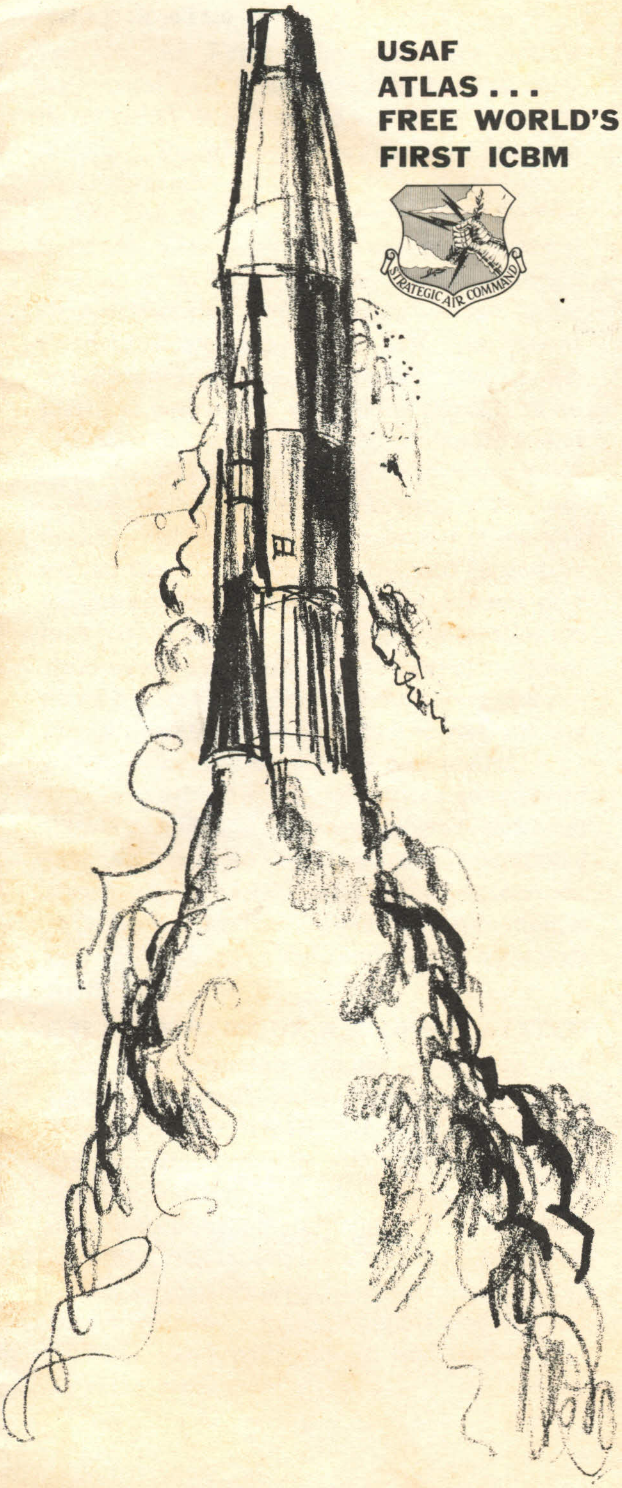
Jenkins

USAF ATLAS . . . FREE WORLD'S FIRST ICBM



STRATEGIC AIR COMMAND

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WHAT IS ATLAS?

The U.S. Air Force Atlas is the free world's first operational intercontinental ballistic missile (ICBM). It is designed as a major deterrent weapon in the arsenal of the Air Force Strategic Air Command.

The SAC mission, as outlined by Gen. Thomas S. Power, SAC commander, at a Congressional hearing, is "to be prepared to conduct strategic air operations on a global basis so that, in the event of sudden aggression, SAC can mount simultaneous nuclear retaliatory attacks designed to destroy the warmaking capacity of an aggressor to the point that he no longer would have the will or the capability to wage war."

With its capability of delivering a thermonuclear warhead more than a quarter of the way around the world, Atlas is designed to destroy top-priority enemy targets within minutes of a national decision to strike. *The real goal of the Atlas weapon system is enforcement of an armed peace by posing such a powerful threat that potential aggressors are unwilling to risk starting a war. Atlas is achieving this goal today.*

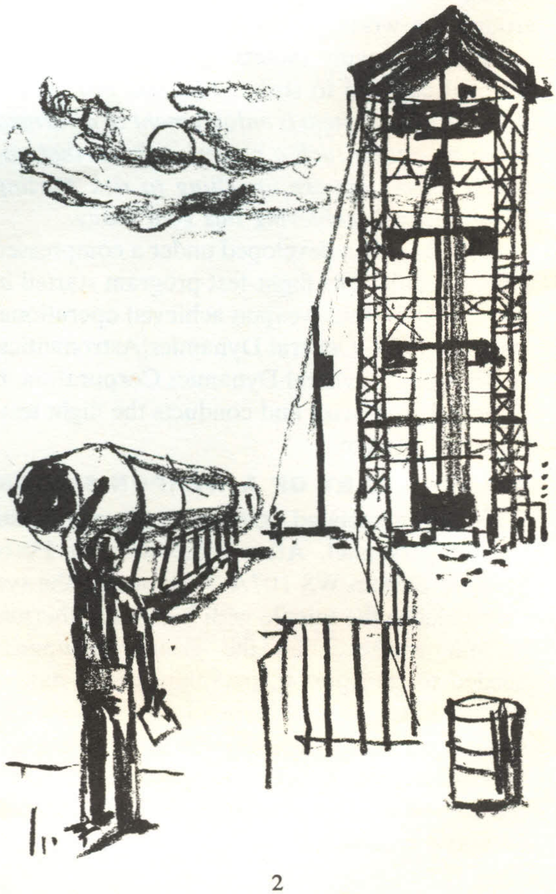
Atlas has been developed under a compressed time schedule. The flight-test program started in mid-1957, and the weapon achieved operational status in 1959. General Dynamics|Astronautics, A Division of General Dynamics Corporation, is principal contractor and conducts the flight tests for the Air Force.

ATLAS IS PART OF A WEAPON SYSTEM

With its associated ground equipment and trained personnel, Atlas comprises Air Force Weapon System WS 107A-1. Basically, the system includes the missile with high-yield thermonuclear warhead; all the ground equipment needed to transport it, maintain it in a state of readiness, fuel it, and launch it; the trained personnel to man the operational bases; the bases themselves; and a logistic support system which includes spare parts, shops, and trained men to make repairs.

The ground elements of a weapon system have assumed greatly increased importance in the transition from manned aircraft to missiles. In the missile, many of the functions of pilot, navigator, and bombardier have been assumed by intricate mechanical and electronic systems. Some of these are in the missile itself, some on the ground. During tests, intricate radio linkage between the missile systems and the ground systems is required to obtain test data. In an operational situation, all preparation of the missile prior to flight—including the electronic consoles which "quiz" the missile systems about their readiness—belongs to the ground complex.

Therefore, the structure, equipment, and procedures needed on the ground are part of the total design problem and must be handled as if they were a part of the missile itself.



HOW ATLAS WAS DEVELOPED

In 1946, the Air Force awarded General Dynamics|Astronautics (formerly Convair) the first U.S. research and development contract to develop a ballistic missile. As the first step, Convair designers under Karel J. Bossart, now technical director of General Dynamics|Astronautics, developed the MX-774 research rocket. Defense Department economy cutbacks in 1947 forced cancellation of this program, but Convair was able to complete three MX-774s with unexpended funds. They were launched at White Sands Proving Ground in 1948.

This remarkable MX-774 introduced three innovations which have been adopted universally in rocket technology.

1. First swiveling engines for directional control. (The only previous long-range rocket was the 200-mile German V-2, which was controlled by rudder-like graphite vanes in the jet stream.)
2. First integral tanks, with skin of the missile serving also as the wall of the propellant tanks, to effect a substantial saving in weight.
3. First separable nose cone.

From the MX-774 test flights in 1948 until early 1951, Convair continued limited ICBM studies with its own engineering team. A new Air Force study and development contract was awarded to Convair in 1951, and in 1954 the ICBM was assigned top Air Force priority. Early in 1955, Convair received its present contract for the Atlas.

Before the first missile was tested, directors of General Dynamics Corporation appropriated $20 million for a new plant at San Diego, Calif., for production of the Atlas and space vehicles. The Air Force supplied machine tools and other heavy equipment of nearly equal value. Additions to the plant have since raised General Dynamics' investment to more than $33 million and more than 2 million sq. ft. of floor space.

The Atlas program has been marked by a greatly compressed development cycle. In the normal development of a weapon system, the steps of design, system testing, flight testing, final design changes, and production follow in regulated sequence.

In the Atlas program, these steps were overlapped to save time. Production facilities were ordered before the first missile had been built; design of the operational bases was started before the first test flight; production was increased early in the flight-test program, and operational bases were under construction midway in the research and development program.

It has been estimated that the development

cycle of modern weapon systems averages seven years. If the go-ahead of January 1955 is taken as the starting point for WS 107A-1, the system attained operational capability in just over four and one-half years.

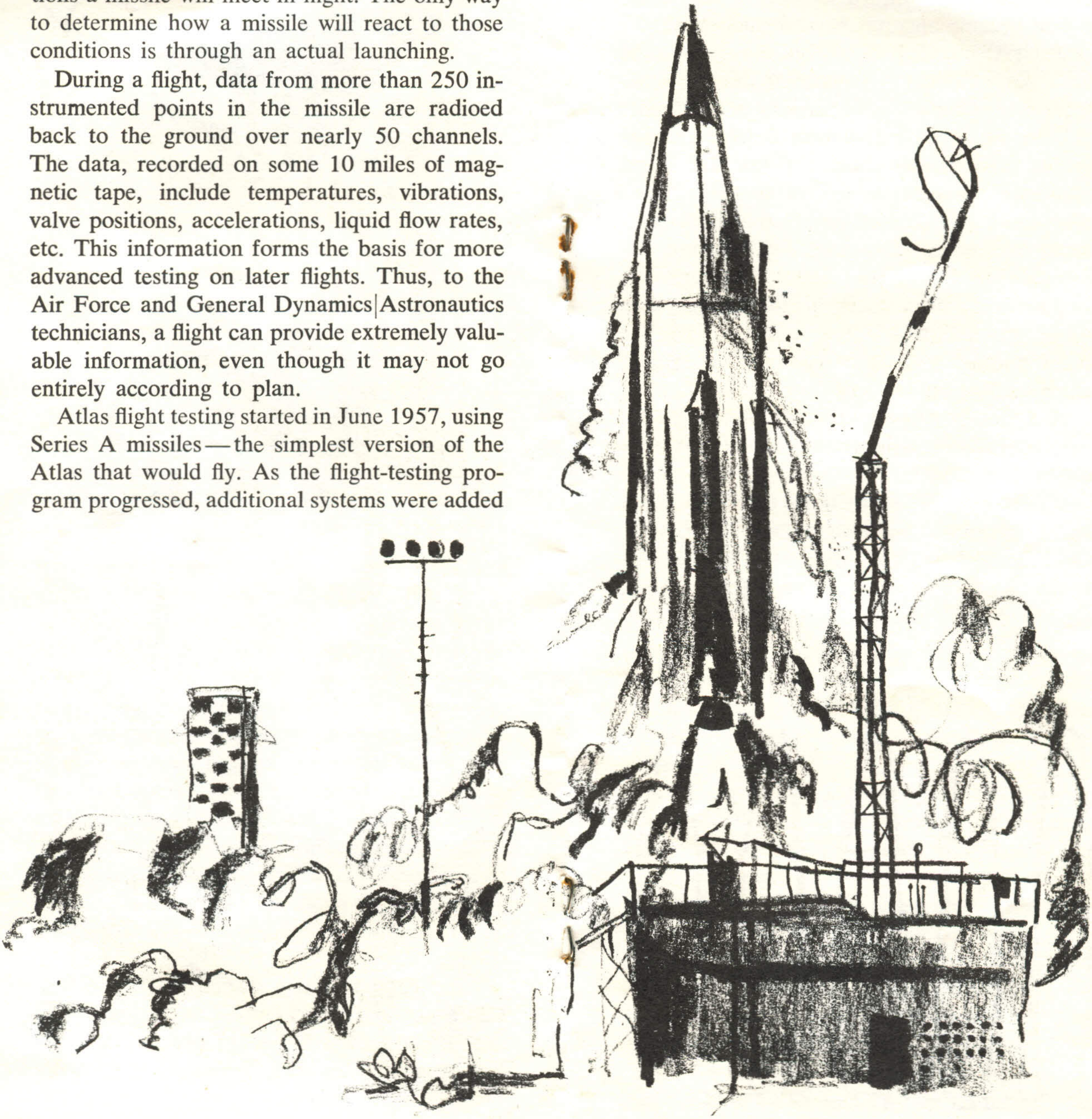
In order to achieve this rapid pace, design and development of the many components and systems in the missile are carried out according to an extremely detailed schedule. Each component is tested as a unit; then when it is combined with other components into the next size, that unit is tested, and so on until the missile is assembled. The results are tested by captive missile firings on a hold-down test pad, or in flights from Cape Canaveral, Fla.

Atlas captive testing started in 1956 at two California sites: Sycamore Canyon, near San Diego, and Edwards Rocket Site, northeast of Los Angeles. The same missile is fired many times on these stands.

Although flight conditions are simulated as much as possible in captive testing, it is not possible to duplicate on the ground all the conditions a missile will meet in flight. The only way to determine how a missile will react to those conditions is through an actual launching.

During a flight, data from more than 250 instrumented points in the missile are radioed back to the ground over nearly 50 channels. The data, recorded on some 10 miles of magnetic tape, include temperatures, vibrations, valve positions, accelerations, liquid flow rates, etc. This information forms the basis for more advanced testing on later flights. Thus, to the Air Force and General Dynamics|Astronautics technicians, a flight can provide extremely valuable information, even though it may not go entirely according to plan.

Atlas flight testing started in June 1957, using Series A missiles—the simplest version of the Atlas that would fly. As the flight-testing program progressed, additional systems were added



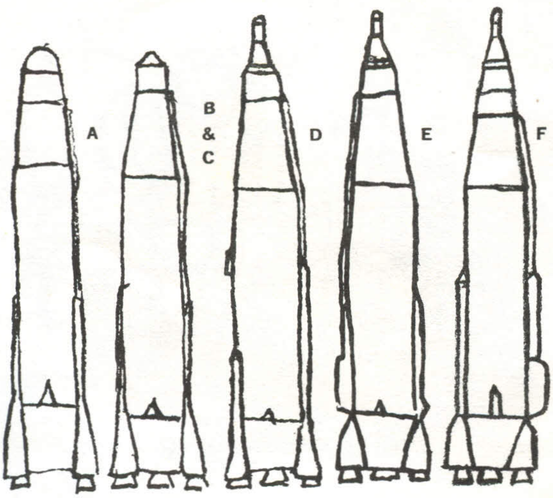
until the initial operational configuration — the Series D missile — was tested starting early in the spring of 1959. The Series E missile became operational on 10 October 1961. Series F first became operational on 4 June 1962.

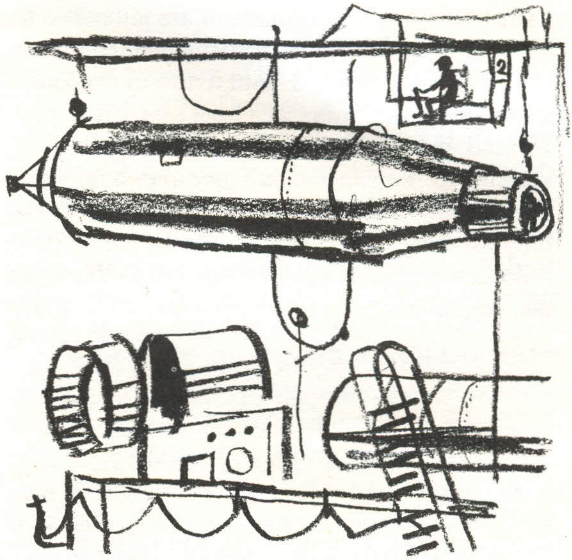
The "A" missile had only booster engines and dummy nose cone; "B" added the sustainer engine, guidance system, and separable nose cone; "C" incorporated refinements developed from testing the first two series, and the "D" added additional refinements. Series E and F followed with more powerful engines, all-inertial guidance, and other flight and configuration improvements.

The first full-range flight went more than 6,000 statute miles on 18 November 1958. The Atlas boosted itself into orbit and became an earth satellite on 18 December 1958.

A Series D Atlas successfully flew a 9,042-mile course with an operational-type nose cone on 26 May 1960.

Vandenberg Air Force Base, Calif., is a combined operational and training base for ICBMs. Operational bases for Atlas are: Warren Air Force Base, Cheyenne, Wyo.; Offutt AFB, Omaha, Neb.; Fairchild AFB, Spokane, Wash.;





Forbes AFB, Topeka, Kan.; Schilling AFB, Salina, Kan.; Lincoln AFB, Lincoln, Neb.; Altus AFB, Altus, Okla.; Dyess AFB, Abilene, Tex.; Walker AFB, Roswell, N.M., and Plattsburgh AFB, Plattsburgh, N.Y.

HOW ATLAS IS MADE

The Atlas tank structure is a constant 10-ft. diameter and is made of thin, lightweight stainless steel. The tanks maintain their shape through pressurization from helium or nitrogen gas pressure; there is no stiffening by internal framework.

During handling, transportation, and preparation on the flight pad, tank pressures of less than 10 pounds per square inch are maintained.

All electrical and electronic systems are housed in external pods along the missile tank.

The propulsion section includes a single sustainer engine mounted on the rear of the tank structure, two booster engines which flank the sustainer, and two small vernier engines mounted externally near the tank base.

All five engines are ignited on the ground. After a few minutes of flight, the booster engines and associated equipment are jettisoned to lighten the load. The sustainer engine continues to accelerate the missile until it attains a velocity of about 16,000 miles per hour; then it is shut off and the small vernier rockets "trim" the velocity to the exact value required, and make orientation corrections. After vernier shutdown, the nose cone is separated from the missile and follows a purely ballistic (unguided) course to the target.

MANAGEMENT OF ATLAS PROGRAM

Research and development phases of Project Atlas are directed by the Air Force Systems Command, Ballistic Systems Division, Inglewood, Calif. At Cape Canaveral, Astronautics launching complexes and assembly/checkout buildings are part of the Atlantic Missile Range.

As systems integrator for Project Atlas, Astronautics builds the airframe, the autopilot system and various components; assembles and checks out the missiles; conducts both captive and flight tests; activates new Atlas bases under the direction of the Ballistic Systems Division, and trains Air Force personnel who will man the operational bases for the Strategic Air Command.

Associate contractors are Rocketdyne Division of North American Aviation, which builds the rocket engines; General Electric Company and Burroughs Corporation, radio-inertial guidance; American Bosch Arma Corporation, all-inertial guidance; General Electric Company and Avco, nose cones. Space Technology Laboratories serve as technical staff to the Air Force Systems Command.

For its part of the Atlas task, Astronautics draws upon resources of more than 3,000 subcontractors and suppliers in 41 states.

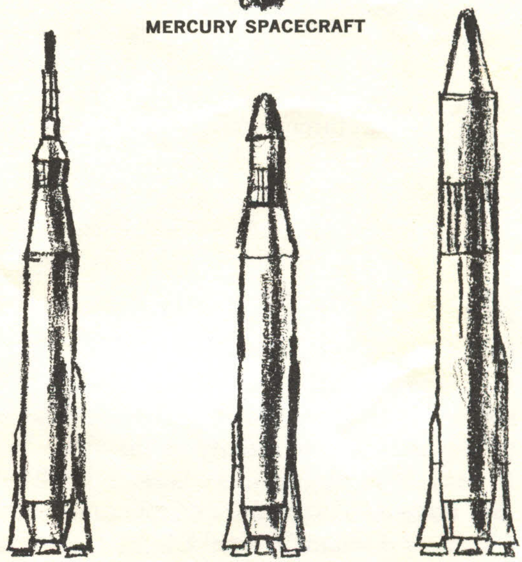
ATLAS IN SPACE

As the free world's first extensively tested ICBM, and the first to launch itself into orbit (Missile 10-B), Atlas is a workhorse of the early space age. Missions accomplished or underway

include:

1. Project Mercury, the United States' man-in-space program. The manned spacecraft was developed by McDonnell Aircraft Corporation, and boosted into orbit by Atlas. On 12 February 1962, an Atlas successfully launched Astronaut John Glenn on the free world's first earth-orbital flight. Glenn made three complete trips around the earth. On 24 May 1962, an Atlas placed Astronaut M. Scott Carpenter into orbit, duplicating Glenn's achievement. Astronaut Walter Schirra was Atlas-boosted on 3 October 1962, completing six earth orbits. Project Mercury was concluded with a 22-orbit journey by Astronaut L. Gordon Cooper, whose spacecraft was placed into orbital path by an Atlas on 15 May 1963.

MERCURY SPACECRAFT



MERCURY - ATLAS ATLAS-AGENA ATLAS-CENTAUR

2. Project Centaur, a high-energy upper stage for Atlas, capable of orbiting payloads of several tons. Centaur is built and tested by General Dynamics|Astronautics for the National Aeronautics and Space Administration. Through its use of liquid hydrogen-liquid oxygen powered engines, Centaur is serving as the nation's major research and development tool for the new technology of hydrogen propulsion. The engines were developed by Pratt & Whitney Aircraft. The first Atlas-Centaur flight test was conducted in May 1962.

General Dynamics|Astronautics launches these vehicles.

CAPSULE INFORMATION ON ATLAS

Length: 75 ft. to 82.5 ft. depending on nose cone type.

Tank Diameter: 10 ft.

Diameter of Propulsion Section Housing: 16 ft.

Range: More than 9,000 miles.

Weight: About 260,000 lb. at takeoff.

Thrust: About 360,000 lb. at takeoff (Series D), and 389,000 lb. at takeoff (Series E, and F).

Stages: One and one-half, so called because of the unique system of igniting all engines prior to launching. This eliminates any risk that the missile will abort through failure to achieve second stage at high altitude.

Guidance: Radio-inertial (requiring a ground station) and all-inertial (that is, completely contained within the missile.)

ASTRONAUTICS AND GENERAL DYNAMICS

General Dynamics|Astronautics was established as a separate unit of the former Convair Division in 1957 to develop the Atlas missile and to expand Convair activity in the space field. In May 1961, Astronautics became a full division of General Dynamics Corporation. Astronautics is located in San Diego, Calif. Also in San Diego are General Dynamics|Convair and General Atomic Division of General Dynamics Corporation. General Dynamics|Convair builds the medium-range 880 and the long-range 990 commercial jet transports. General Atomic Division conducts research, development, and production in the nuclear field, and research in other scientific fields.

General Dynamics Corporation has these other divisions and wholly owned subsidiary:

Electric Boat, Groton, Connecticut, built the first atomic-powered submarine. The *Nautilus* made the first transpolar underwater cruise; the *Skate* navigated submerged over the North Pole twice, and the *Seawolf* set a 60-day underwater endurance record. Electric Boat also produces nuclear submarines for launching of Polaris missiles.

General Dynamics|Electro Dynamic, Bayonne, New Jersey, produces electric motors, generators, and motor generator sets of advanced design.

General Dynamics|Fort Worth, Fort Worth, Texas, manufactures the Air Force B-58 Hustler, the world's first supersonic bomber.

General Dynamics|Pomona, Pomona, Calif., builds the Navy's Terrier and Tartar and Army's Redeye missiles.

General Dynamics|Electronics, headquarters at Rochester, New York, manufactures electronics products.

General Dynamics|Liquid Carbonic, headquarters in Chicago, Illinois, produces medical and industrial gases.

Stromberg-Carlson, headquarters at Rochester, New York, manufactures communications equipment.

General Dynamics|Material Service, Chicago, Illinois, supplier of construction materials, coal, and limestone.

Canadair, Limited, Montreal, Canada, the largest airframe builder in Canada, is a subsidiary.

GENERAL DYNAMICS
ASTRONAUTICS