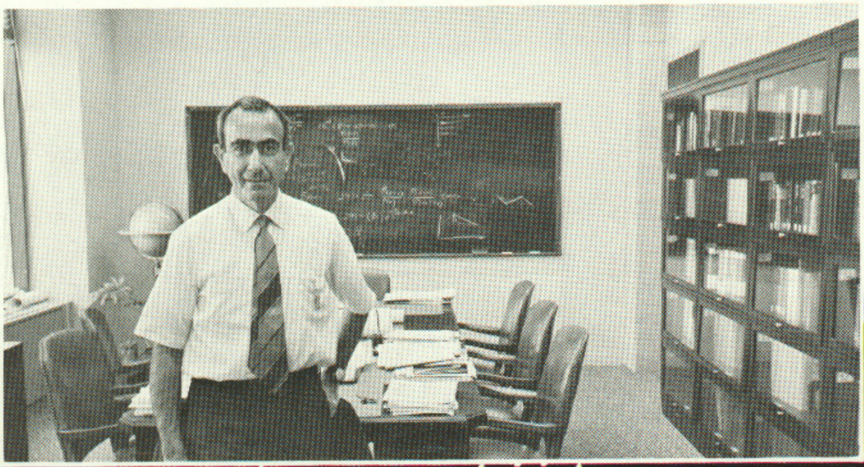
The Jewels of Isabella



JOC James Johnston

In 1953, Commander Bob Truax put it this way: "The new horizons opened to science by space travel in all its aspects would amply justify the cost. Astronomers would certainly love to have an observatory beyond the atmosphere, and the physicists would be ecstatic over a high vacuum laboratory of infinite size. For all their enthusiasm, however, scientists are in general

a poverty-stricken lot — and I am talking about a project that would cost a great deal of money . . . .

"If we allow events to take their natural course, we will probably have space travel eventually . . . but you and I would very likely not be alive to see it. I, for one, am not content to let the matter rest thus. To me, one of the greatest thrills of living is the emotional lift, the sense of wonder and awe that comes from witnessing, firsthand, great human achievements. If the majority of Americans feel the same way, the arguments of immediate utility are unnecessary . . . .

"If the people of this country just *want* to, they can provide the 'jewels of Isabella,' opening a new Age of Exploration that will make the discoveries of Columbus seem tame by comparison.... Landings on the moon and journeys to the nearer planets may well come within our lifetime — but these things will happen only if we act *now.*

"The cost of even a satellite station has been estimated at upwards of a billion dollars — a staggering sum. But, look, take the billion dollars and spread it over a period of ten years of the station's usefulness. Divide this by approximately fifty million taxpayers and we have just two dollars per taxpayer per year. Two bucks — a pint of cheap whiskey. Wouldn't you give that up each year for a ringside seat at one of the greatest adventures on which mankind has ever embarked? To me there can only be one answer. A pig, rooting in the mud, would pass by a diamond for a half rotten potato, but if the people of this country would do the equivalent, then the pioneering spirit of our forefathers is indeed dead, and decadence has truly begun."

Bob Truax's 1953 cost estimate really wasn't too far off. For example, the fiscal '71 budget for NASA is $3.6 billion. In terms of the federal budget, it represents 1.7 percent of the total — roughly $17 per person in one year. Since the Manned Space Program uses about one-third of NASA's funding, it costs the average American less than $6 to have man walk on, and *investigate,* the moon!

Compare this with $400 per person we spend on social actions — federal expenditures for education, health, housing, social security and veterans benefits — or with the $35 per person on alcoholic beverages, $17 on tobacco or $16 on cosmetics.*

When we consider that each of us is spending nearly 25 times as much each year on the human resources programs than on space, it becomes clear that even if we had no space program — even if every dollar spent on space were spent on health or housing or education — the impact on those programs would hardly be noticeable.

*Statistics provided by George M. Low of NASA in May, 1970.

But, even more important, where would we be today had we not undertaken to meet the challenge of space? What have been the benefits — the "spinoffs?"

As a result of space technology, man is beginning to learn how to solve problems that have beset him throughout history — hunger, sickness, social ills, crime and pestilence. If you ask the people at NASA, they will identify more than 3,000 spinoffs from space that are of benefit to mankind. Most of these have been applied in the highly technical fields of medicine, electronics, astronomy, geophysics, meteorology and oceanography.

On the Navy side of the coin, let us examine a sampling of space-related contributions which have resulted in the betterment of mankind.

Foremost among these is the Navy navigation satellite system, often referred to as *Transit,* which actually came about because of the curiosity of two young scientists at Johns Hopkins University's Applied Physics Laboratory (APL). In 1957, Drs. W. H. Guier and G. C. Weiffenbach found that when tracking the first Russian *Sputnik,* they were able to fix its position by measuring the Doppler shift of its signal. An idea occurred that if the reverse would be true, signals from the satellite could be used for precise positional fixes on the earth. As a result, the Navy navigational satellite system became operational in 1964. (The USS *Long Beach* employed the system on a round the world cruise that year.)

In 1967, Vice President Humphrey announced that the government was releasing the system, designed originally for Navy ships, for commercial shipping. Since that announcement, the history of the system has been well marked. The Navigation Satellite Set *(Navset)* was used by the *SS Manhattan* on her legendary voyage through the Northwest Passage. The *Queen Elizabeth II* has used it since her maiden voyage. It is employed by the *Glomar Challenger* and several other oceanographic research ships, and cable-laying and rescue vessels.

Navset, which provides data for computing a navigation position, costs only $12,000 per unit. Its accuracy pro-

DR. FRIEDMAN AND THE CRAB NEBULAE

vides a tolerance of one-tenth of a nautical mile, a fact which accounts for the remarkable positioning of naval ships involved in recovery of manned space flights. According to Captain C. J. Seiberlich, commanding officer of the USS *Hornet,* "Had Navset not been aboard, the navigation problem in the South Pacific recovery of *Apollo 12* would have been considerable.

The Johns Hopkins APL, which works largely under Navy contract, also developed *thin wafer-type* solar cells for use in satellites. Their heat pipe, which transfers heat immediately from the nuclear power unit of a satellite to any other of its parts while maintaining uniform temperature is now being used commercially in cooking utensils.

Johns Hopkins' scientists more recently created a new rechargeable cardiac pacemaker to treat patients requiring artifically generated electrical heart-triggering pulses. The problem of reliably powering remote electrical devices of minimum weight and size was intensively studied for spacecraft applications. Current versions of these tiny (one inch, two ounce) nickel-cadmium cells require recharging every 18 months. The Hopkins team hopes to extend this to 20 years or longer.

Manned space flight obviously requires precision in timing. Not only did the Naval Observatory develop the atomic clock,but observatory personnel have provided the star charts astronauts use in navigation and visual orientation.

The list of Navy contributions and their applications is too lengthy for complete coverage in this general treatment. But it is worth our time to take one last look at certain activities of the Naval Research Laboratory. Obviously, such NRL work as that done on environmental systems for *Polaris* submarine crews had its carry-over into similar systems for spacecraft. More fascinating, however, is their actual space research program.

NRL pioneered solar rocket astronomy with the V-2's in 1946, and today the program is still one of the foremost in the country. The list of NRL space research firsts is voluminous: ultraviolet spectra beyond the atmospheric, cutoff, detection of X-rays from the sun and associated high altitude photography, the solar radiation satellites *(Solrads),* and so forth.

In an effort to reduce the huge mass of technical achievements and goals down to layman's terms, a visit was made to NRL's space research director, Dr. Herbert Friedman.

Dr. Friedman joined NRL in 1940 and since then has conducted or directed programs devoted to measurements of ultraviolet, X-ray and high-energy radiations. Thinking back on the earlier days he recalls, "The V-2 gave us a vehicle for sun research. One result of the subsequent work is that we can now predict solar flares — and therefore communications blackouts — which have a direct bearing on our manned space shots.

"Beginning with the simplest forms of ultraviolet and X-ray photometers, we have progressed to moderately large telescopes, image converters and high resolution spectrographs in the present generation of rockets. After having spent so much of the early years in the study of the sun, it was only natural to look further out — to see what could be done with more distant places.

"One result of this deep space research is the supporting evidence of the 'big bang' theory that the universe was created billions of years ago by the explosion of a fireball."

Dr. Friedman and the Navy astronomers contend that at one time all the matter for a potential universe was contained in a primordial fireball, a tremendous single atom of 10 billion degrees temperature. This condition existed only a second, then exploded into stars, galaxies and planets. The radiation from the blast still pervades deep space and this echo of creation is yet detectable by radio astronomy. The evidence was obtained by an X-ray telescope carried on an *Aerobee* rocket 102 miles above the White Sands range.

"There have been," states Dr. Friedman, "some totally unexpected surprises in this work. For instance, we had some slight clues that since the sun is an X-ray source we might find stars with a somewhat higher output. But what we have found are stars within the galaxy with a *billion* times the sun's X-ray output!

"When we look at external galaxies now we detect X-ray and radio-wave emissions so powerful that it becomes difficult to explain the radiation mechanism on the basis of conventional nuclear physics. It becomes a borderline question of whether there is enough energy in nuclear fusion available to produce the emissions we are now looking at. We find that some of these are 100 times more powerful than the X-ray *spectrum* and so one has to look for other, possibly *unimaginable,* mechanisms.

"But so much data is pouring in that we believe the answers will come. This fundamental research, this looking for answers without really knowing what the questions are, is necessary. Who would have thought 30 years ago that from nuclear physics would come atomic power, and from atomic physics the laser, or that from solid-state physics, transistors and molecular circuitry.

"The first phase of exploratory science is behind us. Now we have a level of technological sophistication that permits us to move ahead in space research with far greater economy."

Navy goals in space are a mixture of the search for scientific knowledge, applications for national defense and peaceful benefits to mankind, and the sheer human adventure of man — that same old *restless* man — trying to escape the cradle of his surroundings.

As Dr. Friedman and others have declared, "Ultimately the yield of new knowledge will far overshadow all the more obvious benefits of space technology."

Dawn on the Atlantic off the Kennedy Space Center. Photograph by JOC James Johnston

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