TELEDYNE, INC. ANNUAL REPORT 1967

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On the cover: Three prime areas of Teledyne activity are symbolized by a diagram portraying the crystal and grain structure of hafnium, zirconium and titanium; a seismic recording; and a microcircuit interconnection diagram.

TO OUR SHAREHOLDERS:

The corporate form of organization has ancient origins, but the history of corporate enterprise as we know it in the United States today covers a span of only about a hundred years. Prior to the second half of the nineteenth century individual proprietorships and partnerships could provide the modest capital and management that was necessary to maintain the business and supply the markets of those days. Few corporations existed, and those that did were mostly local quasi-public bodies, designed primarily to serve the public interest.

Shortly before and after the Civil War, industrial techniques that required large capital investment began to be used. The rapid spread of these techniques, together with the associated growth in size of the individual enterprise and changes in its administrative organization marked the emergence of the modern corporation.

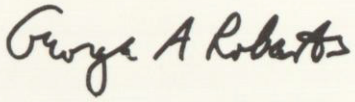
The rise of the great business corporations was stimulated by technological innovation. Most if not all of the organizations which have become today's leading industrial corporations were originally set up to exploit advances in technology. For example, the invention and development of the steam locomotive gave rise to the railroad industry, which by 1869 had crossed the continent and continued to grow for another fifty years. The invention of the internal combustion engine and its development led by the turn of the century to the beginnings of the automobile and aviation industries. Today many of our largest corporations are engaged in manufacturing cars and aircraft, or in supplying fuel for them. More recently, advances in electronics technology have led to the growth of organizations manufacturing equipment for

communications, computation, and automatic control.

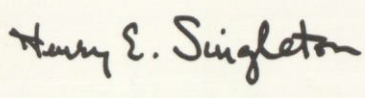
Underlying and making possible the advances in technology which have created modern industry have been the steady advances in our understanding of materials. Rapid progress in metallurgy did not become possible until the beginning of the nineteenth century, when refractory materials capable of holding molten metal were developed. Our most important energy conversion devices—the internal combustion engine and the nuclear reactor—are limited in efficiency because of the temperature and other environmental limitations of the materials out of which they are made. Advances in aviation, in electronics, and in many other branches of industry will continue to be paced by advances in materials technology.

The perspective furnished by studying the history of corporate enterprise in the United States—and the parallel history of the influence of technology upon industrial growth—can be helpful to those engaged in managing large industrial organizations. While the initial purpose of an industrial corporation may be to exploit an advance in technology, it is clear that in order to sustain substantial growth the corporation must continually create new technological advances for future utilization. The essence of good management is the optimum unification of capital resources with the resources of technology. At Teledyne we strive always to keep in mind the lessons of history to help guide us in the selection of the right path to the future.

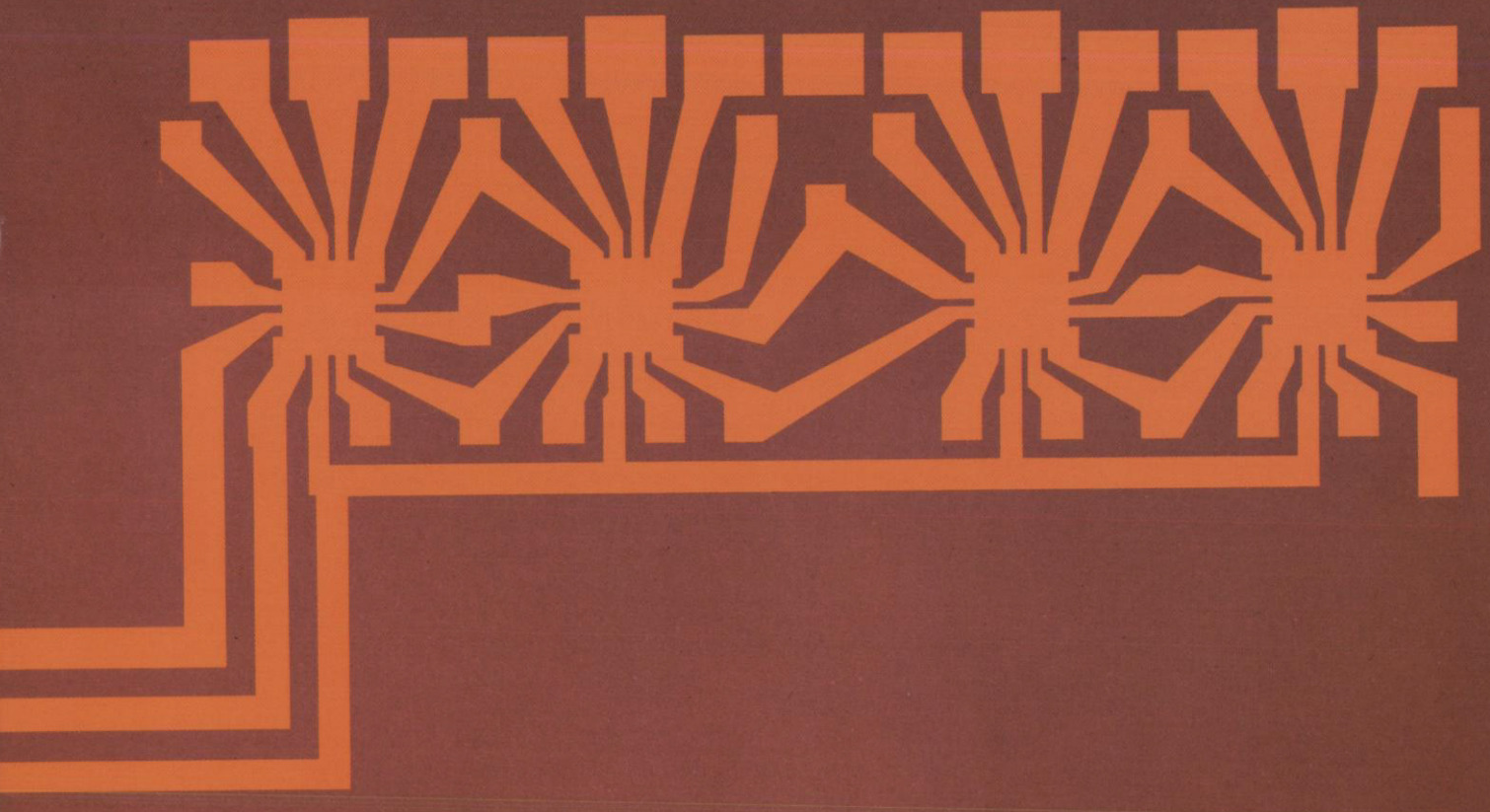
For at Teledyne the purpose is growth. And the history of corporate enterprise shows that the basis for sustained industrial growth is technological leadership.

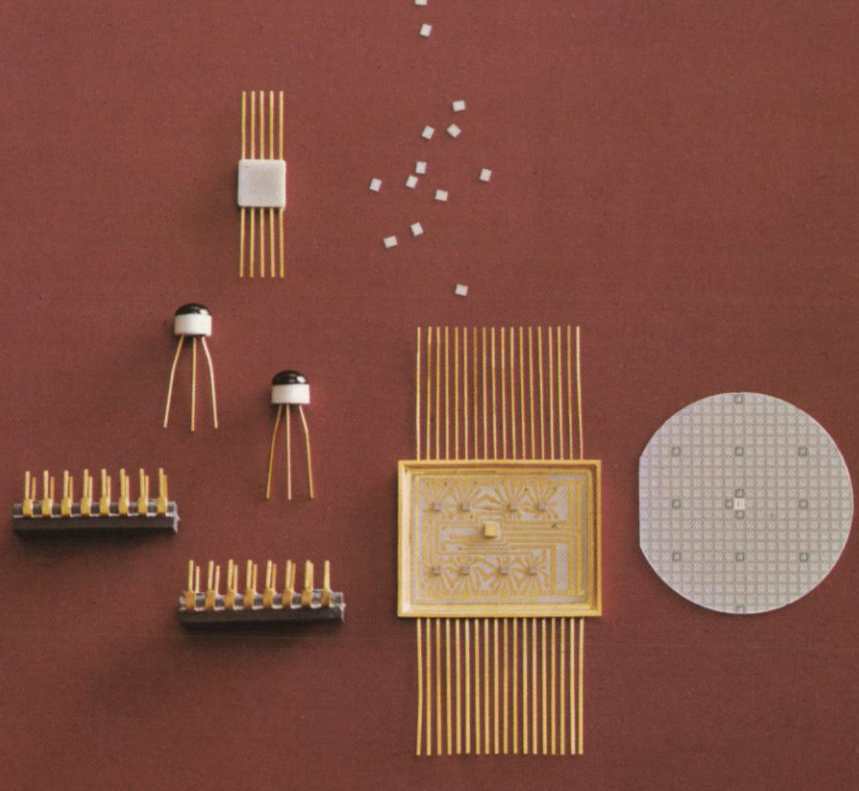


George A. Roberts
President



Henry E. Singleton
Chairman of the Board of Directors





ELECTRONICS AND CONTROL

Nothing has influenced the electronics industry more during the post-war era than the drive towards smaller, more reliable and economical circuits. Initially, the invention of the transistor in the late 1940's made possible the first major reduction in size from vacuum tube circuits. Further impetus was provided in the early 1950's with the use of thin-film techniques, in which passive components and conductors were formed on non-conductive substrates by spray, vapor deposition and other processes with the active elements added separately. In 1960, the advent of silicon planar technology paved the way for microelectronic integrated circuits, monolithic structures in which all passive and active elements are formed on or within a semiconductor substrate by diffusion and thin-film deposition methods.

As in every period of accelerated technological change the original fundamental breakthrough becomes a catalyst for complementary developments necessary to fully realize the potential of the new element. In the case of microelectronics, this potential was for a dramatic reduction in equipment size, weight and cost, and vast improvement in reliability. These benefits could, however, be obtained only by a substantial improvement in the techniques for interconnection and mechanical assembly, eliminating the paraphernalia necessary to a discrete-component technology.

To this end, Teledyne has developed the Microelectronic Modular Assembly, or MEMA, a hermetically-sealed flat ceramic package approximately the size of a postage stamp and containing perhaps thirty individual microelectronic integrated circuits, or chips, each approximately the size of the head of a pin. These are in turn interconnected with fine gold wires via an interconnection matrix deposited upon the ceramic base to perform the desired digital or analog function. Currently in volume production, the MEMA is undergoing continual refinement. Similar units employing "flip-chip" techniques, in which the individual circuits are placed face down on the ceramic to connect directly to the substrate matrix without intervening wires, are in limited production, as are the multiple-layer ceramic substrates required to accommodate more complex flip-chip interconnection patterns.

A good example of the benefits gained from the use of microelectronics and the MEMA is the Integrated Helicopter Avionics System which Teledyne has developed under a joint Navy-Army program and which is currently completing engineering flight test. Allowing all-weather operation of helicopters, the IHAS provides for precision navigation, station-keeping to permit aircraft to fly safely in close formation at night and in zero visibility, terrain following for automatic low altitude flight, an automatic flight control subsystem, and fire control computations for the aircraft's weapons. Integrated through a functionally-modular computer, the system can be tailored to satisfy a wide range of aircraft and missions by adding or deleting equipments and the associated computer modules. The self-contained navigation subsystem of IHAS has entered production for use in the Marine Corps' CH-46 and CH-53 helicopters, with further orders being received during the year for additional production quantities, as well as for other IHAS equipments to support the Army's AH-56 Cheyenne attack helicopter development program. Certain IHAS equipments, notably other configurations of the computer, are also on order for non-helicopter applications. To meet expanding volume Teledyne Systems Company recently moved into the first building in its new 40 acre site in the Los Angeles area.

A design philosophy emphasizing the MEMA technology and functional modularity is also the keynote feature in our audio/visual warning systems, in which visual indicators and a

Semiconductor integrated circuit wafer and chips, individually-packaged components and multi-component assemblies.

Small ultra-reliable digital computers, compact avionics systems that perform a multiplicity of critical functions simultaneously, hand-held television cameras, miniature inertial navigation equipment—these are typical of the advanced electronic equipments made by Teledyne. The vital element common to all of them is microelectronics, the most important development in the industry today. [1] Some 40 major processing steps are performed in the fabrication of silicon monolithic integrated circuits of the type produced by Teledyne. The base material is a single crystal silicon wafer of relatively high resistivity which is lapped and polished.

[1]

prerecorded voice automatically announce to the pilot any failure or hazardous condition in aircraft, engines, or equipment. Successfully tested this past year by the Army on a UH-1 helicopter, initial application is pointed towards the important rotary wing market. However, the ability to modularly expand the number of functions monitored and variety of messages and visual legends facilitates adaptation to fixed-wing aircraft as well, including military fighter aircraft, where cockpit and panel space is extremely limited.

It is toward similar applications, where space is at a premium, that our Flight Reference Stabilization System (FRSS) is oriented. The FRSS is a four-gimbal inertial navigator, consisting of computing unit, power supply and the stable platform itself in a volume of less than a quarter of a cubic foot. Again capitalizing upon the benefits accruing from the use of microelectronics, it offers a significant reduction in cost and weight plus a substantial increase in system reliability. Typical is the mounting of the micro-circuits associated with the inertial instruments directly on the gyroscopes and accelerometers; this results in interchangeable, plug-in instruments allowing simplified testing and fault isolation, fewer connections, and the elimination of approximately half of the slip rings required in previous designs. Featuring gas spin bearings, the gyroscopes have no internal gimbals, using instead minute electrostatic forces to maintain alignment of the delicate parts.

During the year, the first phase of a new program which incorporates the FRSS, the IHAS computer and peripheral elements, and a new Loran C/D receiver was completed for the Air Force. The system is called DIL, an advanced Doppler-Inertial-Loran Navigation System which employs the latest filtering techniques to combine in a digital computer the outputs from the three types of sensors in such a way

An epitaxial layer of silicon is then grown. [2] Diffusion, the substitution of n or p-type atoms for silicon atoms, is effected by processing at temperatures as high as 1,300°C in a special diffusion furnace. [3] When the wafers emerge, junctions have been formed at those locations in the silicon where imbalances of the densities of p and n-type impurities existed. In the photo masking operation, the oxidized wafer is coated with photo-sensitive lacquer, and the mask image is printed and developed. The image is then etched into the oxide. [4] To complete the circuit, the elements are interconnected by a vacuum evaporation process which deposits a thin

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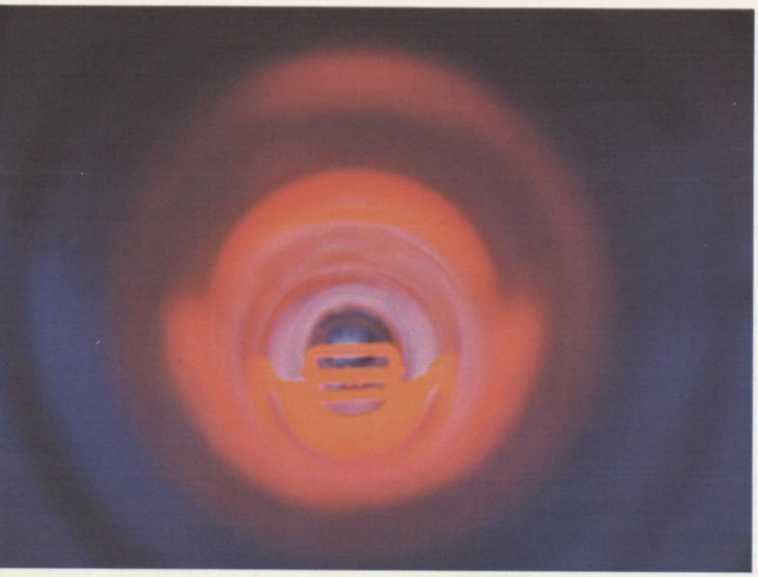

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film of conductive metal such as aluminum. [5] Depending on the complexity of the individual circuit, a single wafer approximately an inch in diameter may contain many hundreds of circuits. Each is carefully checked with a probe to eliminate those failing to meet electrical specifications. [6] When the wafers are sliced into individual chips or dice, they are prepared for packaging. Machines with tiny vacuum quills lift the chip from a container, place it on the header or substrate material, and solder it into place. [7] Hundreds of different kinds of circuits are constructed through these techniques. All components are thoroughly tested, sometimes by

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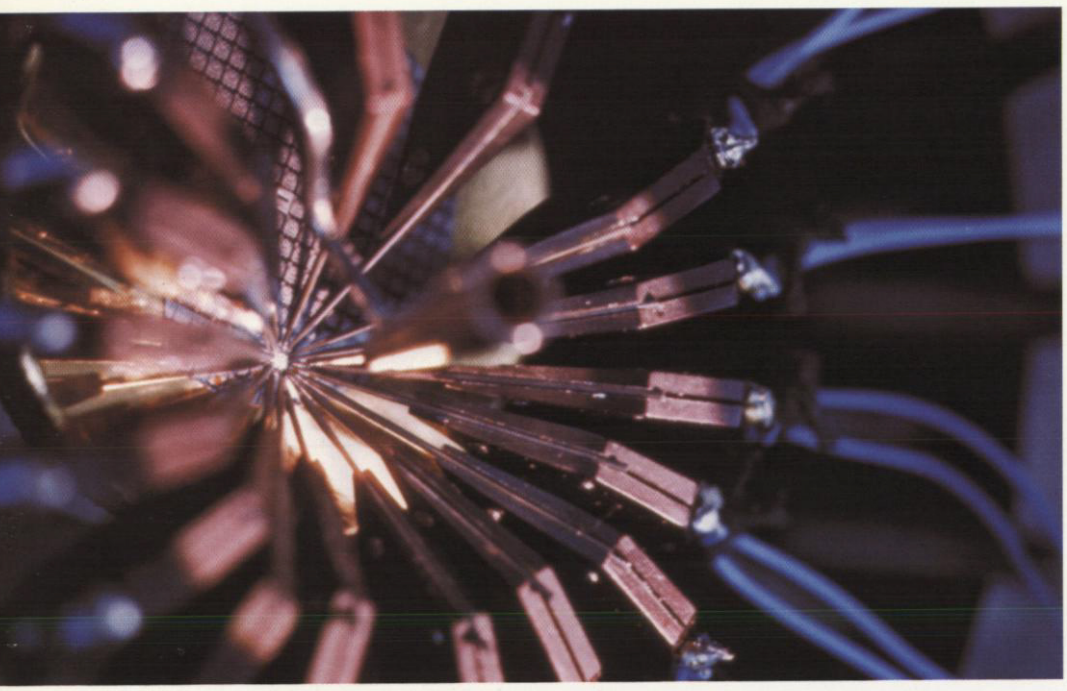

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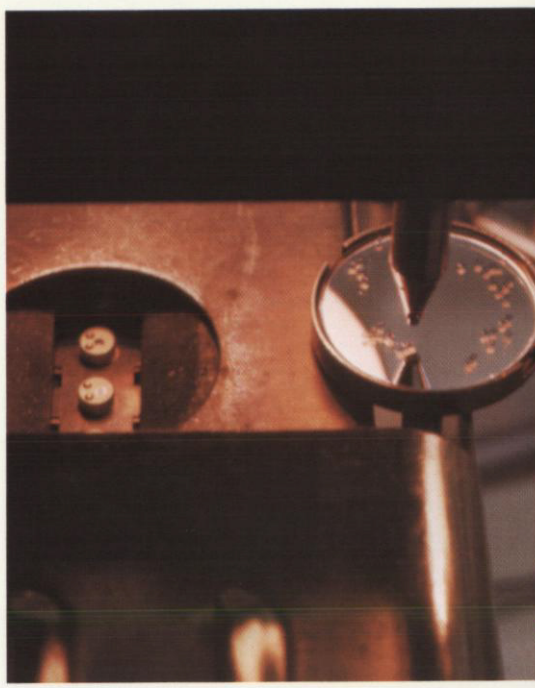

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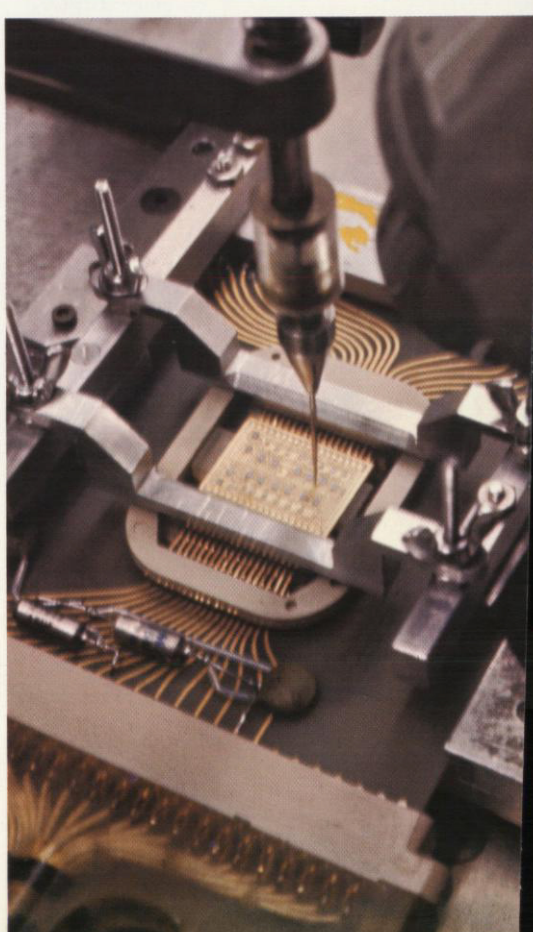

[9]

automatic instruments which produce a printed record of the performance characteristics. [8] By assembling a set of dice into a package of about 1" x ¾" x 1/16", Teledyne has developed the Microelectronic Modular Assembly. The MEMA substrate is a ceramic aluminum oxide wafer on which the desired wiring pattern is affixed through metalization and gold plating. Each integrated circuit chip soldered to the substrate may contain as many as 50 interconnected components. [9] Completed MEMAs are electrically tested with special-purpose test equipment for DC parameters, dynamic characteristics and logic performance. When failures occur, delicate

that the resulting navigational data is substantially superior to that which the sensors could yield independently. Like the FRSS and the IHAS computer, the Loran C/D receiver is company-proprietary in design, using MEMAs to reduce the size and weight of the receiver to approximately one-tenth of that of comparable current equipment. This and the simplification of the electronics have produced a receiver of substantially improved performance that is particularly well suited for airborne use. Demonstrated to the Air Force during the past year, the receiver is currently being prepared for extensive field testing.

Related to such systems are the flight instruments and sensors designed and produced by the company, which include air data computers, actuator servo controls, flight control systems, stability augmentation equipment, synchro-to-digital converters, and transducers of various types. Also offered are angle of attack indicating systems, approach power compensators and a device to enable the pilot to control the rate of climb or descent, the Inertial-lead Vertical Speed Indicator. A real-time rate of climb sensing-display unit, the IVSI eliminates the delay inherent in standard rate-of-climb instruments and improves flight safety. Initially developed for specific customers in many instances, these instruments and related sensory products continued to enjoy wider application in the broad commercial and military aviation community through the year.

Among products developed during the year is a quartz pressure sensor for use in aircraft, missile and space applications where temperature extremes preclude the use of conventional metallic sensors. This sensor is designed for air data computing systems and aircraft engine control systems of such next-generation vehicles as the supersonic transport. Developmental work was also done on control systems for advanced turbine engines, pressure transducers for the engine inlet control systems of supersonic aircraft, and digital sensing and data conversion equipment to supply inputs to aircraft control systems like IHAS.

In the fields of scientific and industrial instrumentation, Teledyne's oxygen monitoring equipment is used in process control loops and in aquanaut life support systems. Our near-IR analyzer is used to measure the water content in chemical process streams, while our portable total hydrocarbon analyzer for monitoring the discharge of organic solvents to the atmosphere has application to current problems of air pollution control.

Microwave technology and its various applications continues to be an area of growing activity. The development of a line of low noise packaged travelling wave tube amplifiers introduced earlier for airborne and other applications where space and weight are critical, has been completed. Our laboratories also announced the Hipolon, a TWT with up to a one-watt power output but with a low 10-db noise figure formerly attainable only in milliwatt-output tubes. A third accomplishment was the development and delivery of a CW power amplifier TWT designed specifically for use in satellite communications transmitters.

Progress in microwave super-components during the past year was also satisfying. Used principally in reconnaissance and electronic countermeasures, these are combinations of TWT's and auxiliary components designed as an integrated assembly to eliminate interface problems and improve system performance. Additional developments in super-components, plus continuing research in such areas as the microwave modulation of laser energy, microwave acoustic amplification and delay devices and solid-state microwave energy sources are planned for the future.

Complementing Teledyne's work in active devices was the continuing development and

probes are used to identify the fault for correction. [10] Among the more elaborate test equipment is a system for simultaneously probing a large number of critical points on the MEMA. [11] The results are displayed on a visual readout device which screens an enlarged circuit diagram of the MEMA assembly under test and indicates the condition of the circuitry by means of a pattern of lights corresponding to the configuration of the probes. [12] Teledyne is now

delivery of a variety of passive microwave components, such as switches, filters and couplers, as well as an increase in our microwave system activity. During the year our unique short pulse radar cross-section and antenna ranges were enlarged and operated on a two-shift basis a large percentage of the time. Involving related technology, Teledyne was also selected to design a major electronic ordnance fuze testing range for a government facility. In the equipment area, prototype models of the IHAS short range stationkeeping equipment were delivered to flight test, and Teledyne was chosen to supply important radar system components for the Air Force F-111 aircraft and an Army helicopter fire control system. Sales of our proprietary line of passive radar augmentors similarly continued to grow.

Moving lower in the radio-frequency spectrum, our communications activities were marked by additional orders and deliveries of our phase-lock tracking receivers for steering large ground antennas, the ARC-73 VHF set for the Army, and the Navy SRC-20 and SRC-21. In telemetry, we continue to supply items of equipment to a number of the major missile and space programs using both conventional components and MEMAs, and are providing transmission links for relaying data for classified tactical uses by the Air Force. Typical of our work in the space area is the Saturn V program, in which some 80 percent of the telemetry system carried aloft by that vehicle last fall was supplied by the company. Installed in all four Saturn stages, they included over fifty pieces of equipment operating in eighteen different data links spanning the range of telemetry techniques, including PCM/FM, PAM/FM, FM/FM, and SSB/FM transmissions, and handling about 3,200 measurement channels.

In addition to supplying the major portion of the telemetry system, Teledyne is making other contributions to the Saturn booster program as a member of the mission support team for the Marshall Space Flight Center and to the Nike X anti-ballistic missile program for the Army Missile Command. Assignments include systems analysis, propulsion and vehicle engineering, testing, and quality and reliability assurance, as well as the design and construction of equipment and components used in these programs. Among other company products supporting the recent Saturn launch were seventy high-speed cameras engaged in photographing various aspects of the lift-off and flight, and two which were carried on the flight to record the separation of the second stage from the first. Operating at film speeds up to 500 feet per second, the company's cameras are also used for scientific and industrial research and aerial photography.

During the past year, Teledyne has increased its research and engineering efforts in miniature optical components as well, and continued the development and production of optical products for other uses. Observation windows for the Apollo capsule, photographic windows for high-performance aircraft and domes and telescopes for infrared applications are among the many current projects, as well as the design of specialized optics for Teledyne's Microeye, the smallest TV camera-transmitter available. Weighing just a pound and a half, yet producing standard 525-line interlaced video of broadcast quality, it represents another example of the dramatic size reduction offered by the MEMA technology.

While integrated circuits and the MEMA perform many functions, discrete electronic components and electromechanical devices continue to be essential for a variety of uses. Typical of these are two new field effect transistors introduced this year. One, the highest power FET on the market, is ideal for r-f and small servo amplifier final stages; the other, the lowest noise unit currently available, is

using the MEMA in many electronic systems. For the IHAS, groups of MEMAs are arranged into small, compact modules which perform various computing functions. They operate in concert with core memories housed within similar modules which store information for computational and data retention purposes. [13] The various modules are contained within several enclosures which comprise a unique computer complex combining both incremental and whole number

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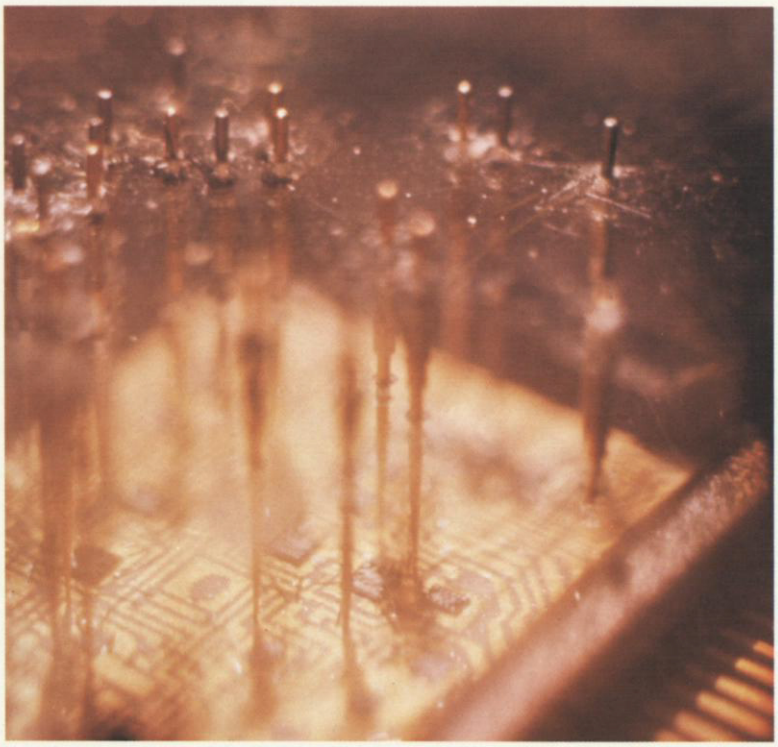

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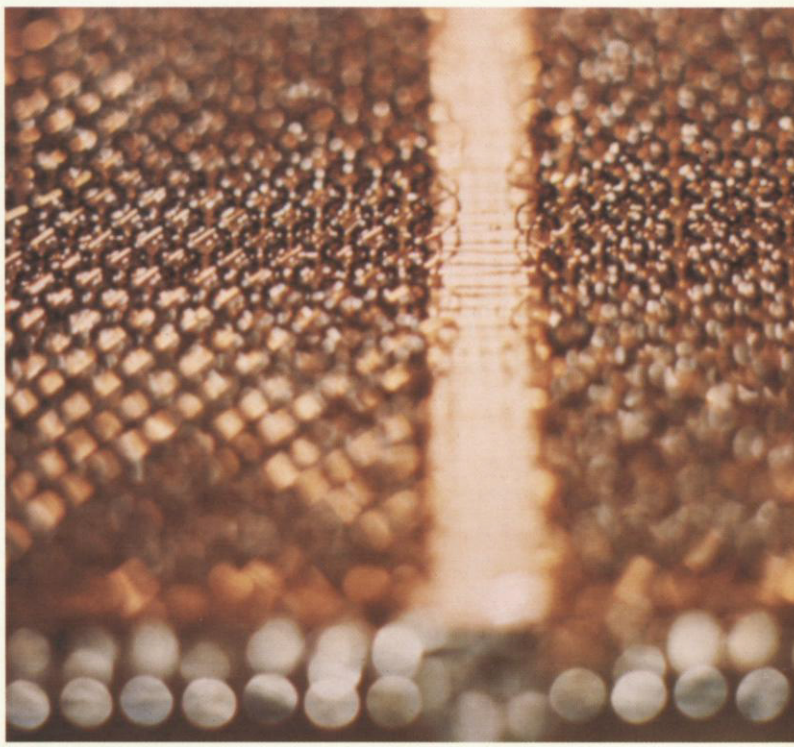

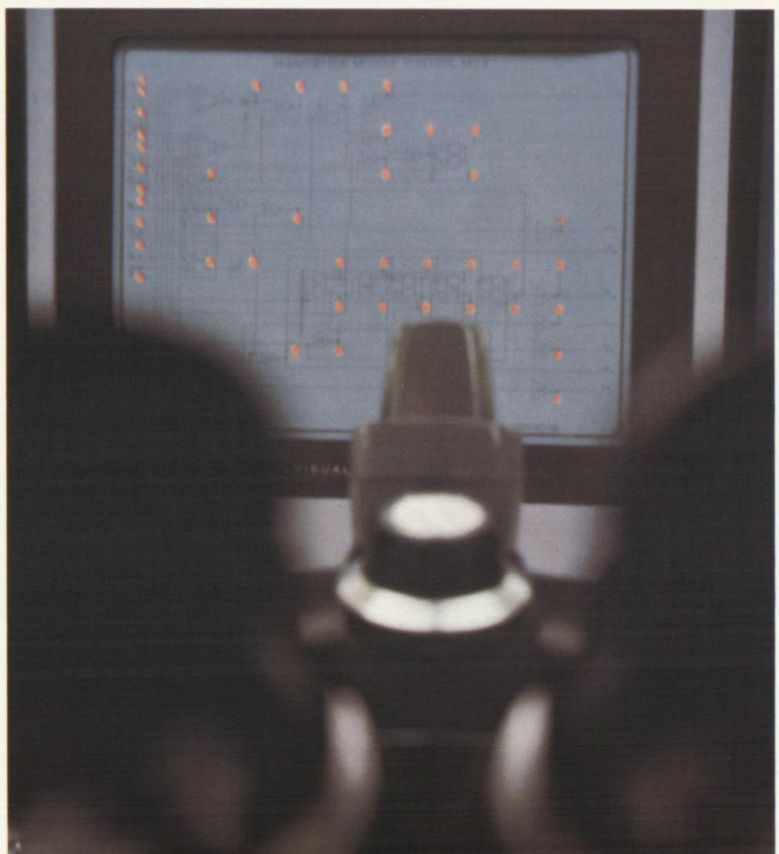

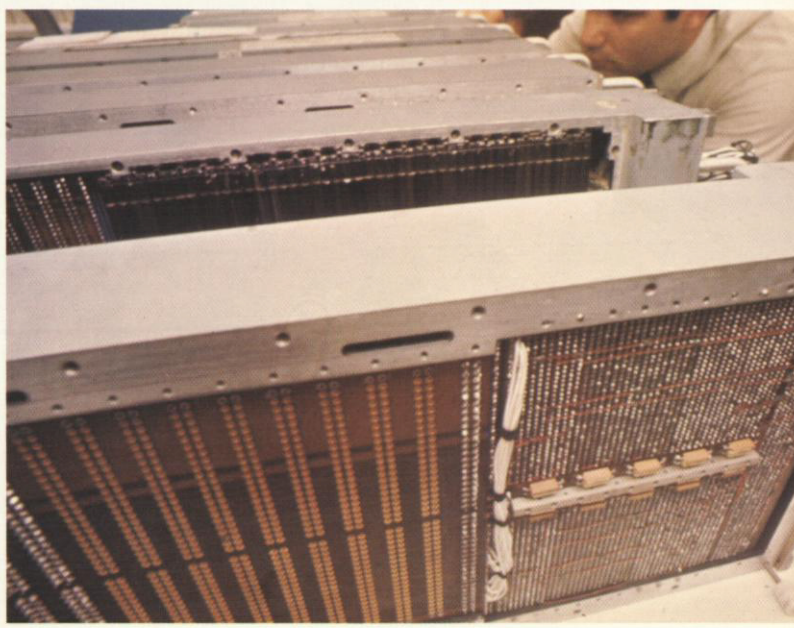

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computing techniques for optimum real-time applications. [14] The MEMA is also used in the FRSS miniature inertial navigation system. The tiny microcircuits are mounted directly on the gyroscopes and accelerometers to greatly simplify the equipment and enhance its reliability. [15] The advances in solid state electronics have supplemented rather than eliminated discrete components. Teledyne's activities include the development of new microwave components. The manufacture of these elements, used in radar, communications and electronic counter-

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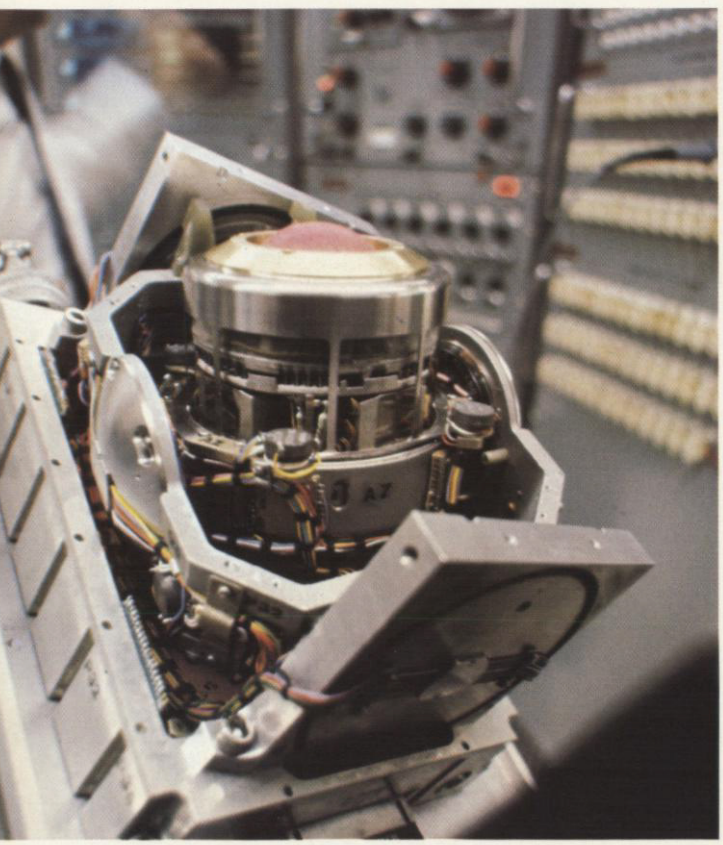

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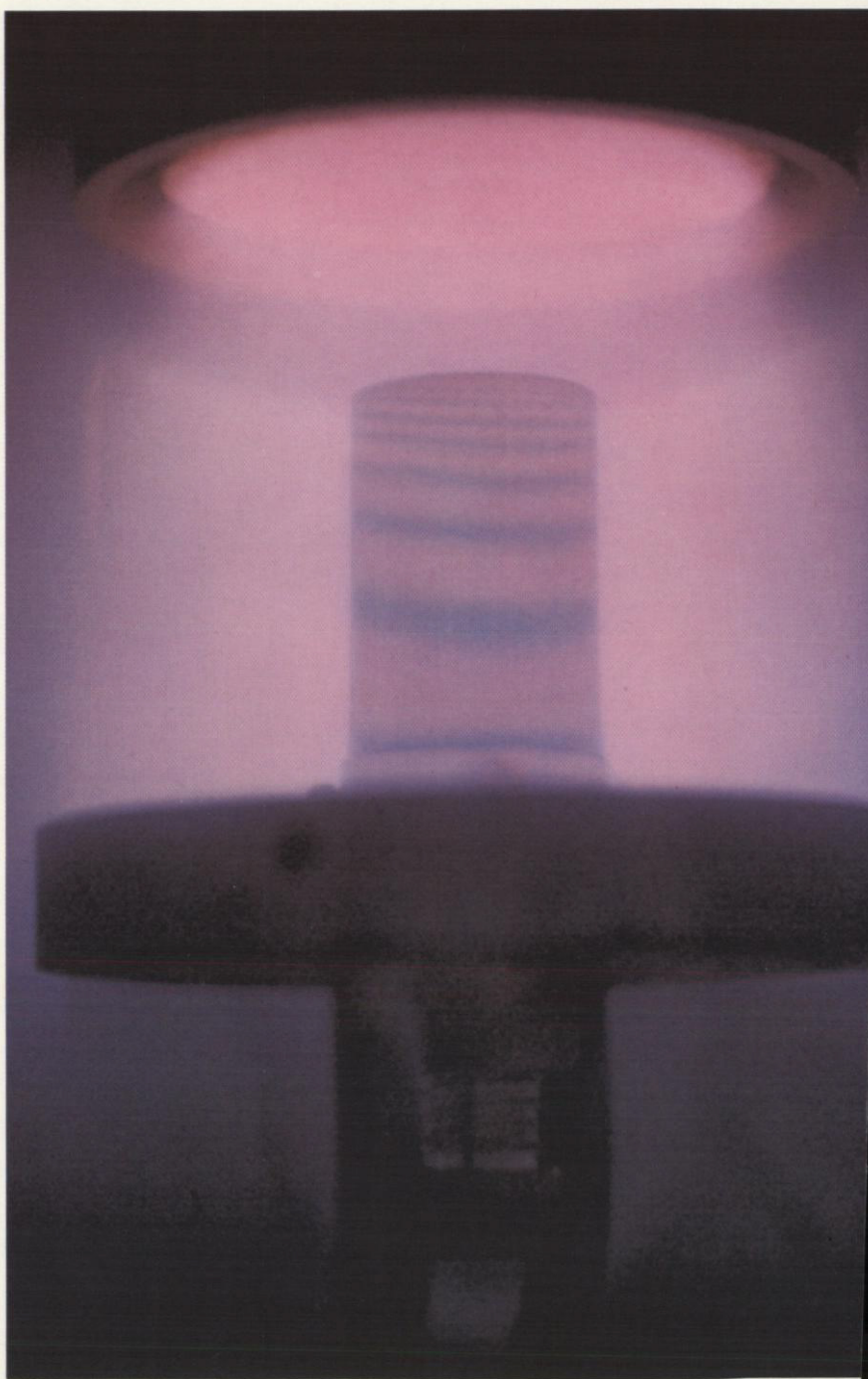

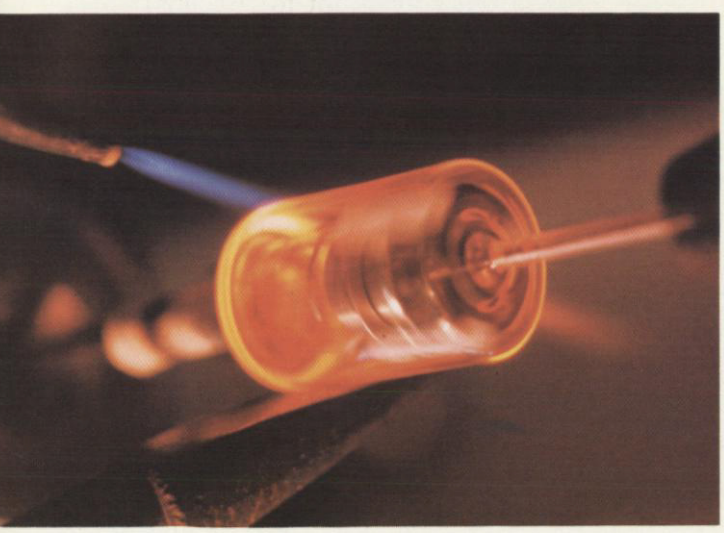

[16]

measures systems, entails many critical operations. Typical is the deposition, by ion bombardment, of metallic materials upon single crystals during the fabrication of solid state acoustic delay lines. [16] After careful alignment of the electron gun assembly with the helix structure in a travelling wave tube, the glass envelope is sealed with a fine torch. [17] Laser technology, which holds great promise for future applications in communications, is used for study of electroacoustical interaction in solids. [18] Teledyne produces a wide variety of flight instrumentation. An example

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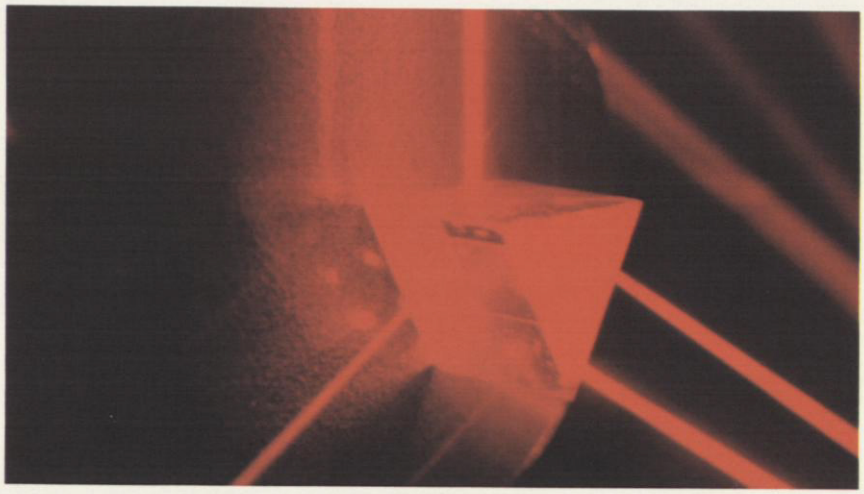

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designed for the amplification of very small signals. Units like these, plus extremely low-resistance switching units, are used in our extensive line of analog/digital converters and analog computing modules sold widely to aerospace, industrial and scientific users. Silicon diodes are another example; here Teledyne is currently the sole approved supplier for a subminiature diode used in the Poseidon and Minuteman II missiles. Additionally, our new radiation-resistant, fast switching one watt and 10 watt rectifiers were approved for the Nike-Zeus missile. Relays are still a third example; during the year we continued to provide our subminiature relays in TO-5 cases, some containing as many as three integrated circuits as well as the electromechanical element inside the miniature case. These relays represent one end of a size spectrum of mechanical switching components. At the opposite end lie the motor-driven limit and sequencing switches supplied by Teledyne for operation in a zero-G environment, or in deep submergence vehicles.

Essential to the operation of any electronic system is power. Teledyne products in this area cover the spectrum of power distribution and generation equipment for commercial, industrial and military use, ranging from electrical wire and cable, connectors and transformers to large high-stability power sources. Typical of the latter is a 250 KVA solid-state, redundant, uninterruptible power system developed for the Navy. Now entering production, this system will supply continuous AC power regardless of input line fluctuation or complete outage. Similarly, two 480 KW supplies now in operation in the Philippines are amongst the largest shore-to-ship supplies ever built. Finally, we continue to supply aircraft ground power sources and static inverters, and are a major manufacturer of aircraft batteries.

Although the input to a system may be electrical, the system output is frequently mechan-

is the angle of attack transducer which directly measures the angle of the aircraft's wing with respect to the natural flow of air. [19] Also essential to efficient flight control are hydraulic systems for control-surface actuation. Valves and actuators are manufactured to tolerances of 25 millionths of an inch by employing numerically-controlled machines. [20] In addition to supplying systems and components for atmospheric flight, Teledyne is solving problems of space flight. A water tunnel simulates the flow of propellants in space vehicle engines in studies aimed at the elimination of cavitation at reduced pressures. [21] To assure the compatibility of men and machines in space, Teledyne human factors engineers don

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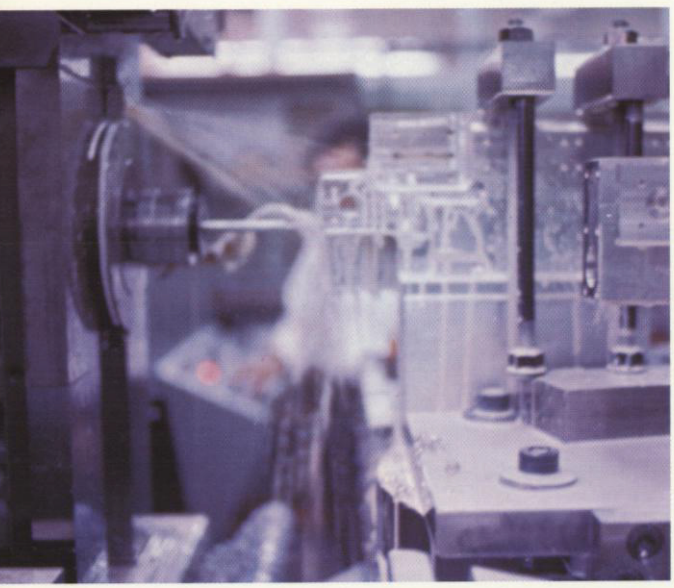

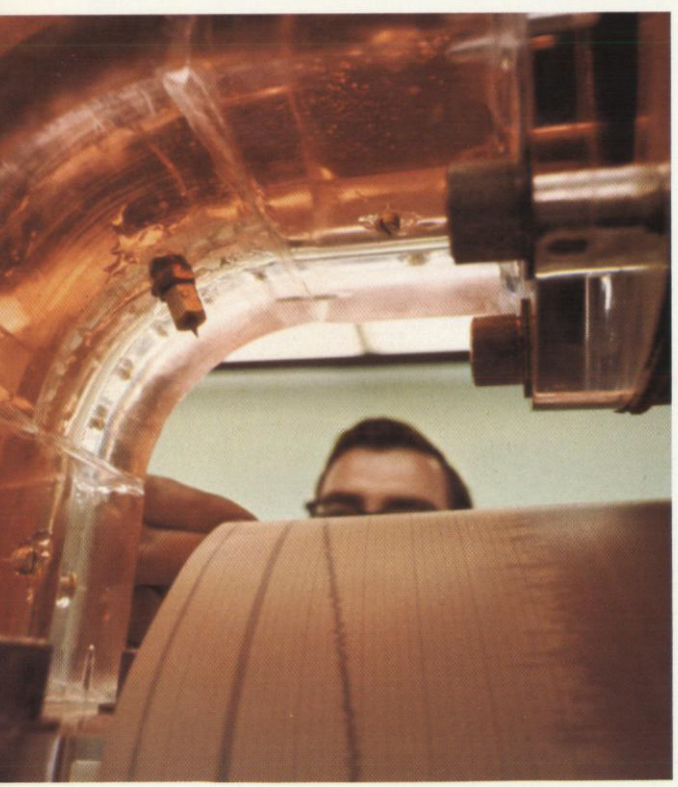

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pressure suits and perform a variety of tasks in a simulated space environment. 22 A scale model of the Apollo Telescope Mount helps design engineers verify the mathematical model by which they analyze the mount dynamic and thermal deflections using a high-speed digital computer. 23 The modern techniques of mathematical simulation, analysis and design, together with advanced components, are the essential elements of those Teledyne equipments and systems in use throughout the world today. Slated to join the present generation of Teledyne systems in serving the needs of defense and industry is the Integrated Helicopter Avionics System, now undergoing flight tests in a CH-53 helicopter.

ical force, where hydraulics are superior. The past year saw substantially increased sales and profits from our proprietary line of brazed hydraulic fittings and custom-designed actuators, and a broadened market base. In addition to providing such equipment for major commercial aircraft types, as well as the majority of the military aircraft and helicopters, during the year Teledyne announced a family of control elements for industrial electric power gas turbine generators, and was selected to supply critical valving for the advanced PX-15 deep submergence research vehicle. In a cooperative effort between our hydraulic and materials activities, we are pursuing the development of a new line of ultra-strong, light weight titanium fittings.

Electrically activated pyrotechnic devices, which are based upon the controlled application of explosive energy are similarly useful where large forces or critical timing are required. During the year we continued to supply such items as exploding bridgewire systems, gas generators, initiators and pyrotechnic delay devices, as well as severance and personnel escape systems for aircraft and space vehicles. Typical is the system for the F-111, which saved the life of a crew forced last fall to abandon their aircraft over Texas. Involving some 30 precisely-sequenced pyrotechnic and explosive functions, when the eject ring of the disabled craft was pulled an explosive cord around the cockpit cut through the metal skin and adjoining structure of the plane to free the escape module containing the pilots and instruments; the capsule was then rocketed away and parachuted safely to earth. Such pyrotechnic timing and actuating devices are also the heart of the complete aerial delivery systems which Teledyne supplies to the Air Force, for the precision in-flight extraction and parachute descent of loads weighing many tons from giant cargo aircraft.

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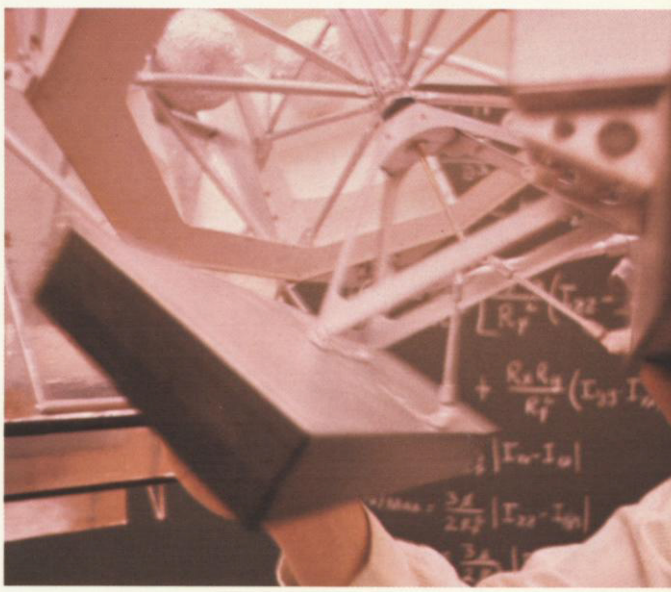


23

GEOPHYSICS AND OCEANOGRAPHY

After thousands of years of occupying the earth, man knows remarkably little about it. Just as Malthus at the end of the eighteenth century was predicting imminent starvation for the peoples of the world, twenty years ago concern was being voiced about the impending exhaustion of our mineral resources. Since then, modern geophysical research has located vast new fields of high-grade ores in various parts of the world, including major finds of iron, lead, copper and nickel on the North American continent. In spite of this progress, even in the United States, which leads the world in geophysics, some 35 percent of the country remains topographically unmapped and 80 percent has yet to be geologically defined. As for what lies in the oceans and underneath the earth's immediate surface, man knows even less. Having penetrated only five of the nearly 4,000 miles to the earth's center, he has much to learn about the composition and behavior of the planet on which he lives.

This past year especially, Teledyne has contributed substantially to both the technology and tools of geophysics and oceanography. Illustrative of this technical achievement was the selection recently of our Wire Arc Seismic Section Profiler, or WASSP, as one of the 100 most significant new technical products of the year by a panel of distinguished judges who reviewed over 20,000 developments from all fields of technology.

For continuous seismic profiling of the ocean's sub-bottom where the greatest stores of material resources essential to the future needs of mankind are believed to be hidden, the WASSP offers an order of magnitude increase in resolution and signal penetration over earlier energy sources for continuous seismic profiling. These benefits are derived through the implementation of techniques for literally exploding hair-fine wire with high-energy electrical discharges, as contrasted to the traditional method of periodically dropping explosives into the sea. The WASSP system also measurably improves the precision, speed, safety and economy of seismic operations.

Another Teledyne accomplishment of international import was last summer's record marathon profiling of a continuous 7,000 mile span of the Atlantic Ocean's sub-bottom. Completed during a two month period, the feat was performed by one of the company's seismic teams using the proprietary subsurface profiling system. In general concept similar to the WASSP but without the exploding bridgewire across the electrodes, the SSP system converts up to 160,000 joules of electrical energy stored in capacitors to acoustical energy by directly forming an arc discharge in the water.

During the trip from Trinidad to Liberia to Capetown, South Africa, the SSP system operated from a vessel traveling at 10 knots, which is twice the speed normally permissible for such profiling. A total of 648,000 shots was fired at a rate of one every four seconds. The resulting energy traveled through ocean depths of up to nearly three miles to produce a structural profile of the earth extending two miles beneath the ocean floor.

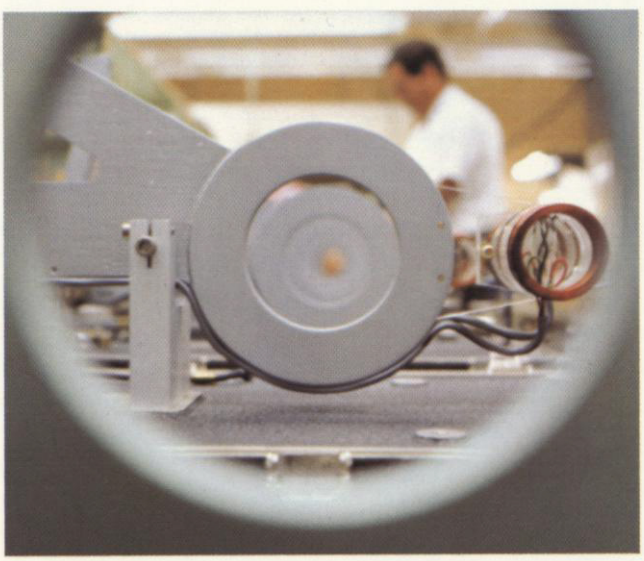
The historic journey produced a seismogram of high resolution approximately 400 feet long revealing formations representing millions of years of geological evolution and disclosing a previously unknown 10,000 foot high mountain plateau rising from the ocean floor. Creating considerable excitement in the scientific community, the project will be pushed around the world in two more steps. The next leg will be from Capetown to Singapore; the final one, from Singapore to the United States.

For such underseas work, the ability to accurately receive and record the subterranean reverberations is fully as important as the generation of the seismic excitation energy. In this context the development of our Common Depth

Gold plated seismometer to be placed on the moon by the Apollo astronauts.

Geophysical activity at Teledyne is centered around the detection, measurement, analysis and interpretation of natural and induced vibrations in the earth. [1] Much of the effort is devoted to the conception, design and manufacture of ultra-sensitive, accurate and reliable seismographic systems and other instrumentation upon which the success of seismic and geophysical programs largely depends. [2] Individual devices range from a variety of sensors and acoustic generators to extremely slow speed recorders with magnetic flux responsive heads of proprietary design.

[1]



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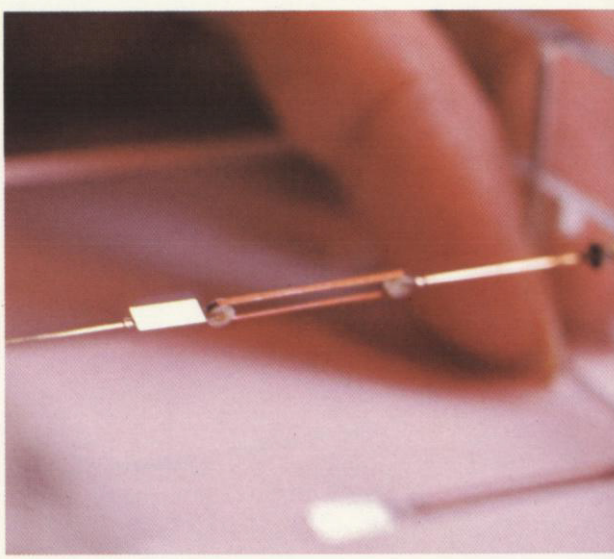

[2]

[4]

These magnetic heads are capable of reproducing data which have been recorded with frequency components of less than one cycle per second, a feature highly desirable for biomedical applications as well as oceanographic and geophysical uses. [3] Delicate assemblies calibrated to measure movements in the earth smaller than one ten-millionth of an inch are characteristic of seismograph systems. [4] [5] Depending on the application, seismometers vary considerably in both external and internal physical configurations. Most are constructed to respond to a single

Point, or CDP, streamer cable is significant in that it provides the means to exploit multi-channel digital recording techniques for greater resolution and penetration. Consisting of leader, depth-control and active sections, the cable is nearly a mile long, with a 3,600 foot active section containing six 100 foot sensing units spaced 600 feet apart. Throughout each sensing unit are distributed 100 sound-sensing elements at one foot intervals. As the cable is towed through the water, the sensor arrays detect the reflected energy, relaying it to surface. Here it is automatically converted to digital form and recorded for subsequent reduction on a high-speed digital computer, whose final output is the seismogram. Our land exploration techniques similarly emphasize digital data acquisition, but use mechanical exciters which shock or vibrate the earth rather than electric arc discharge to couple energy into the medium. During the year, Teledyne provided geophysical exploration services throughout much of the United States and Canada, and in Africa and Australia, principally in support of the petroleum industry.

In the application of geosciences to space activities, Teledyne continued to make progress on the Apollo Lunar Surface Experiments Package seismic equipment, with initial test units delivered during the year. Consisting of both active and passive equipments, the active portion will be used by the astronauts to study the underlying moon strata. The passive portion left behind when the astronauts depart will continue to observe natural seismic activity over the next year, with the data periodically telemetered to the earth.

In the related area of space physics, Teledyne activity was increased during the past year with the development of advanced instrumentation for the measurement of particles and fields in space including alpha, beta and gamma radiation. In addition, development work

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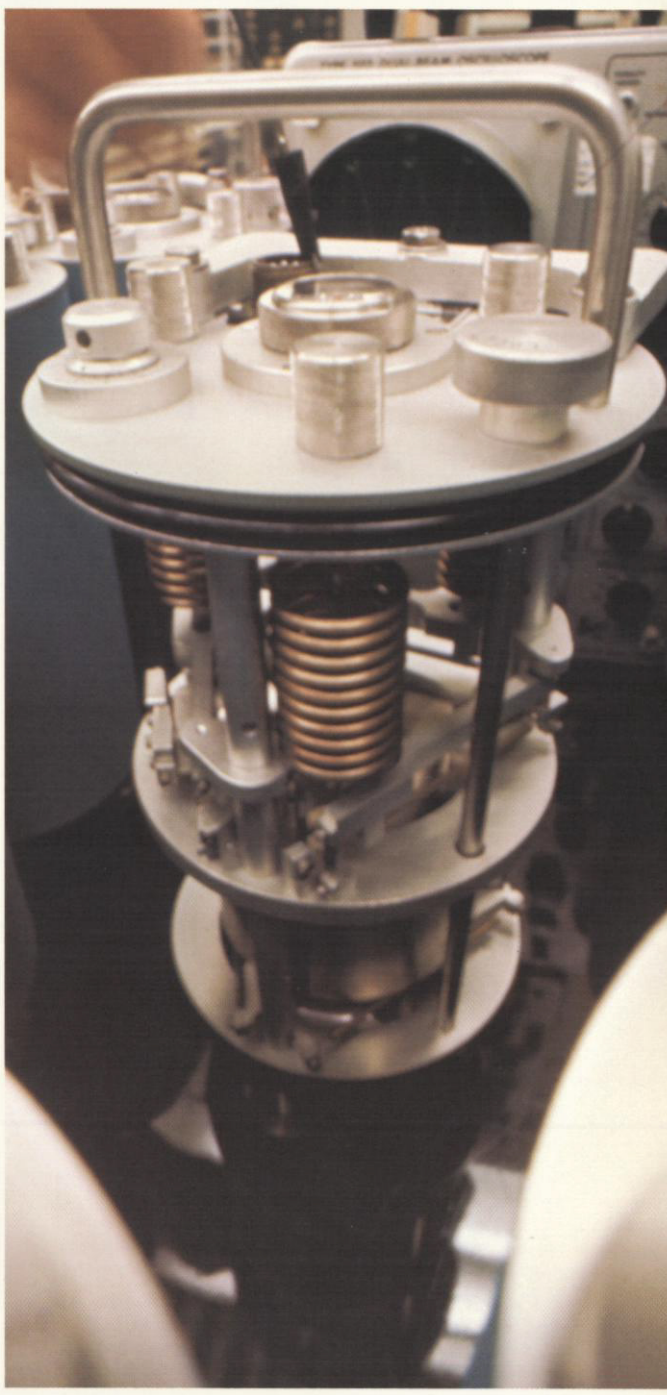


component of motion and are used in sets of three with the axes oriented mutually perpendicular. Others can be adjusted to respond to either vertical or horizontal movement and some are triaxial. [6] For seismic profiling of the ocean's subbottom, Teledyne has developed safe, efficient techniques like the Wire-Arc Seismic Section Profiler to replace conventional explosives. Hair-fine wire is continuously fed to the arcing device by a hydraulically activated dispensing unit. [7] At a predetermined distance behind the exploration vessel, a high energy electrical discharge

[6]

[7]

[8]

is applied which vaporizes precisely measured segments of the wire at regular intervals of time. [8] The energy generated produces a brilliant steam bubble which expands rapidly, collapses and sends an acoustical signal deep into the ocean floor. Hydro-streamer sensors receive the reflected energy for recording of the data on board the vessel. [9] On land, hydraulic systems mounted on special vehicles generate seismic disturbances whose reverberations are monitored and recorded in an adjacent instrumentation van. [10] A nine-foot long triaxial seismometer is

[9]

in quadrupole mass spectrometry, a new generation of spectrographic tools for basic particle investigations is being carried out.

In more immediately practical areas, our ability to assess the effect of seismic disturbance on structures was further broadened by development of two new structural dynamics instruments in the strong motion line, which now covers all ranges of motion and all normally used recording means. One is a magnetic tape recording system which provides three-component data on a one-quarter inch tape cartridge. The other records similar data on 70mm photographic film. Both instruments are completely portable and operate from self-contained rechargeable batteries. Additionally, a special telemetry system for integrating an array of these instruments installed over an area of many square miles has been developed.

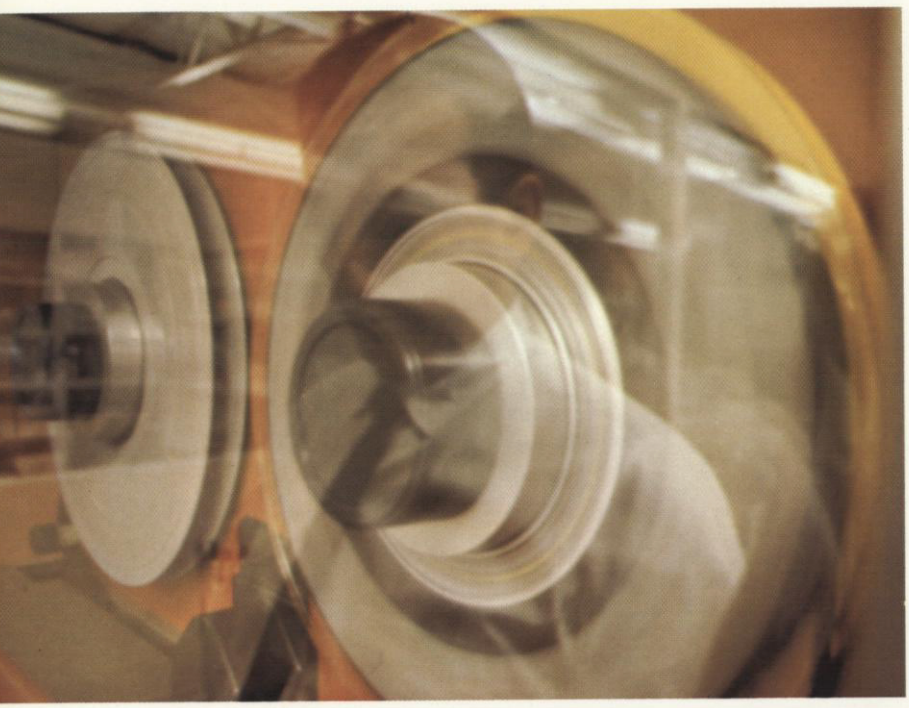
Contract renewals and new contracts were received for a variety of seismological instrumentation and geophysical exploration projects, with Teledyne seismic teams on assignment all over the world. One such program calls for structural services and research relating to nuclear power generating plants. Another requires the instrumentation of a 45-mile subway project in Spain, while yet others involve the collection of data in Peru, Bolivia and on the Greenland icecap. Two large seismological observatories are being operated for the Air Force, for whom Teledyne is also developing a special sensor system for tactical use. The company also retains responsibility for the operation of the government's Seismic Data Laboratory at Alexandria, Virginia. Efforts there are helping to bring closer an acceptable formula for the banning of underground nuclear testing, and may ultimately allow the prediction of earthquakes.

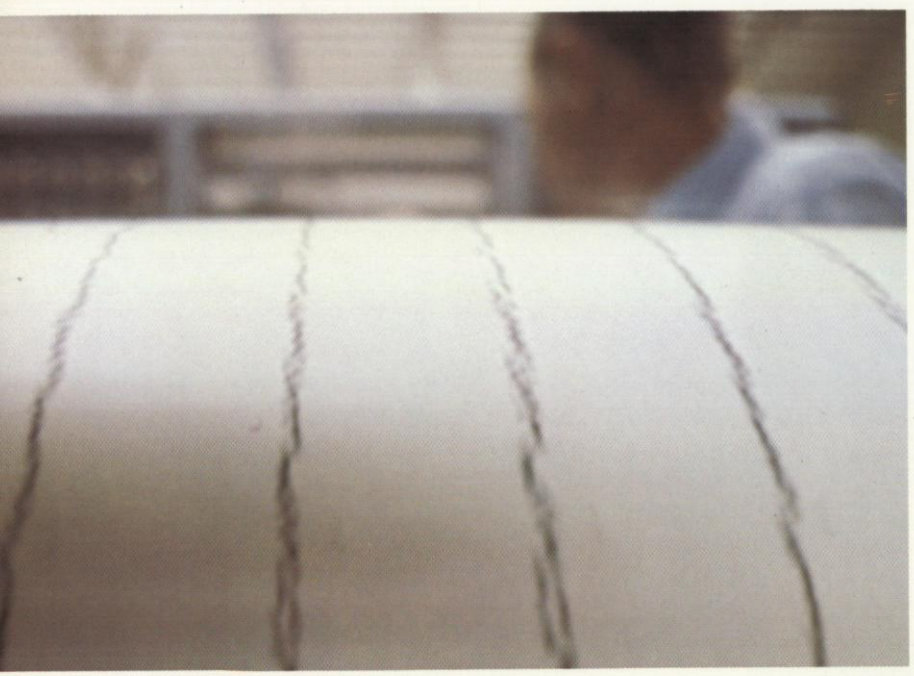
Paralleling the need for knowledge of the earth's subsurface structure are demands for the precise mapping of its land surface area.

[10]

one of the most recently-designed instruments for current deep-hole seismological projects. Lowered into a hole 10,000 feet deep, the versatile instrument detects and sums the result of signals arriving along three different planes. [11] In seismic and geophysical exploration, the useful end product is data. Digital magnetic tape recording systems are coming into increasing favor because of their superior accuracy and resolution compared to traditional analog systems. [12][13] These data, processed in a computer and converted from digital to analog to reconstruct the field data for reproduction on film, are spot checked on a light sensitive

[11]





[12]

Here, the company provides aerial mapping and surveying services on a global scale, utilizing our proprietary Mono-Measurement system which greatly reduces the effort and cost of furnishing precise coordinates and elevations for any point visible on an aerial photograph. Only three horizontal and four vertical ground points are required for full reduction of aerial photographs covering hundreds of square miles, with photogrammetric calculations and adjustments performed by digital computation, and graphical outputs generated automatically by use of an x-y plotter.

During the year, our aerial mapping services were increasingly used by various government agencies, by the mining and petroleum industries and by consulting engineers and planning groups. Representative of such projects is a geodetic survey of over 6,500 square miles in Laos and Thailand. Using both visible light and infra-red photography, the information will provide data vital to the development of roads, irrigation systems, land use and hydroelectric programs in these countries.

In addition to locating new underground deposits of minerals and oil reserves, practical means of gaining access to them must also be developed. To this end, the company designs, fabricates and erects ocean-going structures for offshore drilling operations. The size of the structures offered was tripled this past year to a lift-weight maximum of over 500 tons. Our offshore capabilities were also increased through improved means for anchoring pipelines to the ocean bottom and the extension of pipe-laying operations to greater depths. Additionally, we continued to produce service boats for the support of off-shore operations for commercial customers, as well as delivering a number of high speed craft to the government. Some 45,000 square feet of new facilities were added last year to accommodate the growth in our boat construction operations.

paper recorder, and monitored on a cathode ray tube. [14] The resulting film seismogram presents in great detail the geological structure of the subsurface region under examination. Porous formations and structural traps such as anticlines, faults and salt domes where oil is likely to be found can be accurately identified. [15] The culmination of a seismological project may be the indications of an underground nuclear explosion half way around the world, evidence of an earthquake on another continent or the discovery of a new oil field. With the advent of offshore drilling rigs, oil beneath the ocean's floor is of increasing importance.

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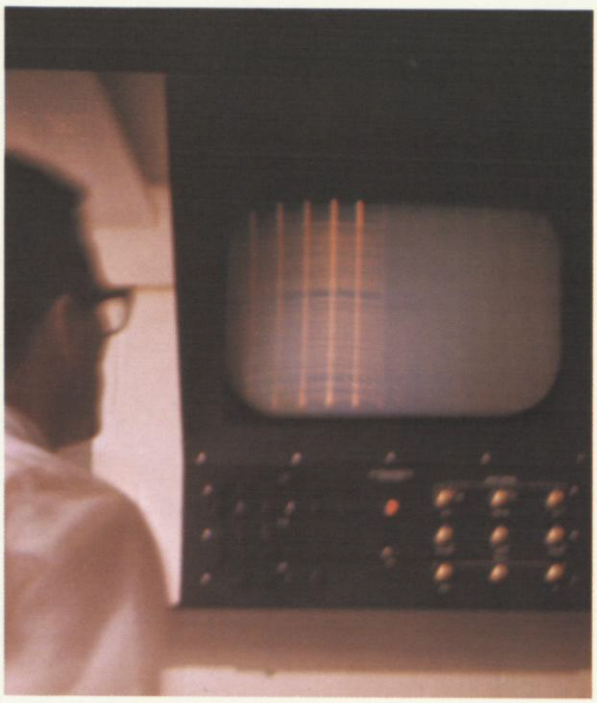

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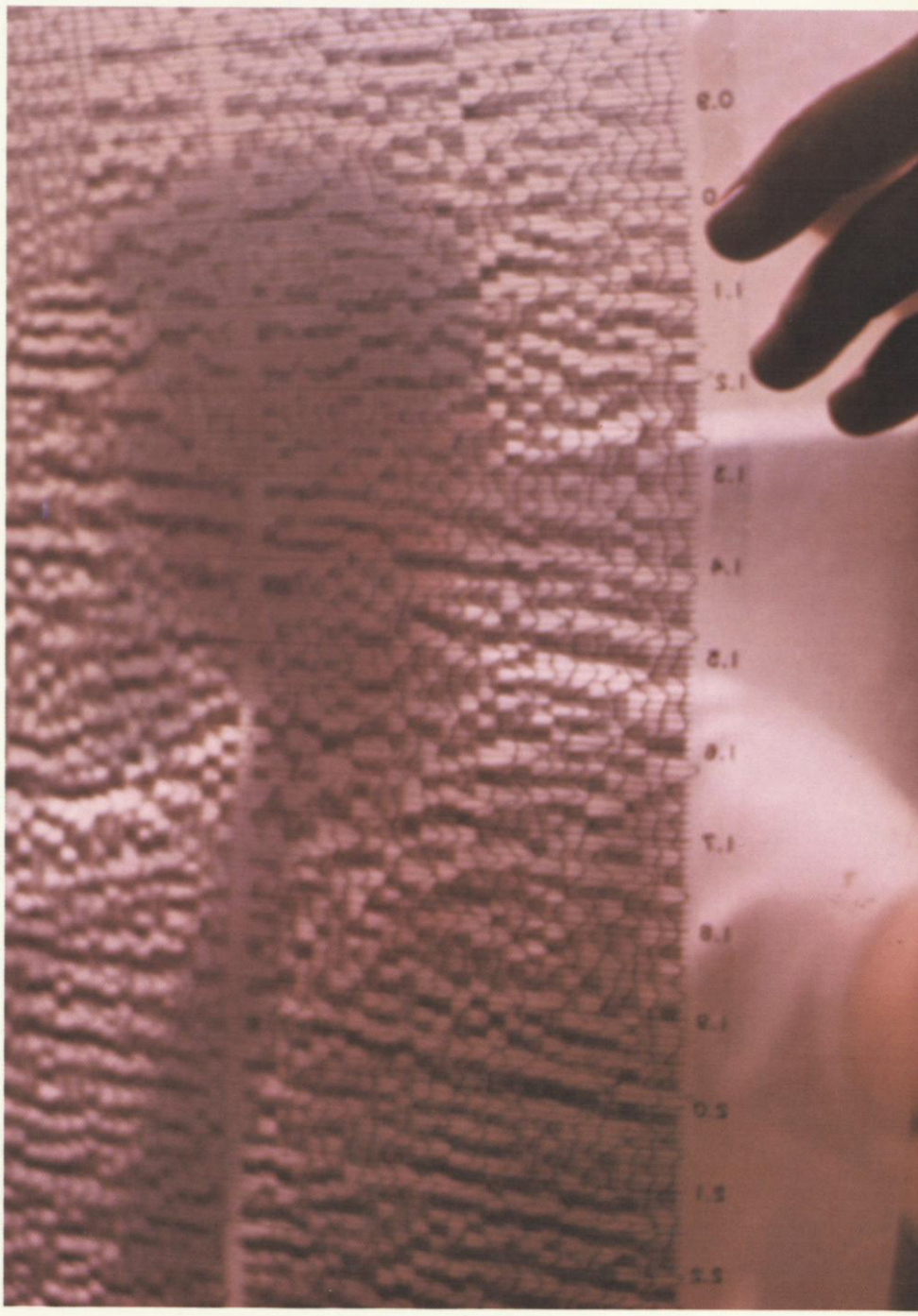

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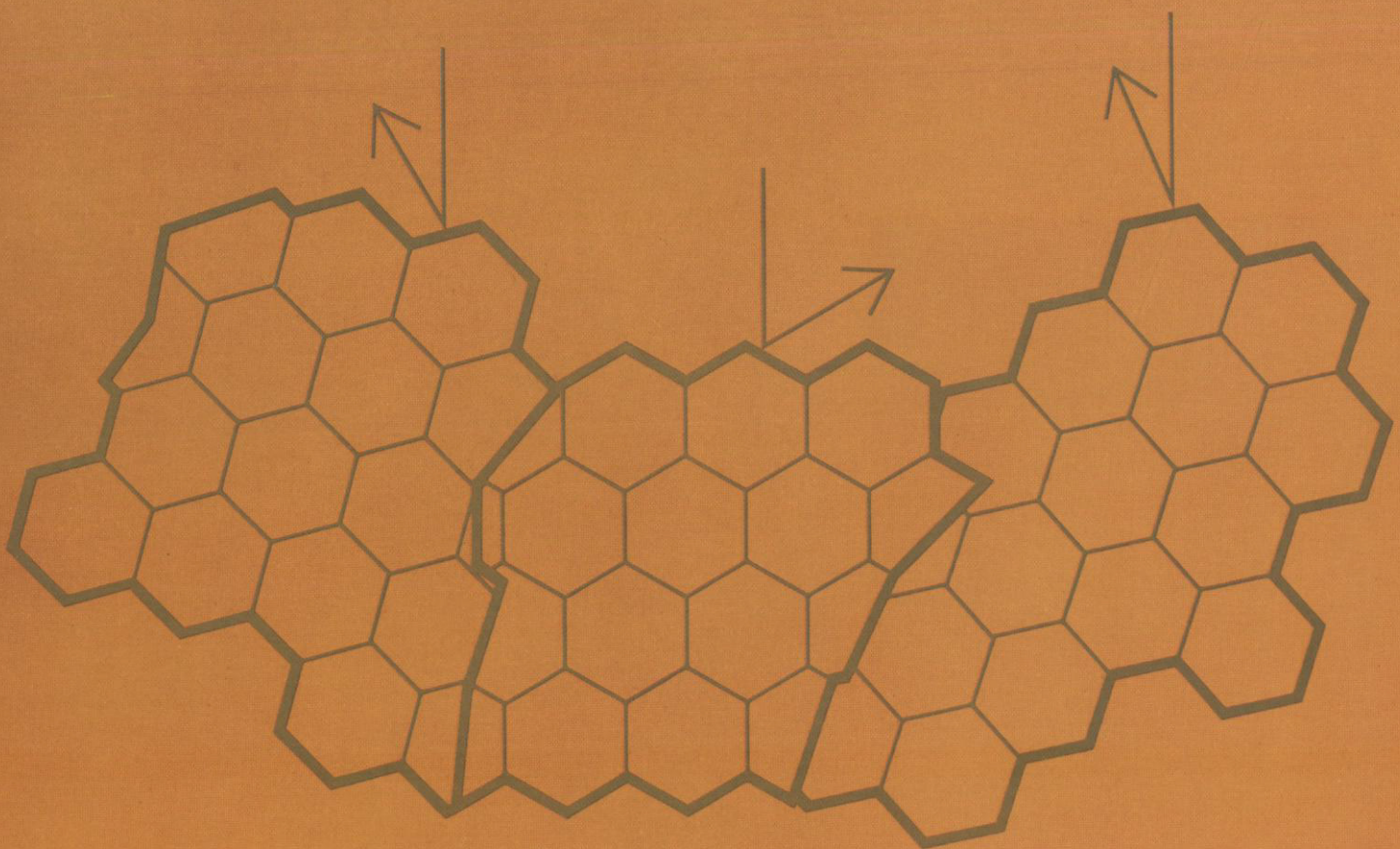

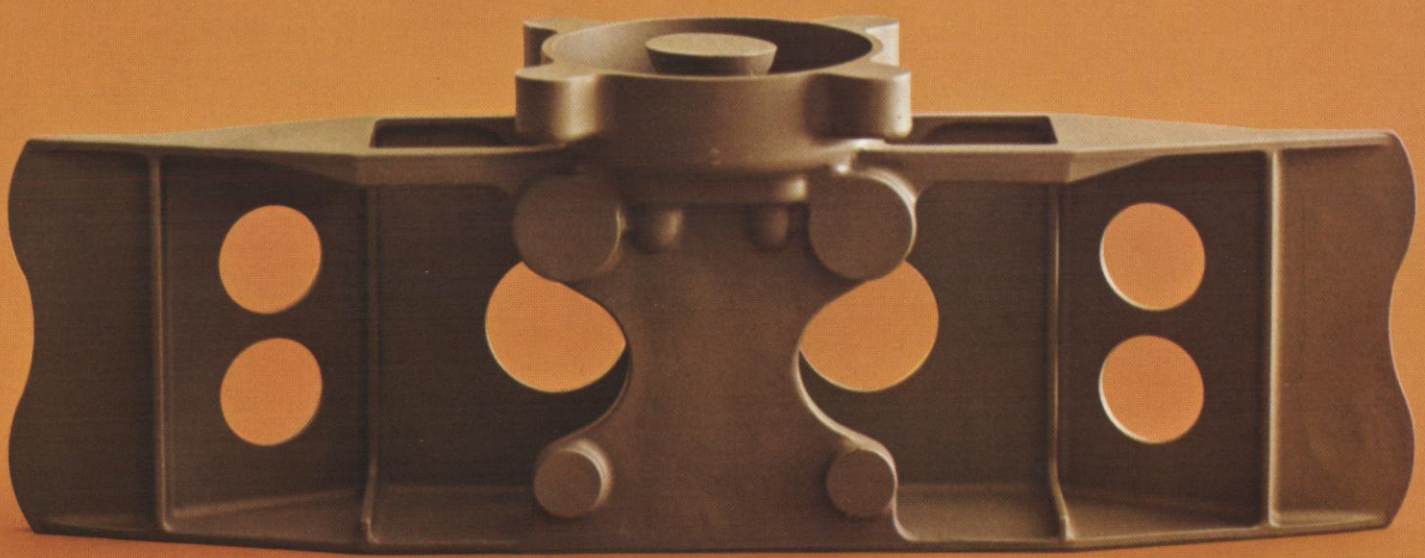

MATERIALS TECHNOLOGY

Metals and metallurgy continue to constitute the core effort of Teledyne operations in the field of materials. Activities range from fundamental metallurgical investigations into the crystalline structure of metallic elements and alloys to the formulation of proprietary processing techniques and the design and operation of advanced production facilities. Responding to requirements for structural, tooling, custom and rare metals of greater strength, reliability, purity and temperature resistance, the company's line of special metal alloys consistently meets the most stringent requirements of customers all over the world. However, while the quest for materials of superior strength and resistance to hostile environment continues, the requirements of nuclear power generators has raised to prominence rare metals formerly of secondary importance. Among these are zirconium and hafnium, of which Teledyne is now the leading supplier for nuclear reactor applications.

Zirconium, in the alloy form zircaloy, is characterized by a low thermal-neutron cross section permitting the easy passage of nuclear radiation, which makes it an ideal material for packaging nuclear fuel. It is also highly resistant to high temperature and corrosion, making it additionally suitable for the fabrication of associated heat exchanger pressure tubing. With the supply of zirconium barely meeting the present need of users, and reactor manufacturers experiencing a growing backlog of orders, the market for zirconium should continue to grow in the years ahead.

A similar upswing in demand is anticipated for hafnium. A byproduct of the zirconium processing operation, it is a high thermal-neutron cross section element suitable for use as an absorber in reactor control rods, up to now used principally in marine nuclear reactors. The company is presently engaged in a cooperative development program with commercial nuclear power manufacturers which would replace with hafnium the borated stainless steel or silver-indium-cadmium control rods traditionally used in civilian power reactors.

To keep supply abreast of demand, company facilities for producing zirconium, hafnium and other rare metals are being expanded in a building program slated to nearly triple our annual production. New vacuum arc and electron-beam melting equipment were installed under this program to increase ingot production as well as new cold-roll mill equipment to increase sheet and bar stock capacity.

Other rare metals such as columbium, tantalum, tungsten, molybdenum, titanium and vanadium and alloys containing these metals are among those Teledyne products widely used in missile and space programs. Representative applications are the silver infiltrated tungsten exhaust insert for the advanced Polaris missile, tantalum alloy linings for a variety of rocket propulsion needs, tungsten and molybdenum parts for numerous high-temperature uses, and high-strength columbium for the skin and structural members of space vehicles. An example of the latter is the columbium alloy crash pad skirt for the main descent engine of the lunar excursion module. Cardboard-thin and weighing about 30 pounds, it withstands 2,700 degrees and 10,500 pounds of thrust. Further, its ductility allows the skirt to crumple uniformly to help absorb the landing shock as the 15 ton module hits the moon at a speed of 10 feet per second. A similar skirt over eight feet in diameter is used on the Saturn booster second stage.

Among the materials of increased strength, wearability and ductility offered by the company, a high-strength precipitation hardening alloy introduced this past year is VascoMax 350. The strongest commercially available maraging steel in production, this new analysis alloy develops strength levels to 385,000

Superalloy part used in the thrust reversal system of jet aircraft.

The knowledge, tools and processes employed to transform raw materials into today's advanced products are well represented in Teledyne's metals and metallurgical activities. [1] Zirconium, which is used in nuclear reactors because of its low neutron absorption, is processed from zircon beach sand. The first step is the firing of the zircon-containing sand with carbon in an arc furnace to form zirconium carbonitride. This is then reacted with chlorine gas to create zirconium tetrachloride. [2] Sponge, the primary metal form, is produced by reacting the zirconium tetrachlo-

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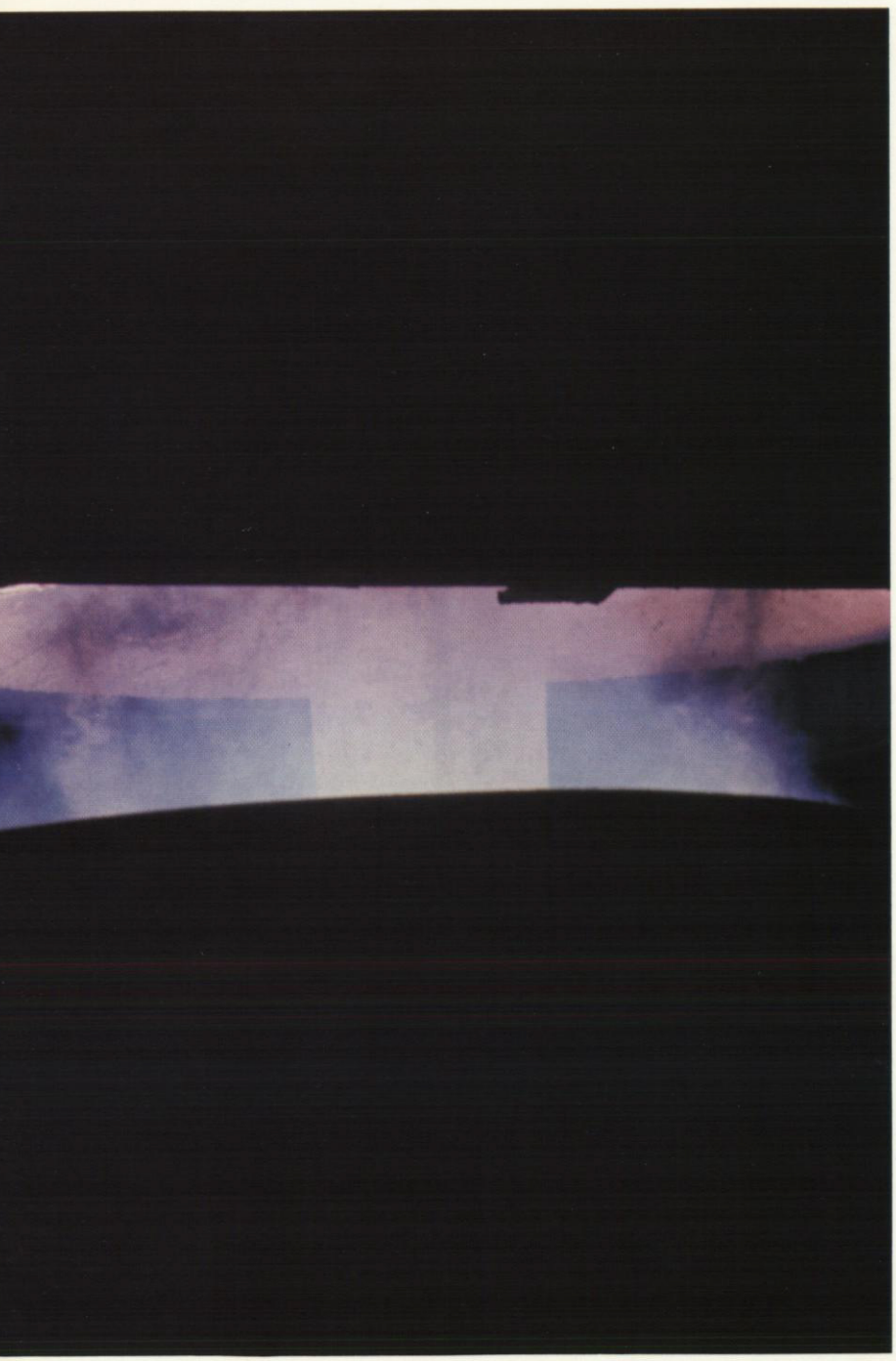

pounds per square inch through precipitation hardening. This exceptional material has attracted substantial interest and is being widely tested and evaluated for use in aircraft and space vehicles and for many industrial applications.

Industrial tooling and structural requirements for advanced materials of maximum fatigue strength and high ductility continued to place a strong demand on our line of matrix steels. These are proprietary Teledyne-patented alloys in which the excess microscopic carbide particles normally entrapped in the matrix of high speed tool steels have been removed, so that the new matrix steel approximates the wear-resistant tooling material in hardness and strength but with improved toughness and ductility.These ultra-strong steels were developed to improve the longevity of gear formers, punches and other similar high performance tools by a factor of five to ten times.

The newest of the matrix steels is Vasco M-A, which offers tensile strength values to 360,000 pounds per square inch and can maintain high strength levels at operating temperatures to 1,000°F. It is readily machined and may be formed by all standard fabrication methods. Its tensile strength can be increased to levels of 450,000 pounds per square inch or greater without a commensurate loss in ductility or notch toughness by ausforming, in which the material is worked while still in its austenitic phase at approximately 600°F. This new steel is useful for high-strength fasteners, airframe structures, space components, high-speed rotors, gears and shafting, as well as tools, pressure vessels and turbines.

Facilities added to increase the productive capacity for special alloys include a new melt shop with innovations designed to improve both product quality and production economies. New annealing facilities with complete atmospheric control were also placed

ride with liquid magnesium. The sponge is then crushed, graded, analyzed and sorted. [3] The zirconium is then pressed into electrodes and double vacuum arc melted, producing 20-inch diameter, 5,000 pound ingots of zirconium and its alloys. [4] Hot press forging is one step in the conversion of zirconium alloys into usable shapes, such as strip, rods and tubing for nuclear reactors. [5] In subsequent steps, both hot and cold rolling are used. Here, pure zirconium destined to become filament material in photoflash bulbs is in the final stages of cold rolling to reduce

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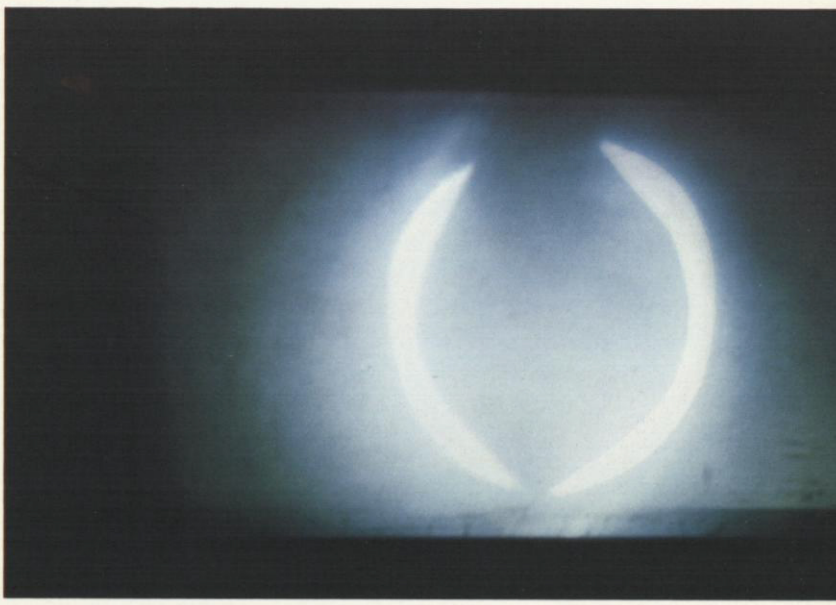

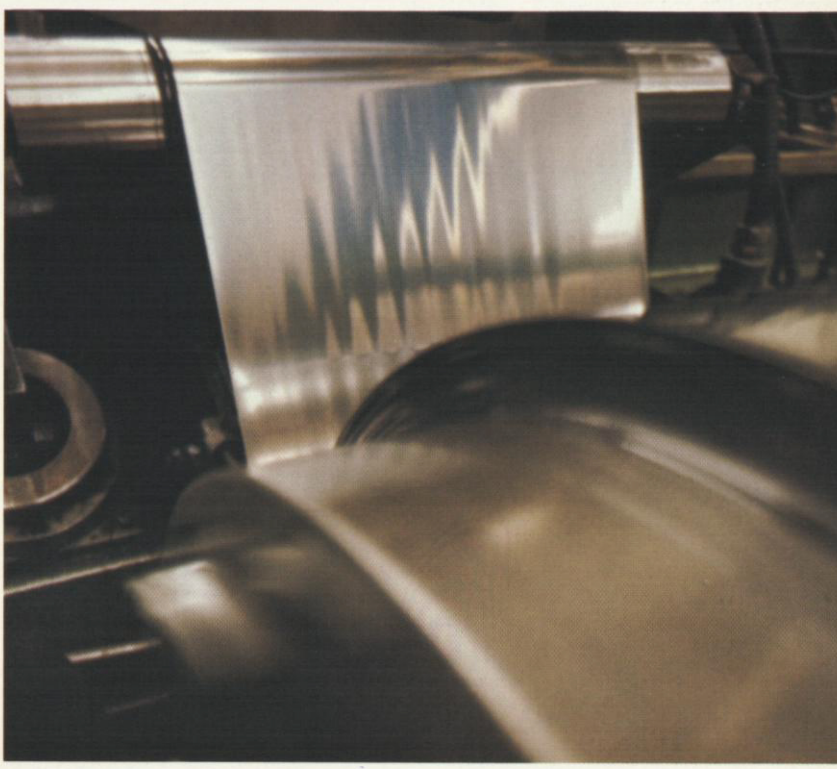

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the metal into sheets as thin as 0.0008 inch. This ultra-thin foil is then shredded for insertion into the bulbs. [6] In the production of high-quality alloys the metals are melted in electric arc furnaces with many new technological refinements to assist in the precise control of as many as fifteen constituent elements. After the molten metal is tapped into the ladle, it is poured into molds to form ingots. [7] To obtain metals of maximum high temperature properties, Teledyne has developed a double-vacuum melting process. Nickel alloys are first melted to the desired chemical composition in induction vacuum melting furnaces and cast into high-purity electrodes. These are then remelted in consumable vacuum melting furnaces for additional structural

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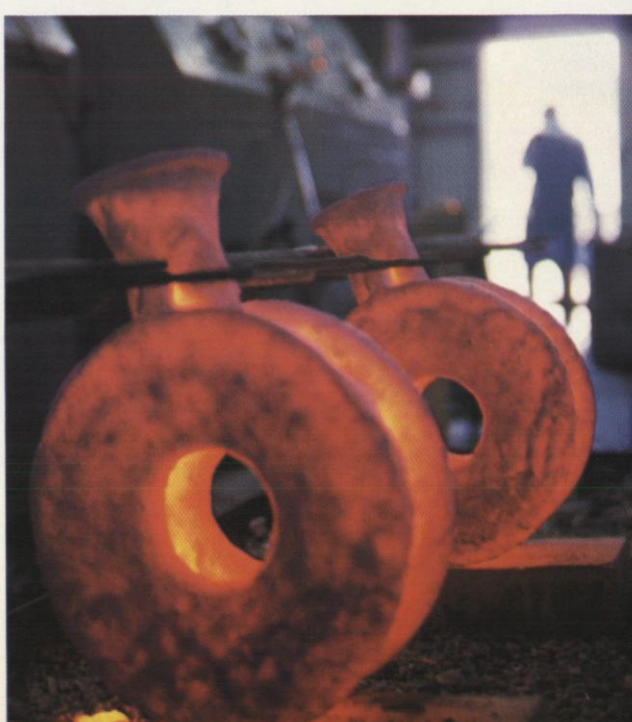

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improvement. [8] Conversion of the resulting ingots into various products is usually performed by hot rolling, followed by heat-treating to obtain the desired high temperature properties. [9] Various alloys may also be converted directly from the melt into functional products by investment casting. Molten metal is poured into ceramic molds created from wax patterns. When the metal hardens, the pattern is broken away. [10] Tests are performed at every stage of metal production. Spectrographic techniques are frequently performed to determine the chemical analysis. In the analysis of hafnium, a densitometer which measures impurity levels as small as one part per million compares the impurity spectrum with acceptance standards. [11] Metallic samples are also

into operation as was a hot forging machine capable of forging bars with cross sections of up to three inches. Superior to a conventional hammer forging press for hot-rolled tool steels, the product emerging from the forging equipment has more uniform grain size and dimensions. Two consumable vacuum melting furnaces adapted for electroslag melting were also placed on stream during the year.

One of the most important new metals to come into general use is titanium, the primary structural material selected for supersonic aircraft. Teledyne is actively expanding its titanium operations, both by development of new products, and by expansion of production capacity. Our investigative metallurgical efforts have successfully produced new titanium braze alloys in powder and rod form. Trial quantities of titanium 15 nickel, 15 copper are now being produced for market evaluation and have already attracted wide interest. Substantial additions have been made to the titanium production facilities. During the year we purchased eighty-two acres of land in North Carolina and erected the first buildings to house the initial portion of our titanium melt shop and weighing, blending and compaction facilities. Equipment installed includes a 33 inch vacuum consumable electrode furnace, a 3,500 ton hydraulic press and associated units. Equipment for fabricating titanium alloy tubing has also been increased. Two new roll forming machines were added to existing equipment for rolled shapes and roll-welded tubing. Other current and projected expansions of our titanium refining, forging and billet capacity and centerless grinding facility will enable the company to obtain an increasing share of the rapidly growing supersonic aircraft market.

The production of special alloys at Teledyne is complemented by perfecting means for cutting, shaping and joining them into useful components and products. In this area electron

[10]

[11]

examined with quantitative television microscopes which permit the precise measurement of grain size and carbide size and distribution. The results are analyzed by computing circuitry operating in conjunction with a television screen. [12] Ultrasonics is a final inspection tool, in which high-frequency transducers activate sound waves that penetrate the finished bars or forgings placed in the ultrasonic tank. The reflections from discontinuities are converted into

beam welding is coming into use as a continuous process for joining materials, or where conventional methods of welding are inappropriate. Employing very high electron beam densities and yielding very narrow weld regions without excessively heating the adjacent material, this technique is often the only means of bonding many of the new metals and alloys without deteriorating the very properties for which they were selected. As well as using electron beam welding in the fabrication of its small-diameter titanium tubing, Teledyne is one of the largest suppliers of electron beam welding services to the aerospace industry. We are participating in such programs as the C-5, Apollo and LEM, by fabricating critical structural elements in addition to producing numerous aircraft and rocket engine components. To make the advantages of electron beam welding available to manufacturers of more conventional products and components, Teledyne has developed processes allowing the economic application of this technology to selected areas of the automotive, chemical, appliance and electrical industries.

Casting, another primary method of effecting the economical conversion of raw material stock into high-strength, close-tolerance finished parts continued to have an important role at Teledyne. Capacity for producing high quality castings of aluminum, magnesium and high-temperature alloys with sand, permanent mold and centrifugal methods was increased by 50 percent and is among the largest on the West Coast. The expansion also allows the production of much larger castings than was previously possible.

A new ultra-high strength casting alloy, PC-75, was perfected by the company during the year. Design engineers are now working with this material to create new parts or to modify old ones in order to take advantage of its high strength to weight ratio. Proprietary techniques for the casting of very high strength magnesium parts were also developed, and are currently being used in the production of parts for the Boeing 747.

An important segment of the casting field is investment casting. Based on the ancient lost wax process, investment casting today employs heat-disposable wax or plastic patterns coated by refractory material to create a monolithic mold, which is then filled with molten metal. After the metal solidifies, the mold is hammered or vibrated away, and the part emerges sharply detailed and smoothly finished to within precise tolerances. Capable of accommodating virtually any shape in a single, integrated casting, the method offers great design flexibility and economy. In many instances, it is the only means of producing complex cast parts which would otherwise require separate forming and assembly operations.

Despite the exhaustive testing of materials and prototypes, or models of the end product, the stresses and environment which will be encountered in actual usage cannot always be accurately predicted or faithfully simulated. Thus, to avoid underdesign with its potentially catastrophic results, and yet not suffer the occasionally significant economic consequences of overdesign, measurement of the actual in-use loads under all operating conditions is necessary. Such a project is the instrumentation by Teledyne of four of the largest ships in the world, a long-range research project being sponsored by the American Bureau of Shipping. The information gathered will reveal important data on hull stresses experienced by these ships while they are at sea under various ocean and weather conditions. These findings, in turn, will assist in the formulation of rational standards for the design and construction of even larger ships in the future. The instrumentation package, designed by

oscilloscope tracings to reveal surface and internal defects and differences in structure. 13 In the production of many alloys, gas analyzers are used to determine the nitrogen, oxygen and hydrogen content. Here, a one-gram sample is vacuum melted, and the evolved gases are quantitatively analyzed. 14 The shape, size, color and distribution of the metallographic constituents which indicate the quality and uniformity of the metal are determined by the examina-

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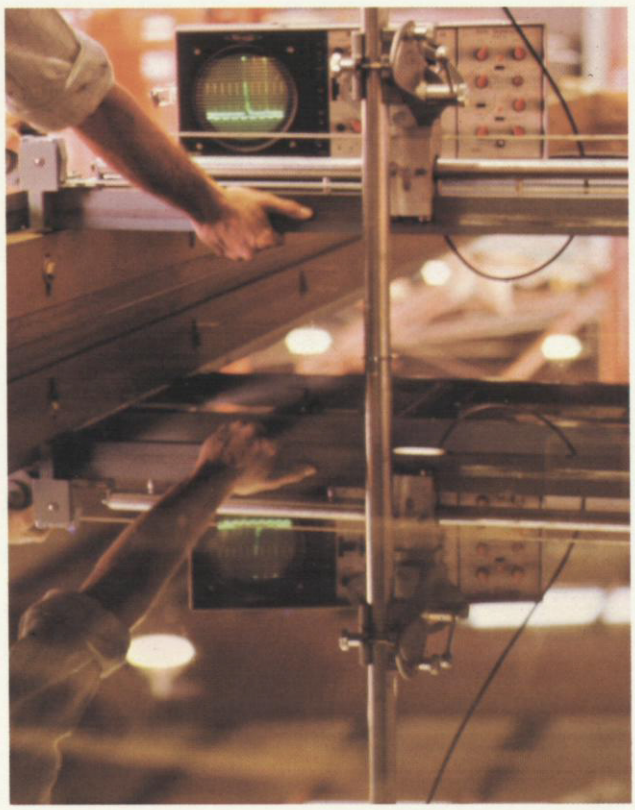

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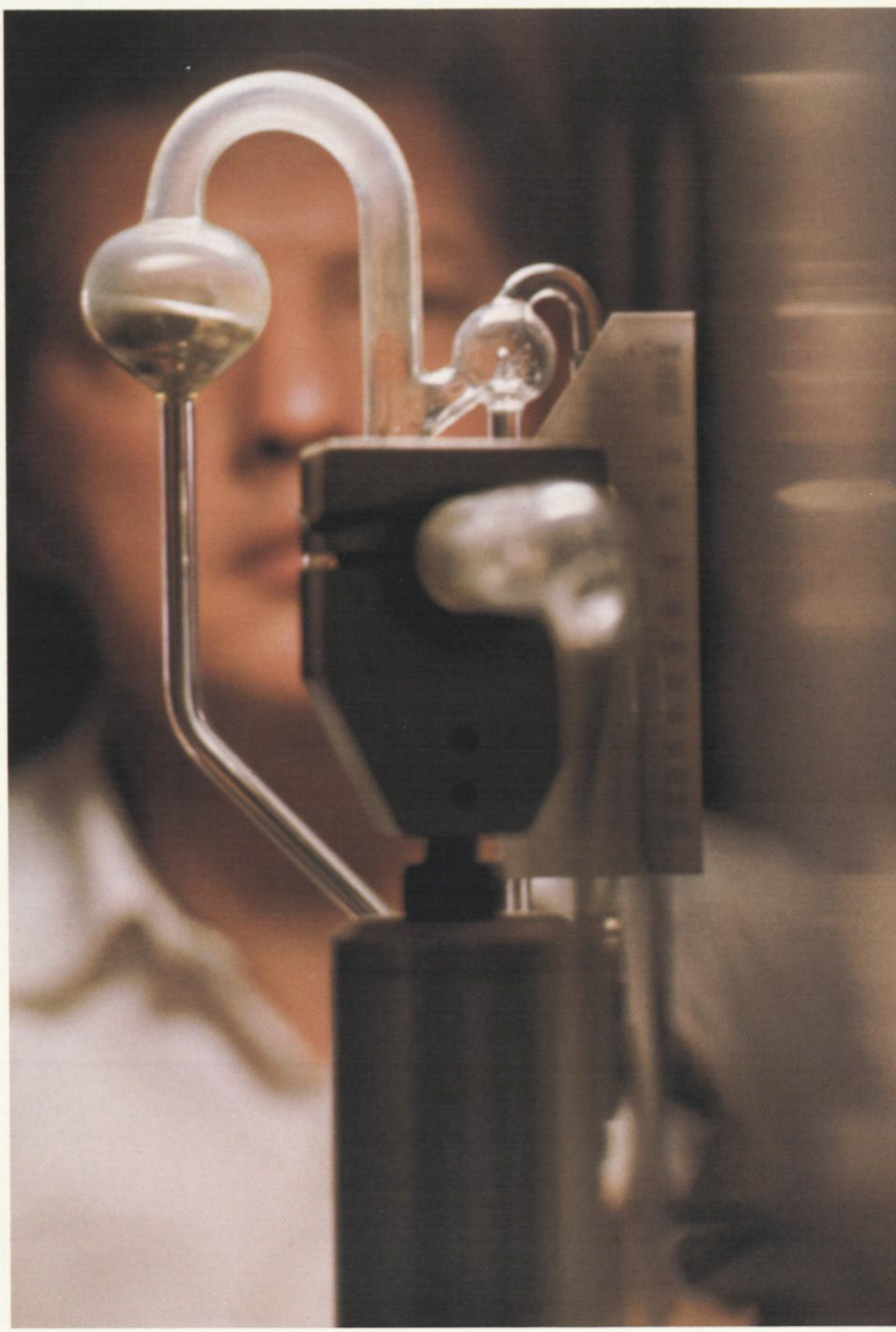

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tion of photomicrographs. [15-17] Precision investment cast parts need only slight finishing before use. They are widely used as structural components in aircraft and space vehicles. High strength titanium wire drawn to exacting dimension is the raw material for the manufacture of aircraft fasteners. Rods centerless ground to a fine, smooth finish are used for the fabrication of a wide range of products from cutting tools to motor shafts. Other Teledyne metal products include flats, plates, bars, sheets, strips, electrodes, forgings and non-ferrous castings. [18] Teledyne activities also include the study and practical application of isotopic materials. Included in this

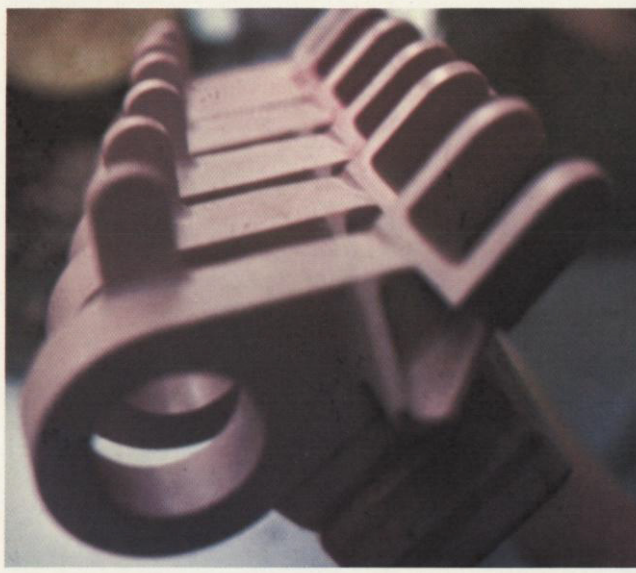
Teledyne and including our ultra-slow-speed recording equipment perfected for our geophysical activities, was installed on the ships at ports in Japan, Germany and Portugal. Similarly, Teledyne is participating in a long-term creep testing program, in which samples of materials have already been maintained under high loads at elevated temperatures for over five years. Such tests are important in verifying the design of piping systems and pressure vessels in nuclear reactor use, where such continuous stress conditions must be met.

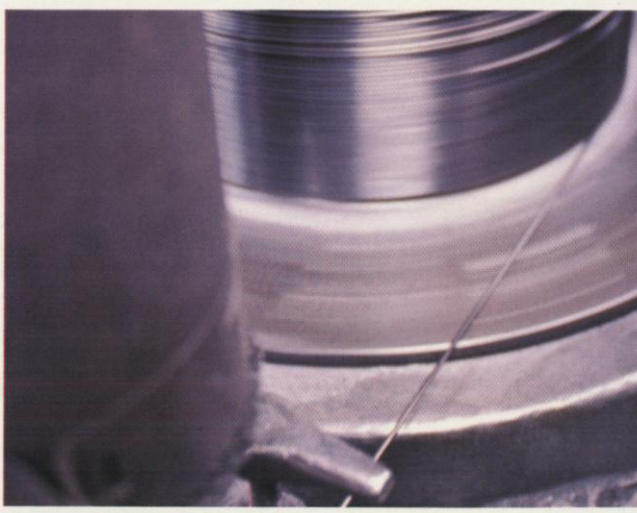
Concurrent with and as a natural outgrowth of competence in the development, production and use of materials in nuclear applications, the company has expanded as a supplier of products and services based on nuclear science and technology. These range from dosimeters of various types for the detection and measurement of radiation for medical, industrial and personnel protection needs to irradiation systems for food preservation.

Among our efforts in the peaceful uses of nuclear technology is the company's participation in a pioneering meat irradiation project. Working cooperatively with the U.S. Atomic Energy Commission, Teledyne has been selected to design the irradiation equipment and mechanical handling system for the world's first commercial meat irradiation plant, with construction scheduled during this year and startup operations early next year. Initial plant capacity will be in excess of 3,000,000 pounds of meat annually. As a prelude to the completion of the permanent structure, under AEC sponsorship and using a portable cesium irradiator, Teledyne is conducting a nationwide demonstration tour to show the advantages of radiation-pasteurization to companies in the food growing, processing and packaging industries.

In another area of broad public interest — air pollution — Teledyne is studying the isotopic

[15-17]





effort is the growing of thallium-activated sodium iodide crystals in stainless steel-clad furnaces. These crystals are used for detecting and measuring high and low-energy gamma radiation, high-energy heavy particles, neutrons, and medium and high-energy beta rays. 19 Boules of sodium iodide up to 13 inches in diameter are grown from the melt by cooling. The large ingots are then cut and processed into a variety of shapes and types, including cylindrical wells which provide maximum absorption of radiation from a sample. 20 Careful control of radiation is necessary when working with radioisotopes. Teledyne activities range from decontamination

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of entire buildings to the purification and reclamation by melting of precious metals used in nuclear material processing and instrumentation. [21] Teledyne also engages in the measurement of the isotopic ratios of low concentration materials. One method of detecting extremely low concentrations is with the absorption spectrophotometer, which measures and plots the transmittance of a material as a function of wavelength. [22] One of the most useful analytical techniques available today is mass spectrometry, the separation of isotopes of different atomic weights into an orderly sequence called a mass spectrum. It is used in atomic and nuclear research, complex mixture analysis, quality control and process monitoring and age determination measurements.

composition and absolute abundance of lead in the environment under a contract granted by the International Lead and Zinc Institute and the American Petroleum Institute. Sources of lead in the atmosphere are being traced and identified through the analysis of isotopic characteristics. Individual experiments are being performed on such diverse source materials as tree rings to study integrated lead deposition over a period of time, surface soils taken on a traverse away from major freeways and airborne solids from Times Square.

A nuclear gauge which has just been completed is expected to see widespread use in the steel industry. Destined for installation in one of the most modern galvanizing lines to upgrade the accuracy and uniformity of zinc coating operations, the gauge is an X-ray fluorescent zinc coating thickness measuring device utilizing an americium-241 isotope source. With direct count outputs suitable for digital computer input, this new instrument also makes possible the use of a closed-loop control system for more consistent and rapid processing in future zinc galvanizing lines.

Knowledge of nuclear materials and their applications has also led to the assumption of a more prominent role as a supplier of radiological services. The company is called upon increasingly to serve as radiological health physics consultants and to perform major decontamination assignments for commercial laboratories, industrial plants and government facilities. During the year the decontamination to an unlimited public use level of the AEC's uranium ore sampling plant in New Jersey was completed and a procedure perfected for the decontamination of platinum and other precious metals used in nuclear programs. Similarly, the company has the responsibility for radiological safety at the NASA Plum Brook nuclear reactor site and the Goddard Space Flight Center.

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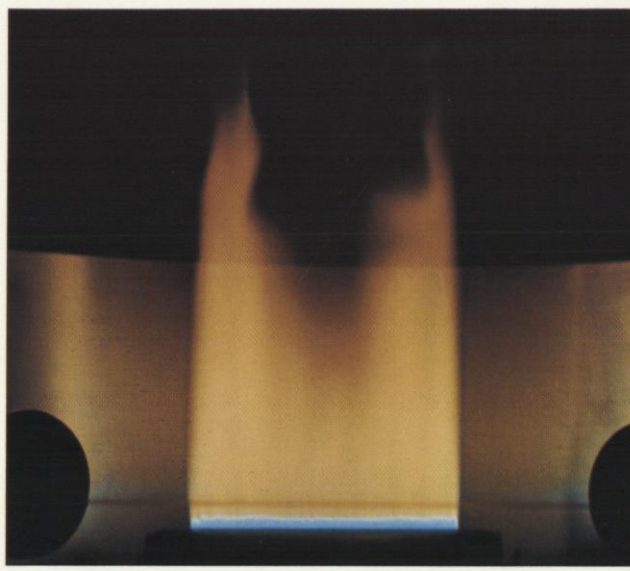

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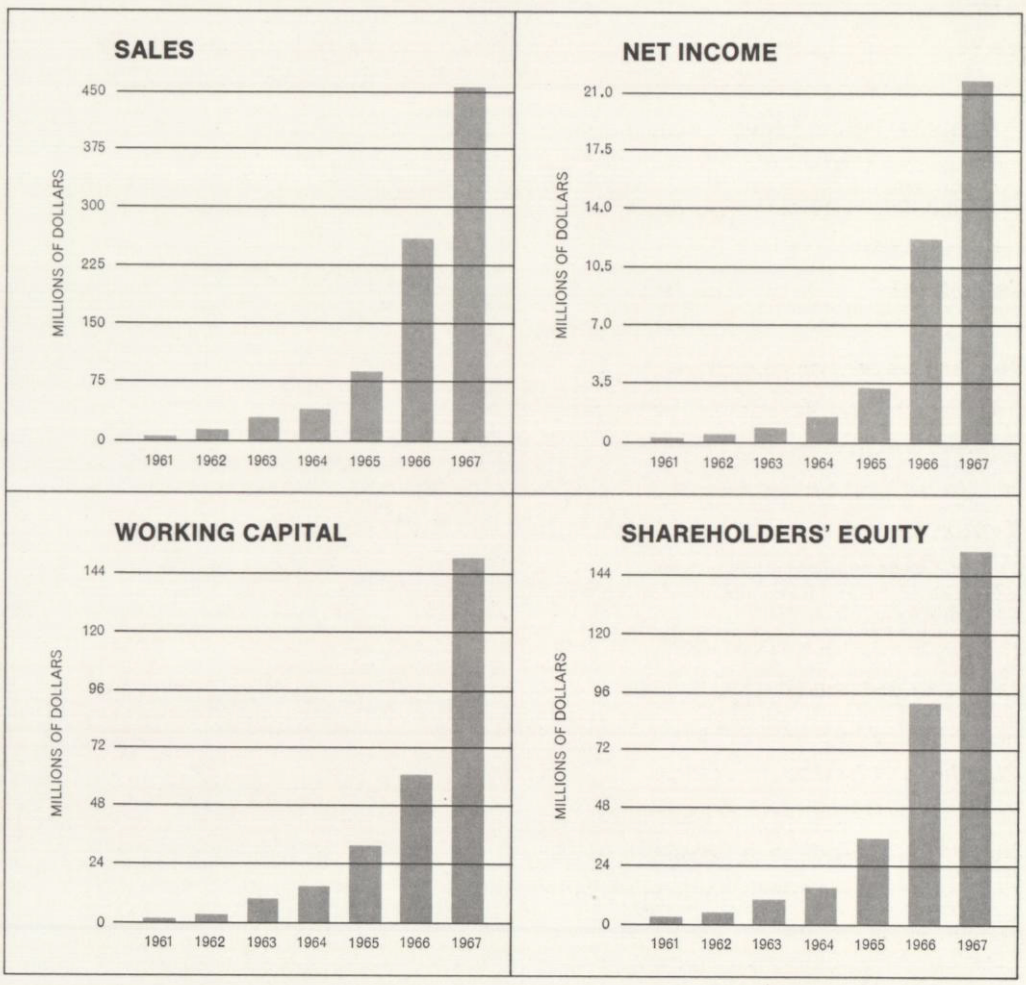
FINANCIAL STATEMENTS

HIGHLIGHTS FROM OUR ANNUAL REPORTS

	1967	1966	1965	1964	1963
OPERATING RESULTS					
Sales	**$451,060,000**	$256,751,000	$86,504,000	$38,187,000	$31,925,000
Net income before Federal income taxes	**40,745,000**	22,185,000	6,502,000	2,979,000	1,505,000
Provision for Federal income taxes	**19,000,000**	10,150,000	3,100,000	1,538,000	774,000
Net income	**21,745,000**	12,035,000	3,402,000	1,441,000	731,000
Net income per common share	**2.66**	1.77	0.96	0.65	0.37
FINANCIAL POSITION (YEAR END)					
Working capital	**$149,942,000**	$ 60,543,000	$30,803,000	$14,220,000	$ 9,263,000
Total assets	**337,703,000**	170,369,000	66,544,000	35,040,000	23,901,000
Shareholders' equity	**153,092,000**	90,205,000	34,765,000	13,672,000	8,629,000
GENERAL STATISTICS (YEAR END)					
Average number of common shares outstanding	**6,947,434**	5,551,980	3,480,512	2,107,864	1,727,403
Number of employees	**26,000**	13,900	5,400	2,400	1,900

The figures in this table are taken from previous annual reports, without adjustment for subsequent poolings of interest. Net income excludes special credits of $356,000, $1,104,000, $549,000 and $175,000 in 1965 through 1962, respectively. Net income per common share (adjusted to give retroactive effect to the two-for-one common stock split and the 3½% common stock dividend effected in 1967) is based on the average number of shares outstanding during each year after provision for dividends on preferred stock. On the basis of including operations of pooled companies prior to the years of acquisition, results for the years 1966 through 1963 would have been as follows: Sales—$394,583,000, $298,105,000, $230,790,000, $205,958,000; Net Income—$16,844,000, $14,208,000, $10,320,000, $7,790,000; Net Income per Common Share—$2.09, $1.84, $1.41, $.97.

1962	1961
$10,438,000	$4,491,000
344,000	133,000
187,000	75,000
157,000	58,000
.12	.07
$ 2,546,000	$1,614,000
10,844,000	3,731,000
3,527,000	2,477,000
1,308,341	953,264
950	450



CONSOLIDATED BALANCE SHEETS

October 31, 1967 and 1966

ASSETS

	1967	1966
CURRENT ASSETS:		
Cash	$ 11,862,000	$ 16,223,000
Marketable securities, at cost, which equals market	20,000,000	—
Receivables —		
Accounts receivable, less reserve	67,365,000	49,727,000
Reimbursable costs and fees under defense contracts	16,985,000	12,515,000
Inventories, at the lower of cost (principally first in, first out) or market, less progress billings of $20,563,000 in 1967 and $6,533,000 in 1966	98,956,000	79,753,000
Prepaid expenses	3,002,000	2,324,000
Total current assets	218,170,000	160,542,000
PROPERTY AND EQUIPMENT, at cost:		
Land	7,195,000	6,186,000
Buildings	34,367,000	26,019,000
Equipment and improvements	124,487,000	98,878,000
	166,049,000	131,083,000
Less — Accumulated depreciation and amortization	67,715,000	57,939,000
	98,334,000	73,144,000
OTHER ASSETS:		
Cost in excess of net assets of purchased businesses	10,359,000	6,556,000
Other (Note 1)	10,840,000	6,377,000
	21,199,000	12,933,000
	$337,703,000	$246,619,000

The accompanying notes are an integral part of these balance sheets.

LIABILITIES

	1967	1966
CURRENT LIABILITIES:		
Notes payable	$ 802,000	$ 19,940,000
Current portion of long-term debt	2,091,000	5,708,000
Accounts payable	26,854,000	30,188,000
Accrued liabilities	25,805,000	19,590,000
Federal income taxes	12,676,000	8,528,000
Total current liabilities	68,228,000	83,954,000
LONG-TERM DEBT AND RESERVES:		
Long-term debt (Note 2)	43,386,000	27,062,000
Reserve for deferred Federal income taxes	2,706,000	1,378,000
Reserve for employee pension benefits (Note 5)	2,681,000	2,360,000
CONVERTIBLE SUBORDINATED DEBENTURES (Note 2)	67,610,000	10,024,000
SHAREHOLDERS' EQUITY:		
Preferred stock (Notes 4 and 5)—		
$3.50 cumulative convertible preferred series	236,000	939,000
Cumulative convertible preferred series B	349,000	359,000
Common stock (Notes 1 through 5)	8,470,000	6,479,000
Additional paid-in capital	96,789,000	77,273,000
Retained earnings (Notes 2 and 4)	47,248,000	36,791,000
Total shareholders' equity	153,092,000	121,841,000
	$337,703,000	$246,619,000

CONSOLIDATED STATEMENTS OF INCOME

For the Years Ended October 31, 1967 and 1966

	1967	1966
SALES AND SERVICE REVENUES	$451,060,000	$394,583,000
COSTS AND EXPENSES:		
Cost of sales and services	345,518,000	304,841,000
Selling and administrative expenses	59,844,000	54,607,000
Interest expense	4,953,000	3,491,000
	410,315,000	362,939,000
NET INCOME BEFORE FEDERAL INCOME TAXES	40,745,000	31,644,000
PROVISION FOR FEDERAL INCOME TAXES	19,000,000	14,800,000
NET INCOME	$ 21,745,000	$ 16,844,000

Costs and expenses include provisions of $12,523,000 in 1967 and $10,383,000 in 1966 for depreciation and amortization of property and equipment.

CONSOLIDATED STATEMENTS OF RETAINED EARNINGS

For the Years Ended October 31, 1967 and 1966

	1967	1966
BALANCE, BEGINNING OF PERIOD (Note 1)	$36,791,000	$45,945,000
ADD OR (DEDUCT):		
Net income	21,745,000	16,844,000
Fair value of 3½% common stock dividend issued in 1967 (Note 4)	(6,835,000)	(22,520,000)
Cash dividends paid on preferred stock	(2,498,000)	(344,000)
Dividends paid by pooled businesses prior to pooling	(1,270,000)	(3,246,000)
Cost of treasury stock of pooled businesses prior to pooling	—	(81,000)
Net income or loss of pooled businesses for short periods excluded from or duplicated in two fiscal years in the statements of income	(685,000)	193,000
BALANCE, END OF PERIOD	$47,248,000	$36,791,000

The accompanying notes are an integral part of these statements.

CONSOLIDATED STATEMENTS OF ADDITIONAL PAID-IN CAPITAL

For the Years Ended October 31, 1967 and 1966

	1967	1966
BALANCE, BEGINNING OF PERIOD (Note 1)	$77,273,000	$52,389,000
ADD OR (DEDUCT):		
Difference between fair value and par value of common stock issued in 1967 for 3½% common stock dividend (Note 4)	6,769,000	22,302,000
Difference between fair value and par value of common stock issued in connection with purchases of businesses	8,633,000	60,000
Difference between proceeds and par value of common stock issued under stock option plans (Note 3), warrants and convertible debentures	4,140,000	838,000
Difference between proceeds or fair value and par value of capital stock issued by pooled businesses prior to pooling	912,000	4,788,000
Transfer to common stock in connection with two-for-one common stock split in 1967 (Note 4), and conversions of preferred stock	(938,000)	(3,104,000)
BALANCE, END OF PERIOD	$96,789,000	$77,273,000

The accompanying notes are an integral part of these statements.

AUDITORS' REPORT

To the Shareholders and Board of Directors, Teledyne, Inc.:

We have examined the consolidated balance sheets of TELEDYNE, INC. (a Delaware corporation) and subsidiaries as of October 31, 1967 and 1966, and the related statements of income, retained earnings, and additional paid-in capital for the years then ended. Our examinations were made in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

In our opinion, the accompanying financial statements present fairly the consolidated financial position of Teledyne, Inc. and subsidiaries as of October 31, 1967 and 1966, and the results of their operations for the years then ended, in conformity with generally accepted accounting principles consistently applied during the periods.

Los Angeles, California,
November 22, 1967.

ARTHUR ANDERSEN & CO.

NOTES TO CONSOLIDATED FINANCIAL STATEMENTS

October 31, 1967

NOTE 1: PRINCIPLES OF CONSOLIDATION —

The consolidated financial statements include the accounts of the Company and all of its subsidiaries, except Teledyne United Corporation. The 1966 financial statements have been restated to include businesses acquired during 1967 and accounted for as poolings of interests. The results of operations of purchased businesses are included since acquisition.

The Company's $1,604,000 investment in Teledyne United Corporation, its wholly owned unconsolidated subsidiary, is carried in other assets at cost. At October 31, 1967, Teledyne United's balance sheet showed cash of $104,000, investment stated at cost of $61,500,000, bank notes of $60,000,000 and capital stock and advances of $1,604,000. The Company has agreed, under certain conditions, to purchase the subsidiary's investment, a 23 percent interest in an insurance company, at not less than cost.

NOTE 2: LONG-TERM DEBT AND CONVERTIBLE SUBORDINATED DEBENTURES —

LONG-TERM DEBT—	
6½% Sinking Fund Debentures due 1992, $1,350,000 payable annually commencing in 1972	$30,000,000
Other (including $6,842,000 secured by land and buildings), due in various installments to 1984, less current portion	13,386,000
	$43,386,000
CONVERTIBLE SUBORDINATED DEBENTURES—	
3½%, due 1992, $3,000,000 payable annually commencing in 1978, convertible into common stock at $121.50 per share	$60,000,000
5½%, $317,000 payable annually from 1969 to 1981, convertible into common stock at $55.56 per share	7,610,000
	$67,610,000

Under the various borrowing agreements, the Company has agreed to maintain minimum amounts of working capital and net worth, and has agreed to certain restrictions with respect to borrowings, purchase and sale of assets and capital stock, and payment of dividends. At October 31, 1967, these agreements were complied with and retained earnings of $11,934,000 were not restricted as to payment of dividends.

The Company has reserved 630,800 shares of common stock for issuance upon conversion of the subordinated debentures.

NOTE 3: STOCK OPTIONS AND WARRANTS —

At October 31, 1967, 209,740 common shares (of which 67,670 were exercisable) were reserved for issuance under outstanding options at prices from $7.97 to $109.00 per share and 121,469 common shares were reserved for the granting of additional options. At October 31, 1966, 239,153 common shares were reserved for issuance under outstanding options and 160,494 common shares were reserved for the granting of additional options. During 1967, options to purchase 42,725 common shares were granted; options to purchase 68,438 shares were exercised; and options covering 3,700 shares expired or were canceled. The above shares reflect the common stock split and dividend effected in 1967.

At October 31, 1967, the Company had reserved 7,414 shares of common stock for issuance under warrants assumed in connection with the acquisition of businesses.

NOTE 4: CAPITAL STOCK —

At October 31, 1967 and 1966, the Company's capital stock consisted of the following shares:

	AUTHORIZED	OUTSTANDING	
		1967	1966
Cumulative Convertible Preferred Stock, $1 par value —	5,000,000		
$3.50 series		235,899	939,203
Series B		348,603	358,935
Common stock, $1 par value	20,000,000	8,470,376	6,479,215

The 1966 financial statements and outstanding shares of common stock have been restated to reflect the two-for-one stock split and the 3½ percent stock dividend effected in 1967.

The holders of the $3.50 Series Preferred Stock are entitled to voting rights, cumulative annual dividends at the rate of $3.50 per share, and preference of $60 per share ($14,154,000 at October 31, 1967) in liquidation. Such stock is redeemable at $100 per share after June 30, 1971, and is convertible at any time into two shares of common stock. The holders of the Series B Preferred Stock are entitled to voting rights, cumulative annual dividends at the rate of $.80 per share through June 2, 1969, $1.60 per share thereafter through June 2, 1971, and $3.20 per share thereafter. Such stock is entitled to preference of $16 per share ($5,578,000 at October 31, 1967) in liquidation, is redeemable at $80 per share after August 29, 1970, and is convertible at any time into 1.035 shares of common stock. The Company has reserved 832,600 shares of common stock for conversion of all preferred shares.

NOTE 5: COMMITMENTS AND CONTINGENT LIABILITIES —

Annual rentals under long-term leases expiring between 1970 and 1984 are approximately $3,600,000 through 1972, and $1,000,000 thereafter.

The Company has conditionally agreed to exchange approximately 198,000 shares of common stock for the net assets of a business. Depending on future events, the Company estimates that approximately 50,000 shares of common stock may be issued as additional consideration for previously acquired companies.

The Company has several pension plans under which it accrues annual pension costs at normal cost plus interest on past service cost, and contributes to trust funds the actuarial value of pension benefits upon the employees' retirement. At October 31, 1967, the actuarial value of earned pension benefits to be contributed in future years upon retirement of employees was approximately $13,000,000. The Company had made all contributions required by the plans through October 31, 1967.

At October 31, 1967, the Company has reserved 30,000 shares of $3.50 Preferred Stock and 122,100 shares of common stock for issuance to employees under stock purchase plans adopted in 1967.

TELEDYNE, INC.

BOARD OF DIRECTORS

Henry E. Singleton, *Chairman*

George Kozmetsky

George A. Roberts

Arthur Rock

Claude E. Shannon

Robert B. Sprague

OFFICERS

Henry E. Singleton,
Chief Executive Officer and
Chairman of the Board of Directors

George A. Roberts, *President*

James F. Battey, *Vice President*

A. V. Holmlund, *Vice President*

Russell L. Kiernan, *Vice President*

Frank W. T. LaHaye, *Vice President*

Jay T. Last, *Vice President*

James D. Nisbet, *Vice President*

William W. Shannon, *Vice President*

H. J. Smead, *Vice President*

Robert B. Sprague, *Vice President*

Teck A. Wilson, *Vice President*

George L. Farinsky, *Treasurer*

J. Spencer Letts, *Secretary*

CORPORATE HEADQUARTERS

1901 Avenue of the Stars

Los Angeles, California 90067

TRANSFER AGENTS

Bank of America

111 West Seventh Street

Los Angeles, California 90014

United States Trust Company of New York

45 Wall Street

New York, New York 10005

REGISTRARS

Security First National Bank

124 West Fourth Street

Los Angeles, California 90013

First National City Bank

55 Wall Street

New York, New York 10005