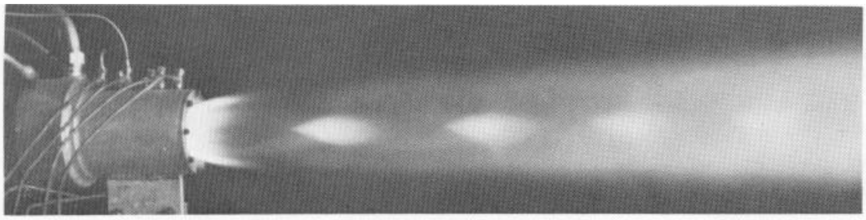
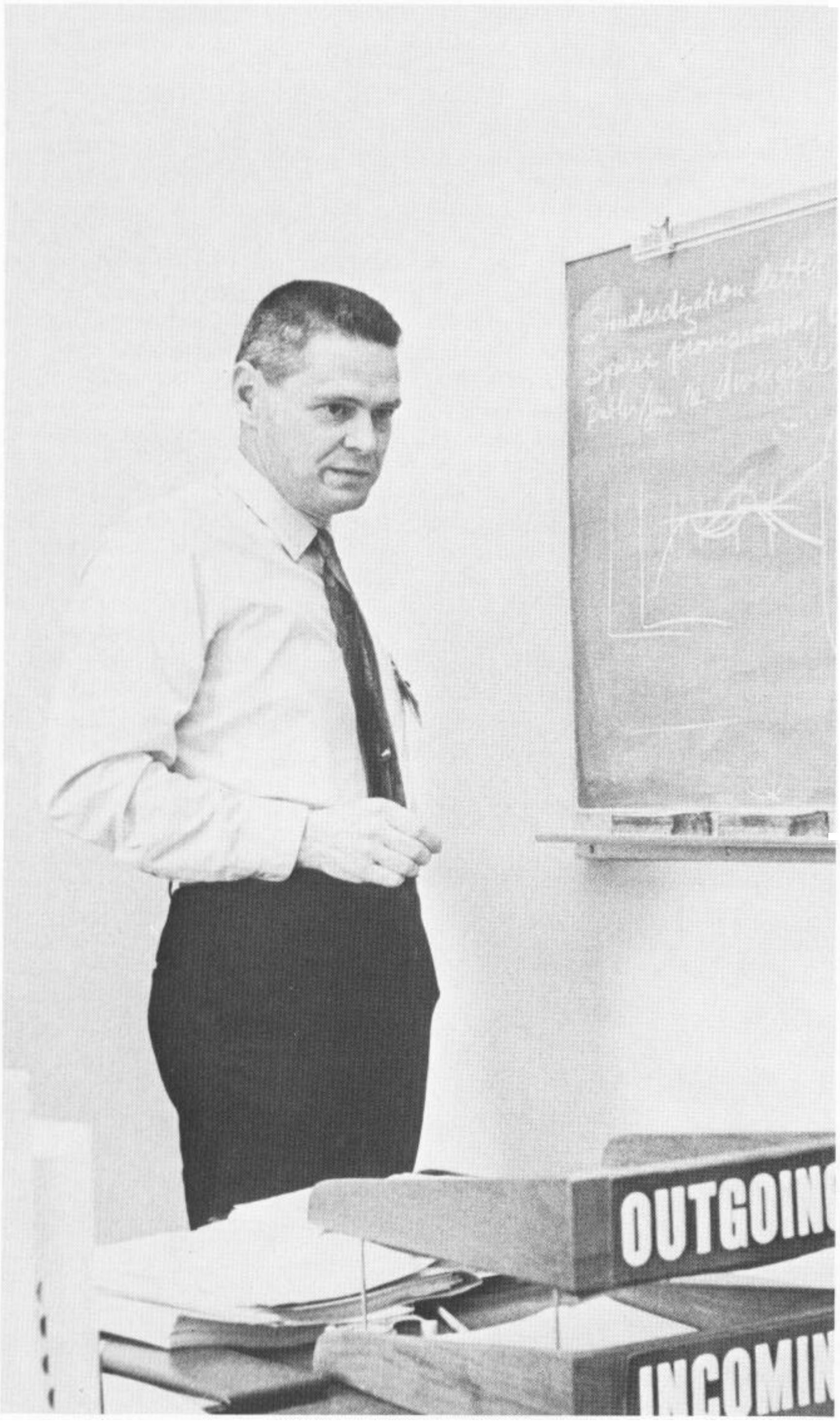


TRUAX/GODDARD

Navy



Photograph by JOC James Johnston

Just inside the main gate of the Naval Ship Research and Development Center on the banks of the Potomac in Carderock, Md., there is a small white building that has a temporary look about it. You get the feeling that someday you might come back and find it gone — a reasonable estimate, because the man who works within is on the move. He always has been. That is the way it is with *rocketeers* — if you are lucky, you may discern a little patch of scorched earth some place and know that one has been there. It is about all they leave behind — that, and an idea. You begin to suspect they are not of this world.

The thing that immediately strikes you about Bob Truax is his energy — and youth. He speaks, and you find yourself on the edge of your chair. He looks, and you see a fire in his eyes. He moves — an equation suddenly appears on the blackboard — and you notice that his hands are constantly in motion. He might have been an actor. Instead, he is *the* rocket pioneer of the Navy — a distinction shared with Dr. Robert Goddard and a few others.

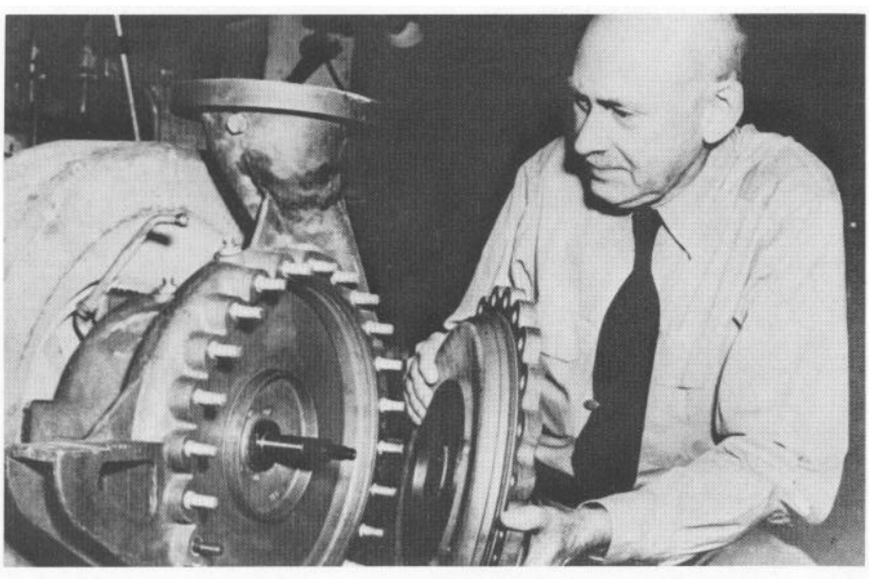
In order to put the work of Captain Robert Truax, USN (Ret.), in perspective, it is necessary to go back a bit and observe that there were three recognized progenitors of our modern space age. The first was a Russian, Konstantin Ziolkovsky, whose proposal for spaceships was published in 1903. Dr. Robert H. Goddard followed with the classic, "A Method of Reaching Extreme Altitudes," in 1919. Then, in 1923, the German, Dr. Hermann Oberth, published his study, "The Rocket into Interplanetary space."

Goddard was the only one to personally put his theory into practice, starting about 1914 when he was a physics instructor at Clark University in Worcester, Massachusetts. In July of that year, while recovering from pulmonary tuberculosis, he was granted a patent, the first of more than 200 over his lifetime. During World War I, one of his developments was the prototype of the World War II bazooka. The war ended shortly after he demonstrated the remarkable antitank hand weapon — too late for that conflict, but useful in the next. His "A Method of Reaching Extreme Altitudes" was quietly released, in limited distribution, by the Smithsonian Institution in January 1920. Then all hell broke loose.

The paper had been aimed at scientific circles, but conjectures on its last pages — especially one dealing with a rocket shot to the moon — had been seized upon by the popular press and sensationalized.

At a time when everyone *knew* that rockets could not operate in the vacuum of space — and that Jules Verne had been a *fiction* writer — Goddard became the target of public ridicule. For a while, he tried to explain his hypothesis; each time he was misquoted and humiliated. Even as he tried to withdraw from the limelight, the hecklers followed and Sunday supplements portrayed him as the "Mystery Professor." The articles were complete with wild illustrations of mad preparations for his lunar trip. Branded a crackpot, Goddard dropped from public view. Privately continuing his work on rockets and space navigation, he guardedly stored his notes in a file labeled "Formulae for Silvering Mirrors."

While the average American made sport of the man with a *new idea,* the European reaction to Goddard was seriously receptive. His Smithsonian paper found acceptance, and among those who entered into correspondence was a mathematics student at the University of Heidelberg, Hermann Oberth. The young gentleman was engaged in a pursuit similar to Goddard's. In the years to come, Oberth would write a textbook on space flight and become associated with Wernher von Braun and the place called Peenemuende. When "Herr Wernher" was being interrogated about the development of the V-2 rocket by a U.S. technical team in Germany after WW II, he said, "I don't know why you ask these questions of me when it is you who have the teacher who expounded the technology that has made the V-2 possible."



Captain Robert C. Truax, opposite page, front runner in early Navy rocket experiments, led the way in development of reaction motors for aircraft and missiles. Above, his wartime civilian associate, Dr. Robert H. Goddard, examines a turbo pump from a captured German V-2 rocket. Dr. Goddard worked, under contract, for the Navy at the Experiment Station, Annapolis.

Goddard was not so thin-skinned as to be truly disheartened by his own countrymen's derision in the early Twenties. He *knew* he was right (the philosophical advantage of a thinking man). In 1926, he launched the world's first liquid-cooled rocket from a farm near Auburn, Massachusetts. More shots followed, until, on July 17, 1929, he got one off with history's first rocket-borne instrument payload — a barometer, thermometer and camera. Unfortunately, a rocket has one especially obnoxious characteristic — noise, and a great deal of it. This particular one caused neighbors to assume an airplane had crashed. Shortly thereafter, he was enjoined by a Massachusetts fire marshal to cease and desist. A friend came to the rescue. Colonel Charles Lindbergh suggested to the Guggenheim family that Goddard's work was worth support. Former Naval Aviator Daniel Guggenheim agreed. The financing resulted in the building of a rocket experimental station near Roswell, N.M. There Goddard was able to make substantial progress.

Robert Goddard's publicity had not gone unnoticed by American scientists. Not long after the base at Roswell was established, the American Rocket Society (ARS) was formed. A hard core of "rocket enthusiasts," finding Dr. Goddard too remote (and uncommunicative), patterned their own organization after Berlin's Vercin für Raumschiffart — the German Interplanetary Society. Soon, thunderous, fiery birds were arcing skyward from such unlikely places as Marine Park on Staten Island, while, in a garage in Alameda, California, violent experiments with combustible powders were being conducted by a youngster named Truax.

"The first rocket I ever built," says the bright-eyed man, moving his hands in a manner reminiscent of a sculptor's, "was, I guess, when I must have been in high school. I was a *Popular Mechanics* fan and, in the early Thirties, there was a splash made. Dr. Goddard was doing a little bit, and the German Rocket Society and the American Rocket Society were just then getting formed. So, every so often, they'd make the *Popular Mechanics*-type magazine. It was far out. Anyway, I got the bug to the extent of wanting to go out and build what I'd been reading about."

Bob Truax looked at the sky and clouds outside his small office. "I guess it just appealed to me. So, I started making rockets. Made gunpowder rockets. Mixed up black powder in the basement and put in a little glue to make a sort of solid propellant.

'It was more an accident than anything else that I didn't kill somebody!'

At right, the first gasoline/oxygen rocket engine built by Truax in 1938. Below, Midshipman Truax with members of British Interplanetary Society in England Noted space writer, Arthur C. Clarke, is at far right.

Some of them burned fairly decently. But others. . . . Well, for instance, I found that Sparklett cylinders (used to make carbonated water), when filled with smokeless powder, do *not* make very good rockets. They explode and send steel all over the place. Once, I blasted the door of my Dad's garage with flying metal particles.

"But then I made one with a toothpowder can which I stuffed full of nitrate film. *That* makes a pretty good rocket." Truax leaned back, chuckling. "The only trouble is that after working fairly well for a while, it came apart, and sent these streamers of flaming celluloid all over my backyard and I had to run around stamping out the fires.

"Well, with the Depression and all, money was tight, so I went to the Naval Academy and, after a while, started to build myself a rocket over in the Steam Engineering Building where they had lathes and other such stuff. I had it finished by 1937 — just the combustion chamber, a rather sophisticated, cooled, liquid-propellant type — and I took it over to the head of the Marine Engineering Department and asked if I could set it up in the foundry and run it. And he said, 'Why don't you take your. . . . rocket and get the hell out of here!" So, I took it across the [Severn] river to the Experiment Station."

At this point, Midshipman Truax found himself subjected to an interrogation by several other heads of departments, whose concern was primarily safety. Young Truax adroitly applied a principle he would never forget — always have an answer. Spouting physics to physics instructors, he made an impression. Captain Cox, C. O. of the Experiment Station, finally said, "Well, fellows, what do you say we give him a chance?"

As Truax recalls, "Once the boss had spoken, it became a grand idea.

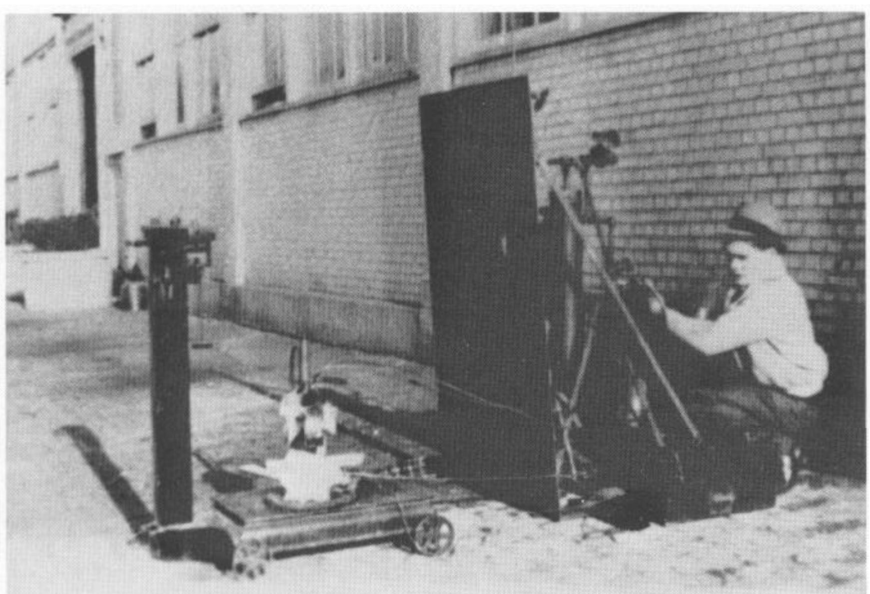
"I never found out what my budget was; it was sufficient for my needs. And they even assigned a little welder to me — Sugar Evans — who was a whiz with a torch when I had to cut up boiler plates and pipes."

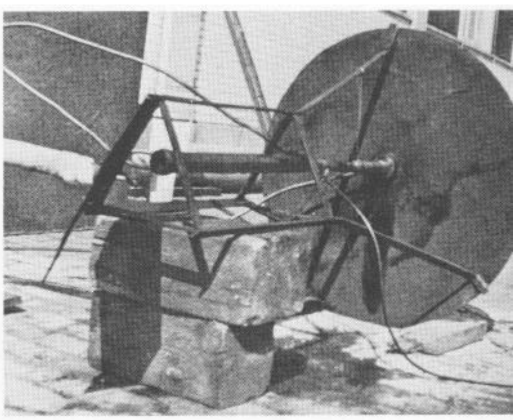
Since spare time is rather limited at Annapolis, Truax decided to stay at the Experiment Station over his Christmas leave (1937) in order to get his rocket going. "I had ten days. One problem was that I needed gasoline and liquid oxygen for fuel. Gasoline was easy, but lox was like the atomic bomb! So, I settled on compressed air. It was more an accident than anything else that I didn't kill somebody!

"But the rocket worked and attracted attention. I remember the workmen would come out of the building during lunch hour to where I was set up and sit around eating their lunches and watch the crazy kid running his rocket. It made a godawful racket — only 25 pounds of thrust — but enough to drive you batty! They'd throw rocks at it, at the exhaust, and watch them go up in the air. Two big guys got a plank and tried like the devil to hold it in the jet. Quite a time they had!

"Perhaps the only real good that came out of the Annapolis thing was the write-up I did in late Spring of 1939 for the Naval Academy *Log.* The technical reports were published by the ARS (American Rocket Society) but went largely unnoticed. However, the *Log* article came to the attention of Commander A. B. Vosseller. He was a 'big boat' (patrol plane) man, and they apparently were having trouble with the PBY-2's. The *Catalinas* were underpowered for certain conditions. So he dropped me a note along about graduation time and said, 'Before you go out to the fleet, why don't you drop in and talk to me?' Vosseller was head of the Plans Division of the Bureau of Aeronautics (BuAer).

"Having an idea of what he wanted to talk about, I ran up to Washington, where he pointed out the problem by saying, 'Do you think you can put a rocket on an airplane?' Well, I just happened to have a little analysis, as applied to the PBY, in my pocket. Then, what he did was suggest I submit a patent paper on my JATO (Jet Assisted TakeOff) unit — and that he would use it as a vehicle to get me assigned to the Bureau and to get





At left, young Truax adjusts his compressed air/gasoline rocket. Above is his regeneratively cooled engine on its test stand. Truax devoted most of his spare time and leave periods to these experimental operations.

a project started, actually develop it!

"It took a little time. I put two years in the carrier *Enterprise* (CV-6) and a destroyer before I was finally ordered to BuAer. The job was to set up a project for JATO's for the PBY. Because the term 'rocket' was always associated with crackpots, I was the 'jet propulsion' man. I worked up a scheme estimated to cost $65,000. My boss, Commander Bolster, thought this

amount was more than BuAer was ready to put into such a venture, but suggested that I take my proposition to Commander L. C. Stevens, the head of the Experiments and Development Branch. Without any haggling at all, Cdr. Stevens, a particularly forward-looking officer, told me to write out a project order for that amount. I could have kicked myself for not having asked for $165,000.

"Well, that done, and with an urge to get my hands a little dirty — I just couldn't sit up there in Washington and be a bureaucrat — I went back down to the Experiment Station at Annapolis to run the thing. From the Bureau files, I had selected Bill Schubert, Jim Patton and Ray Stiff, all Reserve ensigns, to lend a hand. Several months later, the Bureau set up Dr. Goddard in a facility we had established at Annapolis."

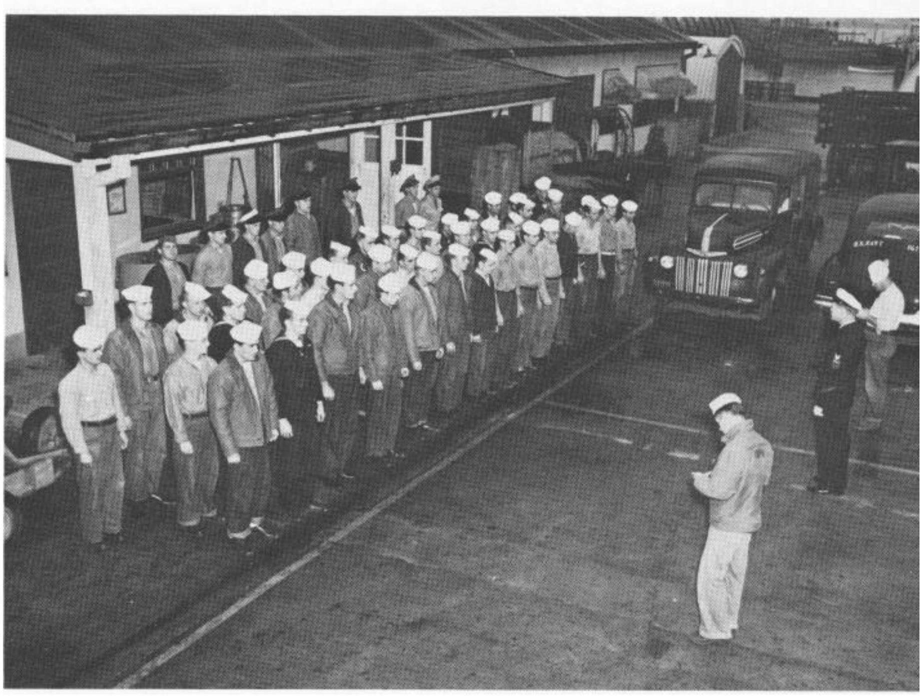
It is a point of interest that Goddard, in the years leading up to World War II, had offered his services several times to the government, and that he had been rejected. Perhaps the "crackpot" image preceded him. Then too, his previous rough treatment at the hands of the Press, which resulted in a *secretive* method of operation, probably branded him as an eccentric outside his small circle. But two military men, an Army flyer named Boushey, and a Naval Aviator, Lieutenant Fink Fischer, did all they could to bring recognition to Dr. Goddard, Both men were interested in the development of rocket-assisted takeoffs for airplanes and eagerly sought to recruit Goddard for this purpose. One story has it that at a point when the war was imminent and a rocket research program seemed to have some possible merit, both Captain Boushey and Fink Fischer simultaneously went after the famous rocketeer. Boushey sent an airmail letter. But Fink Fischer's *telegram* arrived first.

Captain Truax recalls, "In 1942, just before I left the Bureau and went back to the Experiment Station at Annapolis, Dr. Goddard walked in. During the year before, when the international situation had been getting tense, the Guggenheims had recommended that he work for the government as he had in WW I. He had been doing some contract work for the Navy out in New Mexico, and now, here he was in Washington!

"He astonished me a little when he said he thought the rocket had come to the point where it needed engineering treatment, as opposed to the laboratory type of effort, and he needed someone to be his chief engineer. I said, Who do you have in mind,' and he answered, 'How about you?' That was what surprised me. Goddard had been engaged as a private contractor using government facilities. His work and the Navy's were to be separately administered but co-located. As a result, Goddard became Director of Research on Jet Propulsion, at Annapolis, while I was officer in charge of the Navy people. Both efforts were supported by BuAer as Project TED 3401, and Goddard's assignment was the same as mine — to build a JATO for the PBY *Catalina.*"

Others were also at work on the problem of a rocket-assist for aircraft.

One of the BuAer projects at Annapolis was a radio-controlled flying wing. This particular version made one successful free flight, dropped from plane.



At right, the Navy crew at morning muster at the Experiment Station. Dr. Goddard's office and shop were located in the right half of building.

The Army Air Corps, with the help of a former collaborator of Goddard's, Dr. C. N. Hickman, sponsored a program at the Guggenheim Aeronautical Laboratory at Cal Tech (GALCIT). Captain Homer Boushey, working out of Wright Field, conducted a series of tests in mid-1941, using rockets to thrust an *Ercoupe* into the air. Solid propellants were used in both locales, and Dr. Hickman's work was paralleled by the Navy's Bureau of Ordnance at Indian Head, Md. The smokeless powder used in these experiments burned at an uncontrollable rate (some would explode), a factor which made them impractical for service use. Although the British development of extruded cordite was an improvement — Lt. Fischer made successful takeoffs in a Brewster F2A-3 *Buffalo* on May 26, 1942, using British antiaircraft rockets (which spewed burning particles over the tail of the fighter) — the Navy's main program was concentrated on development of a long duration, cooled rocket motor.

"We were asked," Truax continues, "to build either a restartable unit or one that had an idling period. This really threw Goddard a curve because none of his prior work had been directed toward meeting such a requirement. I had decided, long before, that liquid oxygen was not a tractable propellant for military application. Needed was something which could be stored in a tank for a long time and not evaporate. Goddard was of a different mind; liquid oxygen was his baby, and he figured it would be all right.

"My first plan was to use nitric acid as the oxydizer and gasoline as the fuel. This combination proved very hard to ignite. In an effort to find a fuel that would ignite spontaneously on contact with nitric acid, we tried numerous chemicals. Turpentine worked well, but aniline proved best and became standard in rockets for many years.

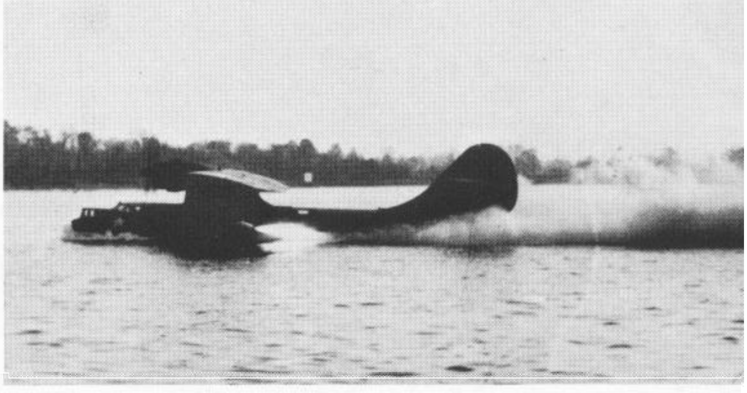
"I can remember Goddard, looking out his window, watching one of my test runs, a look of absolute amazement on his face, because here we were, turning on, turning off, turning on, repeatedly. And there Goddard was, having such a devil of a time with his non-spontaneous propellants.

"He'd have to fire his with either a spark plug or a squib (a pyrotechnic device fitted in the nozzle). But with first ignition, the squib, of course, would be blasted out or, in the case of the spark plug, the tip would be burned off. In either case, this meant he couldn't light off a second time — and that was the requirement. He tried all kinds of arrangements to protect the spark plug. I remember looking at his unit, and it just had tubing in every direction — spaghetti around and under and over. Very complex compared to the self-igniting system.

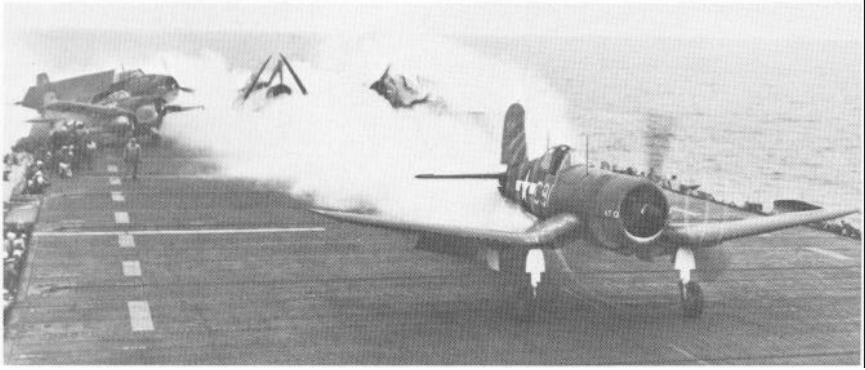
"The requirement itself proved eventually to be unnecessary for JATO and had the unfortunate effect of making Dr. Goddard's problem much more difficult.

"At any rate, by the time Fink Fischer came down from Washington to join us in 1942, we had developed a thrust chamber — a full size, 1,500-pound thrust chamber, working regeneratively, without requiring any extra coolant. It was, I decided, time for me to go off to flight training and become a Johnny-come-lately Naval Aviator."

The work Lt. Truax had done on controls and propellant feed systems had led his group to the discovery of the spontaneously igniting chemicals so widely used later. But the bulk of Dr. Goddard's experimentation at that time still was centered on gasoline and liquid oxygen. On August 1, 1942, a *Catalina* flying boat was delivered to the group at the Annapolis Experiment Station. The flying boat was modified to accommodate Goddard's installation. The unit was very complex, with numerous



Truax and his staff are shown at left during a visit from Dr. Van Karman (in white coat) of Cal Tech. Above, JATO units light off during 1942 PBY tests in Severn River. Craft made one successful takeoff prior to mishap.



An F4U-1 Corsair starts takoff run on USS Altamata (CVE-18) in 1944 after widespread acceptance of JATO units for fleet use.

thermocouples and safety relays. As a result, the test runs conducted in September by Lt. Fischer were only partially successful. Salt spray and the vibration of the PBY kept shorting out the relays, thus shutting down the unit. After five unsuccessful attempts, Fischer, in a desperate effort to get the plane into the air, had the special safety thermostatic cutoff switch removed. He was making sure the JATO unit would keep running throughout a complete takeoff. On the sixth test, the plane took off satisfactorily. Unfortunately, during the seventh run, vibration loosened a liquid oxygen line; the resultant fire seriously damaged the aft end of the airplane.

Nevertheless, further development work culminated in successful flight tests of a JATO-equipped *Catalina* by May 1943. Tests performed with this and other aircraft made it evident that JATO could reduce a takeoff run by 33 to 60 percent — or permit greatly increased payloads. One of the project test pilots, Marine Lieutenant William L. Gore, engineered a remarkable demonstration of JATO potential when he decided to "sell" it to the Pacific Fleet. It was not an easy task.

As previously mentioned, the Army Air Corps had gone to some lengths to develop a JATO capability of its own.

Capt. Bill Gore hung around, probing for a chink in the armor

In spite of considerable success, the Army changed its mind around 1943. In view of the long runways at its disposal, the need for JATO dissipated, and they dropped the project. In the Navy, too, there were those with similar feelings — as Bill Gore found out.

Gore was a long time rocket enthusiast. As an enlisted man and aviator in the Marine Corps, he had built a radio-controlled model dirigible propelled by the powder of Roman candles. His official paper on the use of JATO for flying boats and carrier aircraft eventually resulted in his assignment to the rocket desk in BuAer and promotion to a commissioned grade. He had been Fischer's copilot on the early PBY test and had put on his own show in an F4F *Wildcat.* Now he was out for big game, the Commander, Fleet Air Wing Two — Rear Admiral John Dale Price.

If any man could put JATO on Navy airplanes, Admiral Price would have to be that man. As Gore recalls, it took him three days to fly a PBM *Mariner* from Annapolis to Kaneohe Bay, Oahu, in the Hawaiian Islands. Then for the next five days, he cooled his heels outside the Admiral's office until it became evident he was not exactly welcome. But after that 6,000-mile trip, the Marine Aviator took a risky chance; he finally burst into Admiral Price's office and exclaimed, "I'm here, Sir, to sell you rockets!"

The Admiral quietly replied, "I'm trying to fight a war and what does Washington send me? A guy with a rocket." And then, with mounting vigor, "We don't need *rockets.* We need *airplanes!* Get the hell out of here!"

As a famous man once said, "Nothing succeeds like persistence. . . ." Bill Gore hung around Oahu, probing for a chink in the armor. And then he thought of the solution — a *contest.*

Asphalt potassium perchlorate JATO was demonstrated in 1943 on F4F-3.

Arranging to put on a demonstration of comparative takeoffs between an ordinary PBM and one equipped with JATO, Gore set a time, knowing the Admiral would come out to watch, if only for the sport of it. As an added inducement, it was stipulated that each plane would be loaded with ten tons of sandbags. The opposing pilot was one who also shared the Admiral's disdain for rockets, so he was bound to do his best.

The night before the contest, Gore told his crew chief to have 20,000 pounds of sand put in each PBM. The next morning, sure enough, the Admiral was on the seawall watching as the seaplanes taxied in the bay. At the signal, Gore cut in his rockets and sailed into the air. The Admiral could hardly believe it, especially since the other flying boat was still thundering about, unable to even get airborne! It turned out that Gore's crew chief had loaded the other plane's sand in its stern, far aft of its center of gravity; there was *no* way it could fly.

But Admiral Price had seen JATO. "I want that on every plane in the Navy," he said, and from then on, he was JATO's strongest supporter.

The liquid propellant JATO units of 1943 were reliable and worked well. However, their inherent handling difficulties and the fact that they were impossible to service in forward areas led to the switch to solid propellant units. By the end of the war, it was claimed that more than 3,000 lives had been saved because of its use. It also played a part in unique salvage operations, several times enabling downed flying boats to take off from extremely shallow waters. The most remarkable case concerned a JATO-equipped, four-engined PB2Y-5 *Coronado* that had been forced down in desert sand south of the Salton Sea in California. A ditch 2,000 feet long was bulldozed out, filled with water, and the seaplane floated. From this narrow ditch, it made a successful JATO takeoff and returned to its home base.

But the chief result of the Truax/Goddard liquid propellant JATO program at Annapolis was that it laid the groundwork for the use of rocket power in Navy guided missiles.