in quite dramatic fashion — on a quest to ever greater distances from earth. Engineers and scientists realized that with modifications and increased thrust, the rocket which launched Sputnik could reach to the moon and beyond. The race was on.

would be significant tasks for us in the Vanguard program and that we should start to plan for bigger things to come afterwards. Nevertheless, rumors have it that the Lunchbox report soon found its way to the Pentagon's incinerator for classified documents.

As the Navy's Vanguard development got underway in late 1955, a Technical Panel on the Earth Satellite Program of the US National Committee for the IGY, consisting mostly of prominent scientists from universities, was charged with the selection of payloads for the four scheduled IGY satellites. Although some strong contenders had already been identified, the panel wished to give the entire US scientific community an opportunity to present its ideas in a special Symposium on Scientific Uses of Earth Satellites at the University of Michigan, Ann Arbor, in late January 1956. Of the 34 papers, four were from Signal Corps scientists of SRDL. One of these proposals, a first simple concept to obtain images of the earth's cloud cover by Stroud and Nordberg, was then accepted by the panel and tentatively scheduled as payload for the fourth (and last) Vanguard satellite. SRDL was given NSF funding for this project.

But in addition to this definite instrumentation package, SRDL and other Signal Corps organizations soon be involved in other tasks. The technical operation and maintenance of the primary satellite tracking and telemetry groundstations of the Vanguard Minitrack network, one in the US and five in South America, were assigned by DoD to the Signal Corps and were carried out by the Army Communications Systems Division. Related to this phase of work, SRDL assisted later in calibrating the Minitrack system by producing signals from outer space generated by bouncing radiowaves off the moon using its advance Diana radar facility at Belmar, N.J.

While we at SRDL were busy on our limited IGY assignments, particularly on plans for future satellites which would be developed through military projects, the Army Ordnance Corps' rocket and missile activities were refocused in the establishment in 1956 of the Army Ballistic Missile Agency (ABMA) at Huntsville, Alabama. Maj. Gen. J. B. Medaris was commander and the von Braun team was one of its essential elements. Although the rejection of the Orbiter had been a disappointment for the rocket experts, they soon found useful new ways to advance related rocket and missile technology. Their vital new mission was to develop and operationally test missile nose cones which could sustain the mechanical and thermal stresses of re-entry from space into the atmosphere. In pursuit of this task, the Redstone missile concept was advanced to the more powerful and sophisticated Jupiter C configurations, which in a historical test-flight on 20 September 1956 reached an unprecedented altitude of 682 miles and landed 3400 miles downrange from the launching site at Cape Canaveral.

This test demonstrated, beyond doubt, that the Jupiter C had the full capability of placing a good size satellite payload into orbit. Considering the fact that the Vanguard project seemed to be already in serious trouble, Gen. Medaris pleaded with the Washington authorities for permission to provide our nation with the first satellite, but his request was not granted. In a wise move, he salted two sets of Jupiter C hardware away in safe storage in case Washington should ever change its mind and quick action should be required.

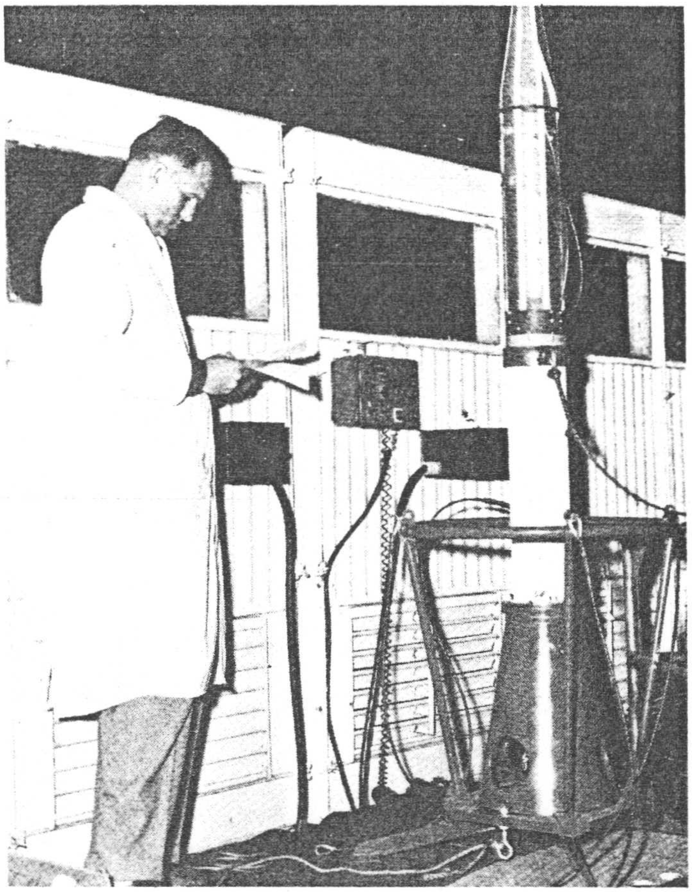
SPUTNIK I

As a tragic consequence of Washington's refusal, the Russians beat us to the punch and surprised the entire world with Sputnik I, which they sent into orbit by means of a powerful military rocket on 4 October 1957.

I shall never forget the impact of this event on all of us at SRDL who had been trying day and night to secure for our nation first place in space. During the preceding days, I had attended one of those international IGY committee conferences in which the Russians were prominently represented. From the very beginning, we had a serious problem with the translation of their presentations and pronouncements, which eventually was provided by interpreters from the USSR Washington Embassy. The Russians mentioned that their satellites would be called Sputniks, which stands for traveling companion, and we were most anxious to get information on their launching dates. There was considerable confusion on the valid translations of their answers which ranged from "in the next days" to "in the near future." But when at a closed executive session of the US delegation on 3 October, it was disclosed that the Russians had informally requested further US support with Backer-Nunn optical tracking cameras, it was concluded that their tracking network was not yet finished and that no immediate satellite launches should be expected. In view of our slipping Vanguard schedules, this was a happy conclusion which prompted me to plan to spend a rare weekend without professional chores.

But I had hardly returned from Washington when the telephone rang.

I must admit that we were poorly prepared for such an event and other organizations, particularly the IGY-



Explorer 1 is checked out by a technician prior to mounting it on the Army's launch vehicle.

Vanguard organization, were even less prepared. In our supreme confidence that our first tracking and observation task would be for a US satellite, we had not given much attention to previous Russian pronouncements.

They had it made known several times that their satellites would transmit in the 20 and 40 MH bands and had even published related articles to alert radio amateurs. These frequencies were incompatible with our US Minitrack system which operated at 108 MH, but no supplementary provisions had been made to watch Russian satellites.

Thus, in the first hours of Sputnik, everybody everywhere scrambled to obtain equipment for the 20/40 MH frequency bands.

We at Fort Monmouth were most fortunate to locate an adequate arsenal and within hours, through the use of military receivers, direction finders and precision doppler analysis equipment, we were in full swing. So efficient was our performance that we have been credited as having represented the backbone of the entire US tracking and observation efforts, at least for the first week — which, as I well remember, meant 105 hours of duty for me. This capability was quickly built up to a Signal Corps Astro-Observation Center, located at Deal, N.J., next to Fort Monmouth, which has served as a US key activity in satellite and space probe observations for many years.

Sputnik I had, however, much more dramatic impact and consequence at the ABMA at Huntsville. At the time the announcement came through, Gen. Medaris and Dr. von Braun and his team were entertaining an evening party for the new Secretary of Defense designee, Mr. McElroy, who was on an orientation visit together with other dignitaries, including Secretary of the Army, Mr. Brucker and the Army Vice Chief of Staff, General Lemnitzer. In a spontaneous reaction von Braun made an emotional plea to the new defense secretary to finally give the Army permission to take the two available rockets out of storage and to launch within 60 days a US satellite, which the more and more troubled Vanguard program could not promise for a long time.

To include a margin of safety, Medaris increased the lead time to 90 days and Mr. McElroy departed from Huntsville the next day, leaving the impression that he would act favorably. But although the Army's plea had soon reached the White House and President Eisenhower in his last action to the retiring Secretary of Defense, Mr. Wilson, on 8 October 1957, had directed "to have the Army prepare its Redstone at once as a backup to Vanguard," it took an excruciating period of more than a month to furnish ABMA proper authorization. Medaris had stuck out his neck and had started preparations immediately, but as time passed, the expenditure of unauthorized funds, although expended with the informal nod of higher echelons, had reached levels which could have not been absorbed had authorization not been given. When President Eisenhower at a later time was appraised of this violation, he is said to have replied: "but that would have been a courtmartial offense!" The question arises: who should have been courtmartialed: General Medaris for his constructive urgency or the fumbling Secretary of Defense who massaged the President's directive for four weeks?

EXPLORER I

While the USSR launched Sputnik II in November and the first crucial test of a three stage Vanguard vehicle failed in December 1957, ABMA was busily preparing the Jupiter C and on 31 January 1958, 118 days after its plea, ABMA placed the first US satellite, Explorer I, into orbit. Explorer I contained a payload of 31 pounds, consisting mainly of cosmic ray and micrometeorite instrumentation, originally planned for IGY Vanguard and adapted by the Jet Propulsion Lab of the California Institute of Technology to the Explorer configuration. SRDL contributed a number of vital electronic components to this payload. Limited by the life of its batteries, Explorer I provided valuable data for almost four months and made the notable discovery of the Van Allen radiation belt.

Of course Medaris was not courtmartialed for his timely accomplishment of this important success; he and his hard working teams at ABMA, however, were disappointed. They received neither recognition nor praise. While the news media and everyone in the professional community hailed the Army's achievement, the nation's highest recognition, the President's congratulations, though generally lauding everyone involved, went specifically to the administrative head of the National Science Foundation whose faltering Vanguard program was the one which had to be finally rescued by this Army effort.

A SPACE FIRST

Going somewhat back in the sequence of events, there was another noteworthy evolution. As the Vanguard vehicle development gradually encountered more problems and delays, a decision was made to use some of the tests, which were intended solely for checking out the capabilities of the final three-stage rocket, to try to carry at least physically a minimum satellite into orbit. The satellite was to be a small 6.4 inch magnesium sphere weighing less than four pounds and to contain only a short-life battery operated Minitrack transmitter, which would prove that it actually had made orbit. This announcement was made by the DoD in August 1957. It sent us at SRDL into high gear of technological and crusading activities.

Since the inception of the Silicon Solar Cell by the Bell Telephone Labs (BTL) in 1954, the Signal Corps had become keenly interested in exploring the utility of solar energy for its purposes. We at SRDL started immediately a research program with the Radio Corporation of America (RCA - Princeton) to search for possibly more efficient materials than silicon. We also initiated new efforts for associated storage batteries, particularly of sealed configurations which would not require maintenance. I was personally deeply involved and had in November 1955 the privilege of accompanying our chief Signal officer, Gen. O'Connell, to the first World Symposium on Applied Solar Energy at Phoenix, Arizona.

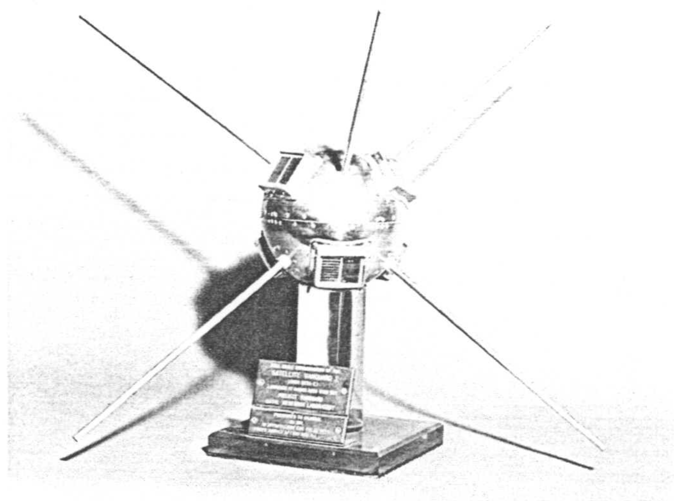
We did not uncover major Signal Corps application potentials at that time, but it was quite evident that solar power was the logical way to power satellites and space probes; in fact, solar power had long been considered standard equipment in science fiction stories.

Accordingly, in our Lunchbox report in 1955 as well as at the Michigan Symposium in 1956, we had made a strong pitch for solar power for satellites. But our hopes were dimmed when the Navy ruled out all unconventional and not fully established concepts, among them specifically solar cells for the IGY payloads. This seemed an inconsistent philosophy since the Navy hinged the entire project on an unconventional not fully established vehicle concept!

But we were not discouraged and continued both our work and our crusade and in July 1956, the Navy agreed to assist us in the evaluation of our developments through testing them on sounding rockets. These tests were then successfully conducted to altitudes of 192 miles in April 1957 at White Sands. The Navy also agreed to include at least one solar cell as aspect indicator in the first two IGY satellites.

Now, in August 1957, with the plan to launch some minimum payloads in the form of little spheres with the available weight unused except for a Minitrack transmitter, we saw a splendid new opportunity to give our solar power supplies a free ride. After considerable debate, our idea was finally accepted and three of these mini-satellites, often called grapefruits, were outfitted each with six clusters of sixteen silicon cells of BTL vintage to power a second Minitrack transmitter in addition to the originally planned battery operated type.

Two of these satellites never reached orbit when the Vanguard vehicle tests on 6 December 1957 and 5 February 1958 unfortunately ended in failure. But the third was launched on St. Patrick's day 1958 and became, under the designation Vanguard I, the first successfully orbited satellite of the Vanguard program. Solar power, as we had expected, functioned perfectly and kept the associated Minitrack transmitter on the air for more than six years, whereas its battery powered companion gave up after the short battery life. Although it was not endowed with any specific scientific instrumentation, this satellite, through the opportunity to observe the orbit over many years, produced valuable new information on the shape of the earth, correcting the long assumed elipsoid configuration to that of a pear.



This sphere is an exact replica of Vanguard I, which was successfully placed in orbit on St. Patrick's Day in 1958. Its estimated life span is 200 years. Its solar cell power kept the Minitrack transmitter on the air for more than six years.

We at SRDL were immensely proud. After this first demonstration of its utility, solar power quickly attained standard equipment status on satellites and space probes.

The US demonstration came none too soon: on 15 May 1958 Sputnik III was in orbit and it included the first Russian solar power system.

The Navy, when later writing the history of Vanguard, hailed the solar power test as the only constructive historic space first of the entire program (a second first was a lessons learned type and consisted in having found an explanation for problems in rocket-stage separation which cause orbit insertion failures). But besides some small print references to the Signal Corps' general fine attitude of cooperation and SRDL's solar power work, the Corps, in spite of proper news media coverage at the time of the event, is not specifically credited as the organization whose technological foresight and perseverance made possible our solar power first — a first which otherwise would have been chalked up on the scoreboard of the USSR.

The unexpected appearance of Sputnik I in October 1957 also had some far reaching impact on top level US government organizations.

NASA

To get a better grip on the three services' diversified competitive efforts in the overall missile field, a Director of Guided Missiles was established on 15 November 1957 as a special assistant to the Secretary of Defense and given wide ranging directive powers.

In a second step, it was decided that the aspects of military satellite programs beyond the involvement in the

Dr. Ziegler (left) and then Col. H. McD. Brown (right) say goodbye to Dr. Werner Von Braun after one of his visits to USARSDL, Fort Monmouth, New Jersey, 13 November 1959.

IGY project and of long range antimissile missile programs required very special attention within the broad concept of Guided Missiles. So on 7 February 1957, the Advanced Research Projects Agency (ARPA) was established as a separate powerful agency for this purpose. It also reported directly to the Secretary of Defense. In one of his first actions, Roy Johnson, ARPA's director, rejected an ABMA proposal for a 500 pound global reconnaissance satellite, with the explanation that this type of satellite was to be an Air Force responsibility. Gen. Medaris, after ABMA's successful launch of Explorer I and his hope that he would now be given a bigger role in satellite work, had submitted his proposal — a longtime favorite dream of his — on 1 February 1958.

But there was a third step of drastic organizational change in the making. In recognition of the increasing civilian interest in scientific and practical aspects of satellites and space probes, it was considered necessary to further separate civilian and military projects. Although, for the time being, only the military services had the capabilities and facilities to launch space devices, a future civilian organization would have to eventually attain self-sufficiency in every respect. This was to be accomplished by drawing from both existing manpower talent and from facility resources of the services and other agencies, as well as by developing its own resources.

After early suggestions in November 1957, President Eisenhower proposed in a message to Congress (on 2 April 1958) the establishment of a National Aeronautics and Space Agency (NASA) into which, as a first step, the existing National Advisory Committee for Aeronautics (NACA) would be absorbed. Civilian oriented projects presently under ARPA would be transferred to NASA. The complexities of establishing such an agency delayed its activation until 1 October 1958.

On the 1958 satellite scoreboard meanwhile, Explorer II failed to orbit on 5 March, but Explorer III was successfully launched on 26 March; another Vanguard test ended in failure on 28 April. As already mentioned, Sputnik III appeared on 15 May, followed by the failures of the first two full size Vanguards on 27 May and 26 June.

And this is the way it was in spring 1958 when the then Col. H. McD. Brown arrived at Fort Monmouth to take over command of SRDL from the then Brig. General E. F. Cook.

We at SRDL were proud of the space contributions we had been able to achieve at that point in time, mainly the first in solar power and the almost completed first cloud cover instrumentation, which was still waiting for Vanguard to carry it into orbit. Since March, we were also involved in a new advanced concept of meteorological satellites and many plans for communications satellites were longing for action.

But our future involvement in space projects seemed to depend strongly on decisions to be rendered by the new super organizations. Although we were quite confident that ARPA would give us fair opportunities, the effect of NASA, especially the possible impact on our manpower resources, was more frightening. Moreover a strained atmosphere of keen and jealous competition prevailed among the various organizations hitherto involved and true credits for achievements in projects, which included participation of a conglomerate of military and civilian agencies, were hard to obtain. With the new super agencies, no doubt struggling to quickly prove the value of their existence, improvement in this respect could hardly be expected soon.

In summary, the inheritance awaiting Col. Brown when he arrived at SRDL was a mixture of pride over past accomplishments, ongoing projects and solid plans for future progress tempered with anxieties about the opportunities for their execution, and a good measure of past and anticipated frustrations — all of this, however, topped by the availability of an enormous pool of outstandingly competent and dedicated scientists and engineers, enthusiastically poised to attack any challenges of electronics technology. The laboratories at that time encompassed a work force of some 3000 civilian and almost 500 military personnel in five operating departments covering the broad Signal Corps R&D mission assignments: communications; surveillance, including EW; meteorology and avionics; components, covering passive and active devices and power sources; engineering sciences, including electromagnetic environment aspects; and exploratory research, supporting all activities.

Dr. Hans K. Ziegler was born in Munich, W. Germany, where he received his degrees from the Technical University. For 10 years he carried out research in German Industry and then was invited in 1947 to join the US Army Signal Corps' Laboratories at Fort Monmouth, N.J., whose Chief Scientist he became in 1959. After the Army reorganization he was appointed in 1963 to Deputy for Science and Chief Scientist of the US Army Electronics Command and in 1971 to Director of the US Army Electronics Technology & Devices Laboratory, from where he retired in 1977. Dr. Ziegler has presented and published numerous papers, is a fellow of the IEEE and the AAS and a member of the Signal Corps Association.

The Army has recognized his achievements with two Meritorious — and the coveted Exceptional — Civil Service Awards.