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# TELEDYNE, INC. ANNUAL REPORT 1964

TELEDYNE, INC.

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Bank of America National Trust
and Savings Association, Los Angeles

**REGISTRAR**

Security First National Bank, Los Angeles

**CORPORATE OFFICES**

12525 South Daphne Avenue, Hawthorne, California

# Annual Report 1964

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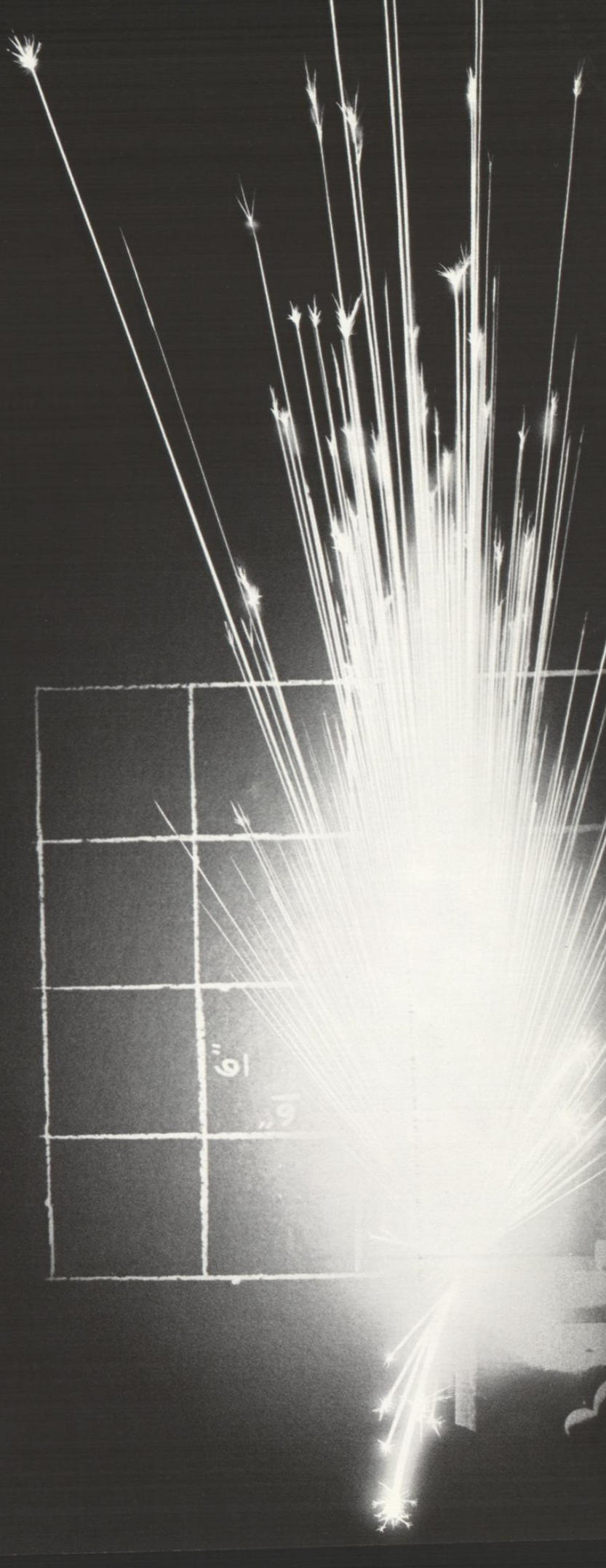
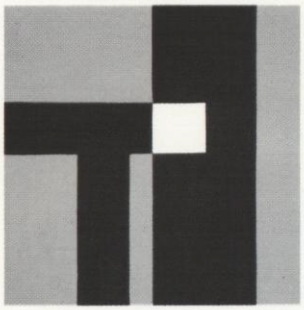


*Test of miniature igniter developed by McCormick Selph division. Designed for ignition of control rocket motors on re-entry vehicles, the device operates at altitudes up to 250 miles.*



## TO OUR SHAREHOLDERS

As it has each year since its inception, in fiscal 1964 your company again achieved record sales and earnings. New highs were also recorded in orders booked, number of people employed, amount of plant space utilized, and other measures of business activity. Sales were up 20 per cent to $38,187,127. Net earnings for the year increased to $2,545,388, a gain of 98 per cent over the $1,280,296 reported for 1963. Earnings per share advanced to $2.35, a 68 per cent increase over last year's $1.40.

At year end Teledyne's financial condition was the strongest in the company's history. During the year working capital increased 54 per cent to $14.2 million, stockholders' equity advanced 58 per cent to $13.7 million and total assets increased 46 per cent to $35.0 million. The ratio of current assets to current liabilities was 2.4 to 1.

Even more important than the gain in operating results was the progress made during the year in broadening and strengthening the company's foundation for future growth. Our product base was expanded; plant facilities and equipment were increased and improved; industrial and commercial activity was stepped up; and several important acquisitions were made.

Substantial additions were made to plant facilities, with the amount of floor space in use increasing 30 per cent to a total of 650,000 square feet at year end. New production and test equipment was added throughout the company, and we continued our program of upgrading and modernizing existing machinery. Book value of company-owned facilities rose to over $7 million, a gain of 40 per cent over last year.

Teledyne's fundamental dedication to the field of automatic control systems, equipment, and components was exemplified by the broadening of the company's product base that took place during the year. The products in this field, including sensors, computers, actuators, displays, and communications links, are characterized by a high rate of technological obsolescence, and dictate a strong dependence on technical innovation and leadership. Your company continued to invest heavily in research and development throughout the year. As a result many new products were introduced, ranging from highly advanced integrated analog circuits to jet engine starting systems. Additional new products are under development, and scheduled for introduction in future years. Balancing our internal product development program is our systematic addition of selected products through acquisition. This year acquisition brought us such important new products as communications equipment, explosively actuated devices and aircraft display equipment.

Our participation in industrial and commercial markets continued to grow. Non-Government shipments approximated $7 milllion, a 40 per cent increase over last year. Subsequent to year end we further increased our industrial product base through the addition of Pacific Industrial Controls and Analytic Systems Company, acquired as part of United Electro-Dynamics. The products of these two divisions, used throughout the nation for a broad range of automatic control applications, considerably enhance our position in the general field of industrial process control. Because of the prospective future growth in the industrial applications of electronic control equipment, we are proceeding with a vigorous program of further development in this area.

Subsequent to fiscal year end Teledyne acquired the business and assets of Servomechanisms, Inc. SMI has been active for many years in the development and production of aircraft flight instruments, being particularly well known for its air data computer systems. SMI's capabilities complement our existing activities in flight control and instrumentation. Because of our conviction that air data instruments will be of growing importance as our airways become more crowded, we place a high valuation on the long-term importance of the SMI acquisition.

Also shortly after year end United ElectroDynamics, Inc. was acquired and consolidated with Teledyne. UED's activities, other than the industrial controls business mentioned above, include airborne telemetry and seismic equipment and services. Through the UED acquisition we have taken a place among the leaders in these two fields, both of which are compatible with our present activities and long-range interests.

The product area of automatic control equipment is one of unlimited promise. If properly developed and wisely employed, machines have the ultimate capability to free man from labor, and to extend indefinitely the range of his intellect. It is our privilege at Teledyne to have achieved a strong position in this field of limitless opportunity. We are confident that our efforts will result in further progress in the years ahead.

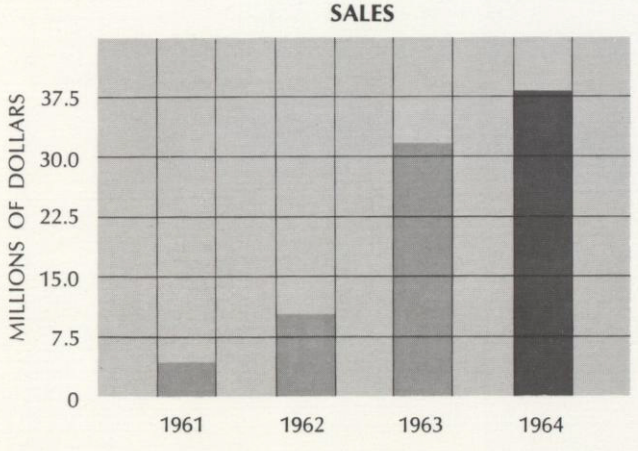
Henry E. Singleton

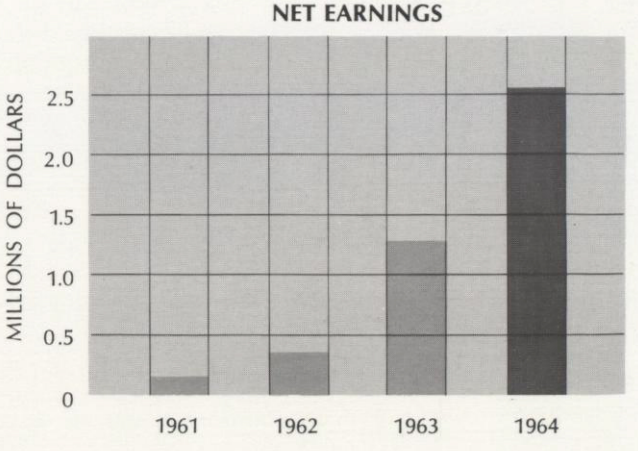
*President*

## HIGHLIGHTS FROM OUR ANNUAL REPORTS

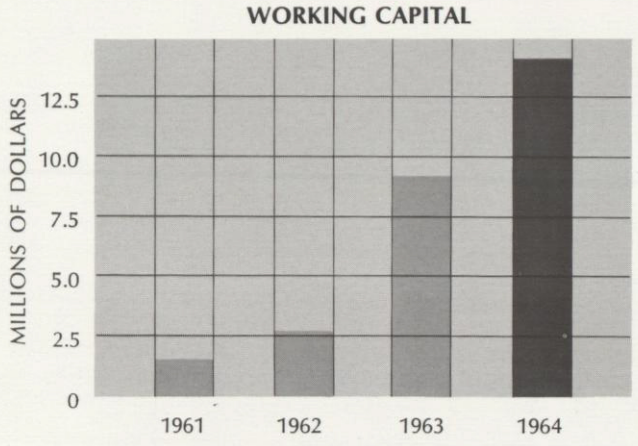
| **Operating Results** | **1964** |
|---|---|
| Sales | $38,187,127 |
| Net earnings | 2,545,388 |
| Net earnings per common share | 2.35 |
| **Financial Position (Year End)** | |
| Working capital | $14,220,320 |
| Total assets | 35,039,515 |
| Stockholders' equity | 13,672,200 |
| **General Statistics (Year End)** | |
| Shares of common stock outstanding | 1,050,996 |
| Number of employees | 2,400 |

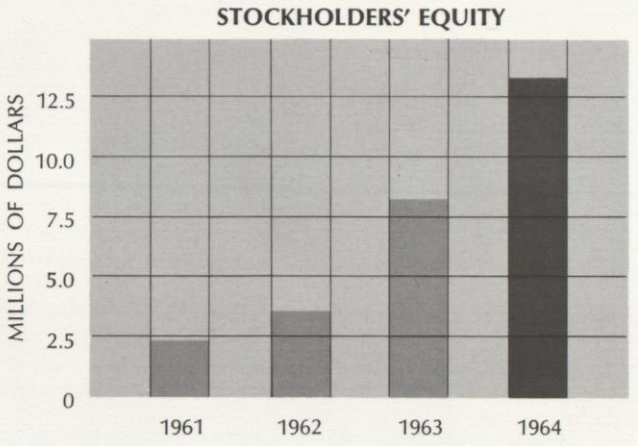
*The figures given in this table are taken from the company's annual reports for the indicated years, without adjustment for subsequent poolings of interests. See Note 1 to Notes to Financial Statements.*



| 1963 | 1962 | 1961 |
|---|---|---|
| $31,924,685 | $ 10,438,367 | $ 4,491,431 |
| 1,280,296 | 331,518 | 133,190 |
| 1.40 | 0.50 | 0.25 |
| $ 9,262,796 | $ 2,545,723 | $ 1,613,792 |
| 23,901,085 | 10,843,760 | 3,730,811 |
| 8,628,957 | 3,527,448 | 2,476,781 |
| 849,461 | 654,857 | 519,550 |
| 1,900 | 950 | 450 |



*Assembly of computer memories and precision flight instruments*

# REVIEW OF OPERATIONS

## ELECTRONIC SYSTEMS AND EQUIPMENT

### Computers and Data Systems

Progress continued this year on the detailed design of Teledyne's unique new family of digital computers. The machines are potentially applicable to a broad range of real time control system requirements, where the modular design of the computers permits them to be precisely tailored to the intended application. Combining the simple functional organization and high speed response of analog computers with the accuracy and logical capabilities of digital computers, the machines make use of a combination of incremental and whole number computing techniques. Very little programming is required. Through the use of majority logic and built-in failure detection and isolation circuits which initiate automatic self-reconfiguration to bypass any failed element, virtually failure-proof operation is assured. The microelectronic integrated circuit modules utilized in the computer are produced by our Amelco Semiconductor division.

Work on several other important digital computer projects was carried forward this year. Among systems completed and delivered in 1964 was an advanced Loran A & C Digital Simulator developed for the Federal Aviation Agency utilizing a magnetic tape-stored position program. The simulator provides a real time input to the Loran receiver system under evaluation. It precisely simulates characteristics that are normally encountered in actual flight conditions, including aircraft velocity, rate of turn, ground-wave, sky-wave, coding, and doppler effects among others.

This year also marked delivery of the Computer Data Recording System to McDonnell Aircraft Corporation for use in the pre-launch checkout complex for the Gemini program. The equipment is currently installed at Cape Kennedy, and has been utilized in the successful test launches of Gemini Capsules I and II. Production also continued throughout 1964 on the FADAC fire direction computers for the Army.

Final development is under way on the POLYLINGUA system, a computer program system to produce automatically translation programs for the special languages (such as FORTRAN or COBOL) commonly used by programmers. This system uses highly advanced techniques including a new theoretical model for language syntax. As a result, the translation programs which it produces are very competitive with respect to speed, and can be operated in all but the smallest computers. This programming system significantly advances the art of translation program production. Such programs can be automatically produced for any programming language, and for almost any computer.

### Communications and Antenna Systems

The past year has seen a continued growth in the company's activities in communications and antenna systems and related technologies. An outstanding new program is for the design, fabrication, and delivery of a feed subsystem for use on a 60-foot Cassegrain reflector antenna. The system is being built for Navy/NASA satellite tracking applications, and will permit simultaneous operation at both L and X band frequencies. It will also provide a choice of either monopulse or conical-scan tracking. The same NASA/Navy system has led to a development program for a complete receiving subsystem to provide compatible operation with the feed subsystem. The receiving subsystem utilizes Teledyne's monopulse tracking receiver in conjunction with a specially designed down-conversion unit to achieve high stability operation at UHF, L-band and X-band frequencies. As a part of this unit, Teledyne is developing a step-recovery diode multiplier, the completion of which will materially strengthen our integrated systems capability.

Directly related to our existing capability in antenna systems is our continuing development of parametric amplifiers and broadband mixers. This product line is based on proprietary design techniques which permit achievement of large gain-bandwidth products and extremely low noise figures. With the addition of this capability, Teledyne is now prepared to offer complete receiving systems for low noise applications in telemetry tracking, satellite communications, and radar target location.

*Communications assembly department at Los Angeles production plant*

For several years Teledyne has pioneered in exploring techniques for microwave passive ranging utilizing a proprietary design concept. Recent studies performed for the Navy have culminated in the completion of an experimental system to verify the operational feasibility of the approach. The experimental equipment is currently undergoing flight tests under Navy sponsorship. Completion of this phase of the program is expected to lead to development of service test models and subsequent production.

Progress in production of communications equipment matched that achieved in research and development. Production of R-390 receivers, ARC-73 UHF transceivers and monopulse tracking receivers has continued, and further improvement in manufacturing efficiency has been achieved by the use of automated production techniques. Chassis and subsystem flow is controlled by motor-driven conveyor belts which position cycle between work stations in accordance with optimum time standards for each assembly operation. In addition, our machine shop facilities have been expanded to provide improved production support.

Dubrow Electronics, our production organization in Burlington, New Jersey, continued shipment of UPA-35 radar display consoles, and began production of GRC-19 communication sets. The addition of Dubrow Electronics has strengthened our over-all manufacturing capability, and gives us a greater degree of flexibility in making best use of our specialized talents in electronic assembly and fabrication.

## Airborne Telemetry Systems

With the acquisition of United ElectroDynamics shortly after year end, Teledyne became one of the nation's foremost suppliers of airborne telemetry equipment. In 1956 UED made the first application of solid state circuitry to airborne telemetry in the Sergeant missile program, and since that time has been a leader in advancing the technology of airborne telemetry.

In 1964 UED was an important supplier of telemetry components and systems on several major programs. UED supplied both the RF links and the analog modulation systems for all operational test flights of the Minuteman intercontinental ballistic missile. Another major contribution was the continued supply of PAM/FM/FM telemetry systems to the Ballistic Systems Division of the Air Force for use on every operational training flight of the Atlas, Titan, and Thor missiles flown from Vandenberg Air Force Base.

In applications to manned space flight, 1964 saw development of the signal conditioning amplifiers which constitute the backbone of the telecommunications signal conditioning subsystem of the Apollo spacecraft. Production of the prototype hardware was completed, and production was started on flight units. We will continue production of Apollo spacecraft signal conditioning amplifiers during the first half of the year, and we anticipate continuing participation in the upcoming second Block II phase of the Apollo program.

Also in 1964 UED designed, qualified and delivered the pulse code modulation telemetry systems for use in NASA's micro-meteoroid satellite (Pegasus). This program was followed by the design of an extremely flexible 80-800 channel high and low-level PCM system for use in the NASA Flight Research Center Lunar Landing Research Vehicle, and UED continued to supply a unique d-c amplifier for each Agena missile. A further contribution to the space effort is UED's PCM RF transmitter system utilized by several prime contractors in various phases of the Saturn program.

Other projects include the development and production of an advanced telemetry system for ARPA's Hibex (High Environmental Booster Experiment) missile. This system successfully performed through environmental conditions more severe than those sustained by any previous missile system. In support of the Navy's Shrike missile program, UED designed, qualified and manufactured a substantial quantity of battery-operated PDM FM/FM telemetry systems. We have recently gone through the first successful firing of a new telemetry system for the Army's medium anti-tank weapon, and follow-on production is anticipated.

*Developmental model of precision floated gyroscope for aircraft flight control*

Substantial progress is being made in research and development of solid state telemetry transmitters and oscillators—work being concentrated in the UHF region and in increasing the RF power level in the VHF spectrum. Advances are also being made in oscillator linearity and reliability. Development activity in 1964 produced a low-level commutator and an analog-to-digital converter for use in advanced PCM systems.

UED has developed and installed the telemetry communications systems for Standard Oil Company of California which link the offshore oil well platform at Ventura with the onshore operations office, and similar equipment was installed in Standard's remote Alaskan fields.

Currently we have booked, or are in process of negotiating, substantial continuing contracts on the Minuteman, Agena, and Saturn missile programs, as well as on two classified Atomic Energy Commission programs. It is anticipated that these programs will continue throughout 1965. Also, 1965 will see production of an advanced state-of-the-art pulsed RF amplifier system for use by the AEC on a classified test program requiring substantial follow-on production.

## Instrument and Control Systems

This year Teledyne began development of a low-cost Flight Reference Stabilization System (FRSS) for the Air Force's Aeronautical Systems Division. The FRSS is intended for application as a flight reference device to a wide variety of aircraft and space vehicles. In addition to its low cost, this advanced system features minimum size, weight, and power consumption. The FRSS is potentially a large production item for future years. Completion of design, fabrication, and testing of the first models of the system is scheduled for next year.

Development work on inertial devices for the Army Missile Command was continued this year and work is proceeding on the fabrication of flight test units. These devices include a high-acceleration angular-rate measuring instrument, and a free rotor gyroscope that utilizes new concepts to supplement existing technology. We are also developing miniature precision accelerometers for the Air Force and the Navy.

Shortly after the close of the fiscal year, Teledyne expanded its position in the flight instrument field through the acquisition of Servomechanisms, Inc. SMI has been a major factor in the development of air data devices and systems. Air data information, a basic requirement for precision flight control of airborne vehicles, is of growing importance as the number of aircraft in use continues to increase.

During the year SMI completed the development and production design of a lightweight central air data computer for the Douglas A4E Skyhawk attack aircraft. The initial production order for this Navy aircraft is currently nearing completion, and a follow-on order has been received. An additional production order is expected in fiscal 1966, and should extend the program over a period of several years.

We are also supplying the air data computer for the A7A (VAL) aircraft. The design and development, under contract with Ling-Temco-Vought, was carried out this year, and an initial production order has been received. The first unit has been delivered and the second unit, which will be utilized for qualification, is near final test stage. The delivery of the initial production units extends into early 1966, and we are anticipating a substantial follow-on production order in that same year. The A7A (VAL) aircraft is programmed for heavy production for the next several years.

Another contract with Ling-Temco-Vought calls for design and development of a true airspeed computer for utilization on the RF8G aircraft. The initial production order is for some 50 units with delivery commencing in April 1965. Additional purchases are expected in the next fiscal year.

In addition to air data systems, SMI develops and manufactures the pressure transducers which provide the basic inputs to the air data computer. The division also supplies separate pressure transducers for a variety of applications. Many of our transducers are

*Seismic data from around the world is analyzed and interpreted at our Seismic Data Laboratory in Alexandria, Virginia*

*An earthquake recording in process at Tonto Forest Seismic Observatory*

*Aligning angle of attack vane on readout mechanism at Servomechanisms division*

manufactured for NASA and are used on various space programs.

An important adjunct of the air data system is the angle of attack transmitter, or vane. SMI is a leading manufacturer of these precision devices, which detect local air flow and produce an electrical output proportional to the angle between the local airstream and an aircraft reference line. This year SMI qualified its universal vane for the Air Force, and we have just received an award from the Air Force Systems Command for several hundred production units under a multi-year procurement. We are currently providing vanes for the A4E, the F8E, and the A7A (VAL) aircraft, all for the U. S. Navy. Our angle of attack transmitter is also being used on the F-104, on the French Dassault Mirage fighter, and on the new Lear Jet executive aircraft.

The SMI ice detector units have been selected for the F-111 (TFX). The ice sensing mechanism is entirely mechanical and does not rely on any change of pneumatic pressures for its operation, and thus, is not affected by rain or dirt contamination. The independence from pneumatic pressures assures dependable icing indications at all speeds or even when the aircraft is on the ground. For helicopter or VTOL applications this becomes an added advantage since it permits the reliable indication of icing when the aircraft is hovering.

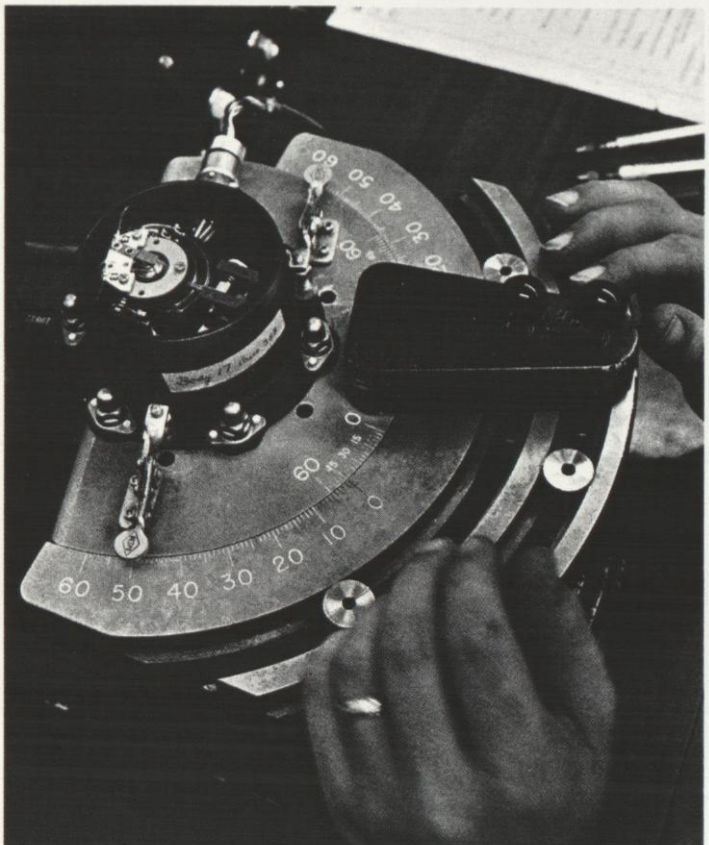
The SMI thermocouple reference junction compensator is receiving wide acceptance. This device electrically compensates for reference junction variations in a thermocouple temperature measurement system. We are supplying compensators for use on the Titan III program, the Minuteman program, and the Apollo Lunar Excursion Module.

## Earth Sciences

Teledyne's entrance into the field of earth sciences was accomplished through the acquisition of United ElectroDynamics. We thus acquired an organization with an established capability in detecting, measuring, and evaluating earth movements. Major improvements in seismology have come about in recent years as a result of the 1958 Geneva Conference, which sought to establish specifications and methods for nuclear test detection. Our earth sciences organization has led in these improvements, and has been a prime contractor on project Vela since 1960. As part of the Vela program, the Earth Sciences division established the Tonto Forest Seismological Observatory, selecting the remote Payson, Arizona site because of the low level of microseismic earth vibration, after detailed study of 53 possible locations throughout the nation. Earth Sciences designed, fabricated, tested and installed the equipment under the direction of the Advanced Research Projects Agency with technical supervision provided by the USAF Technical Applications Center.

The Tonto Observatory monitors and records earth vibrations from more than 80 seismometers of various types, buried in the ground in vaults. A large number of these seismometers are placed in both linear and symmetrical array patters on 23,000 acres of Tonto National Forest. Each seismometer measures movement in the earth smaller than a ten-millionth of an inch. Twenty miles of trails and 525 miles of electrical cable connect the seismometers with the recording and control center. The control center records the seismic motions, and the records are forwarded to our Seismic Data Laboratory in Alexandria, Virginia, for evaluation and analysis. At the laboratory our scientists evaluate the information from Tonto Forest, as well as other seismic information supplied by a vast network of fixed and mobile recording stations, integrating and analyzing the many diverse seismic techniques to improve underground explosion detection methods. We are operating the Seismic Data Laboratory for the USAF Technical Applications Center as part of ARPA's Vela Uniform project.

Subsequent to fiscal year end we were awarded a significant contract related to the Vela Uniform project which involves the installation and checkout of the world's largest seismic array. The work is being performed in the eastern half of the state of Montana and covers a large portion of the state. Some 500 of our seismometers and amplifiers are being installed in holes drilled, cased, and cemented by our crews.



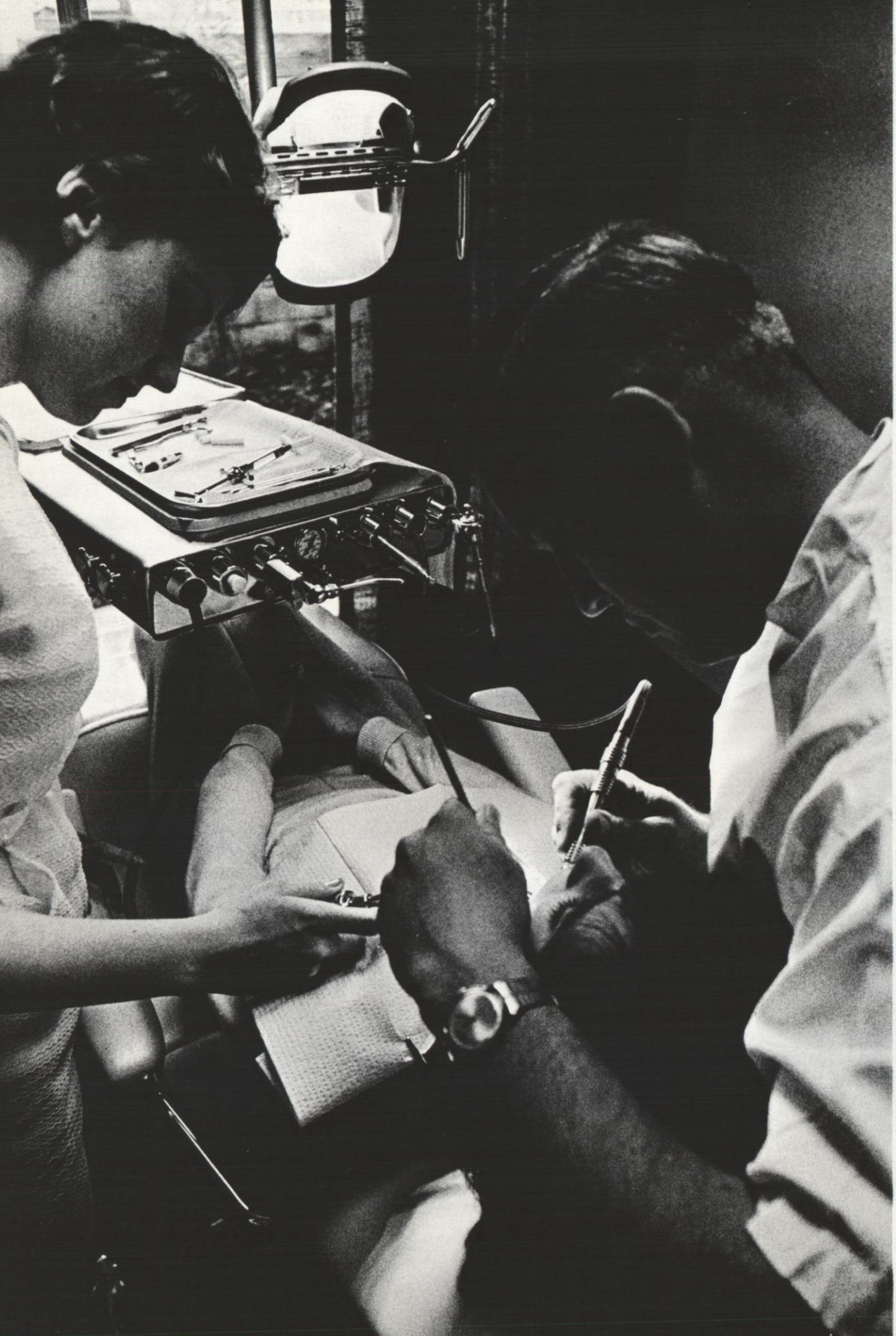

Earth Sciences recently became active in lunar and planetary sciences by teaming with Bendix Systems Division to submit a winning proposal to NASA Headquarters. Our portion of the program requires an extensive study of the potential experiments to be performed by the Apollo astronauts when they reach the surface of the moon. Various types of geophysical information will be obtained by means and instrumentation to be specified for this program as a result of the study. Hardware development in this area is expected to follow our present study program.

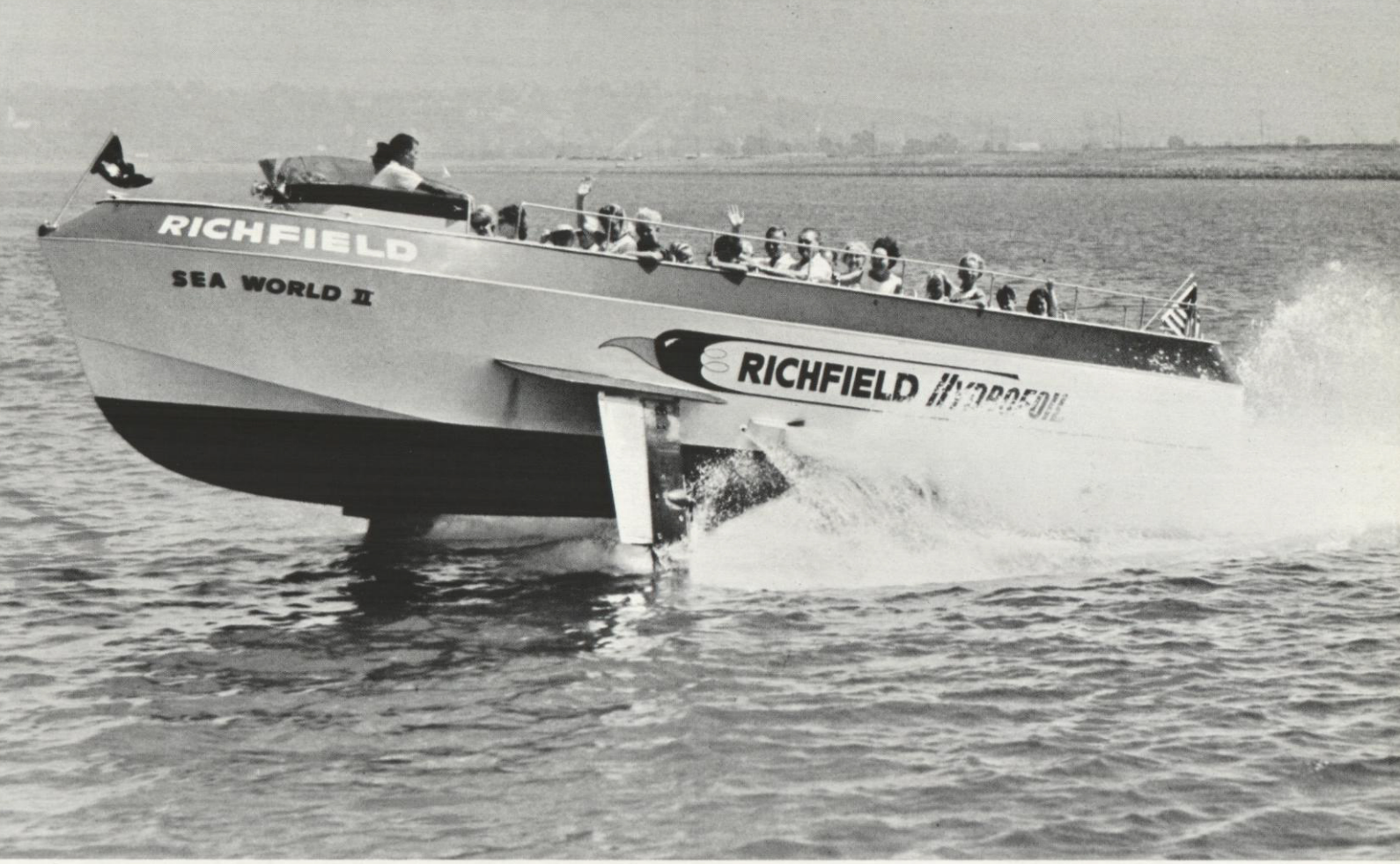
## Integrated Avionics Systems

The Program Definition Phase for the Integrated Helicopter Avionics System (IHAS) has been successfully completed. Our report has been submitted to the Navy and preliminary negotiations are proceeding for the award of a prime contract to Teledyne to develop and supply the complete system. The initial operational application of the IHAS planned by the Navy is in the CH-53A assault helicopter for the Marine Corps; however, the high degree of modularity and flexibility achieved in the system design has led to the contemplation by the Services of the use of the IHAS in a number of other fixed and rotary wing aircraft as well. The planned broad usage of the IHAS by both Army and Navy, in various aircraft, is in consonance with current Department of Defense emphasis on commonality to provide maximum capability per dollar, especially in new developments offering major improvements in system effectiveness.

As an outgrowth of experience gained on the IHAS program, Teledyne has been awarded a contract to study the avionics system requirements for the Army's Advanced Aerial Fire Support System (AAFSS). This effort requires an extensive study of the fire control problems associated with a variety of weapons as well as computational and system problems pertaining to the over-all requirements. Paramount in this study, as in others, is the accurate and objective assessment of the cost effectiveness of the proposed system.

Recognizing the importance of the cost effectiveness concept in defense planning, we have developed, for

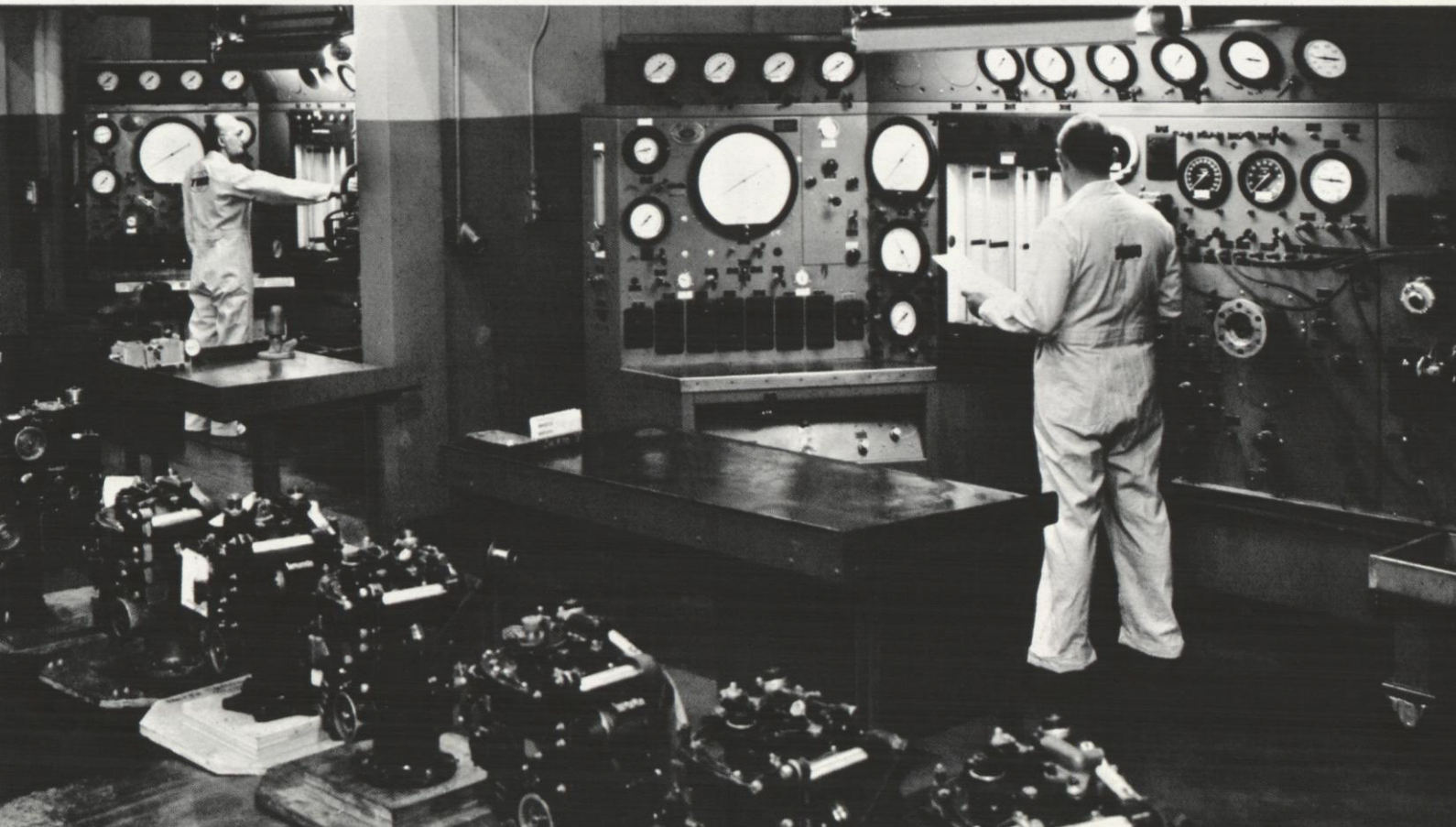


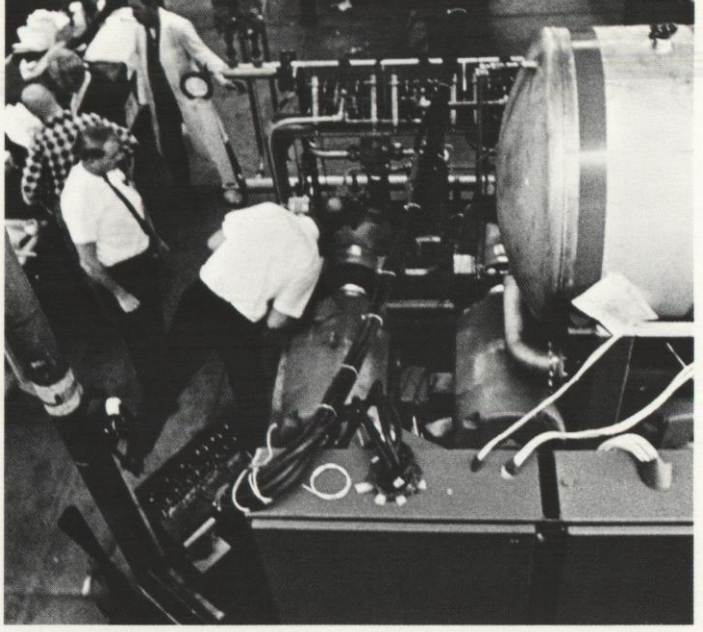



*Teledyne's excursion hydrofoil, in use at Sea World Marine Park in San Diego*

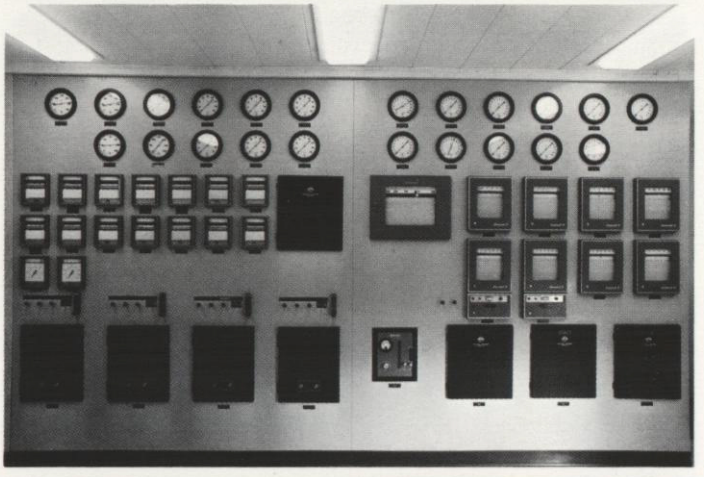
*Our Turner Dental Units, placing all necessary tools at the dentist's fingertips, are now in use across the country*

*Sprague hydraulic test stands testing jet fuel pumps at TWA's Kansas City base*





use on large-scale computers, a generalized mathematical model which has proven to be a powerful tool in the evaluation and optimization of defense systems. We foresee continuing emphasis on the requirement for rigorous validation of planned systems from a cost effectiveness standpoint. By virtue of our considerable and early experience in this field we anticipate further growth of our activities in this area.

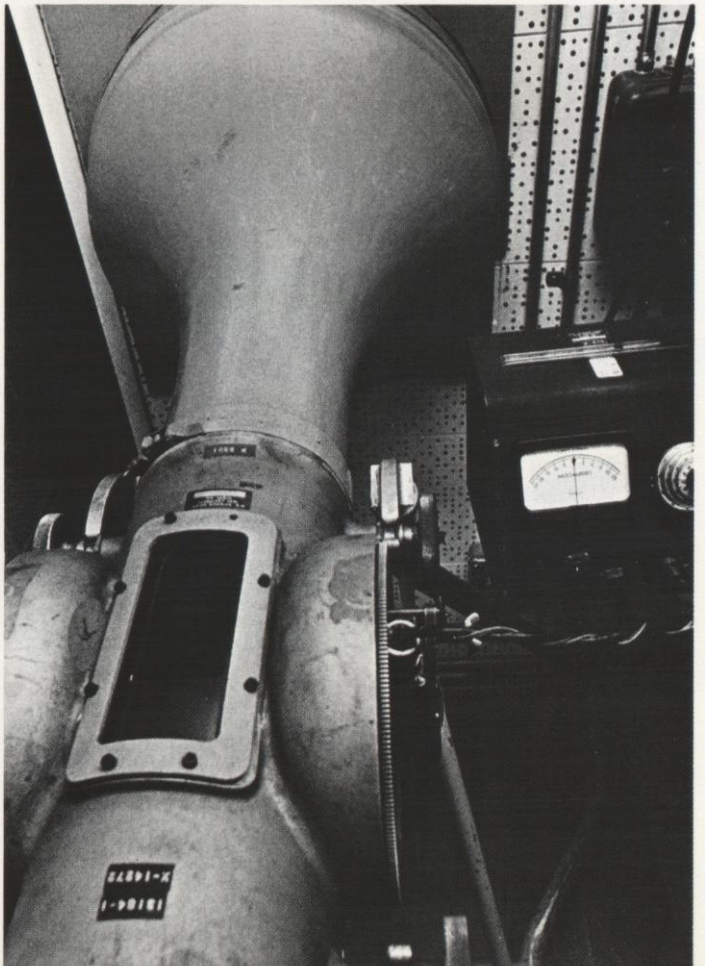


## INDUSTRIAL AND SUPPORT EQUIPMENT

### Analytic Systems

Our analytical systems product line includes eight major types of gas and liquid analyzers applied generally in the petroleum, petrochemical, and chemical industries for on stream process analysis and control. The business is conducted through our Analytic Systems division, acquired shortly after year end as part of United ElectroDynamics.

The eight major types of analyzers can be classified into three main groups. The first group is composed of gas analyzers that include thermal conductivity, trace and per cent oxygen, flame ionization (hydrocarbons) and combustibles monitors. These instruments are used to measure the purity of, and the impurities in, various gas streams, with the majority of applications being in the air liquefaction industry. A less common application now being encountered with increasing frequency is to inert gas generators, where it is necessary to measure both total combustibles and trace oxygen. Other applications relate to secondary recovery in oil fields and to process control in plastic plants. In the latter case, traces of oxygen may change the color and properties of plastics, causing a loss of product and increased operating costs.



The second group of products consists of the near infrared, ultraviolet and infrared photometric analyzers. Here the main applications are centered around needs in the petroleum and petrochemical industries, but recent emphasis has been placed on other chemical industry applications, such as plastics production and fertilizer plant controls. One of the

*System for testing servoactuators of the Saturn V rocket engine is readied for delivery at Sprague Engineering division*

*Process stream analyzers built by our Analytic Systems division for monitoring production of argon, nitrogen and oxygen installed at a customer's plant*

*Calibration of aircraft flight instrument is accomplished on wind tunnel at Servomechanisms facility*

more critical applications of this group of instruments is their use in detecting toxic vapors, such as hydrogen sulfide and mercury vapor. The latter measurement is particularly important in industries where the use of mercury vapor lamps and large amounts of liquid mercury can pose a health hazard to personnel.

The gas chromatograph family of instruments is the newest addition to Analytic Systems product line. Process control gas chromatography was chiefly developed for the petroleum industry. This means of analysis and control also has great promise as a support method for nearly all of the applications previously mentioned for Analytic Systems' other instruments. The market for process chromatography is expected to increase rapidly and we are planning to expand our activity in this field.

## Pacific Industrial Controls

Our Pacific Industrial Controls division was also brought into Teledyne through the United Electro-Dynamics acquisition. PIC manufactures more than 50 different models of pre-packaged controls which automate equipment and conveyor systems by automatically stopping, starting, reversing and changing operating speeds of electric motors. Through PIC we are rapidly becoming an important supplier of such controls. Marketed under the trade name of "Ratiotrol" and "Precision Speed Regulator," PIC's controls are designed to be merchandised as off-the-shelf packages by power transmission products dealers and distributors. The automating controls manufactured by PIC are marketed through the Boston Gear Works of Quincy, Massachusetts, the largest manufacturer and distributor of power transmission products in the United States.

PIC is also introducing an automated clutch and braking device for use on small (up to 20 horsepower) electric motors.

## Power Equipment

In our Inet division we continued this year to expand the use of our brushless synchronous motor-generator set, manufactured in ratings from 1 to 250 KW. A commercial version of this equipment is used by major airlines at terminals throughout the United States. Another product development for airline ground service, and in use in the United States and overseas, is our truck-mounted, 140 KVA, 400 cycle diesel engine generator set complete with all necessary controls.

During 1964 Teledyne began supplying precise static d-c power equipment for the Apollo and Saturn programs. This development has provided a new family of SCR regulated, high current (50 to 500 ampere) d-c power supplies suitable for the most critical system requirements. Exceptional performance and reliability are achieved through the use of high power silicon controlled rectifiers and solid state overvoltage, undervoltage and overcurrent protective devices mounted on plug-in printed circuit boards.

Also this year, shipments were made against an Air Force contract on a new line of static power conversion equipment to be used on USAF Mobile Training Units for the C-141, C-130 and C-133 aircraft.

Another development of particular interest this year was the introduction of our Inet Transient Synthesizer (ITS). To be used for testing communications equipment, the ITS generates a full family of voltage and frequency transients which are programmed and recorded on the Synthesizer Visicorder. The Synthesizer consists of an SCR inverter, programmed by solid state devices, as the controllable sine wave power source; a surge generator for supplying simulated lightning and switching surges; and suitable instrumentation for indicating and recording the pertinent electrical transient phenomena. The ITS is fully portable, and is built in five separate modules, so that the size and weight of any one module is no greater than that of a large household appliance. This allows for easy transportability in order to permit use of the equipment for studying specific performance characteristics of critical communication loads at widely dispersed sites.

## Sprague Division

In 1964 Teledyne's Sprague Engineering division maintained its position as the industry's standard in

*Right: Testing of semiconductor devices on semi-automatic equipment*

*Far Right: One of the many tests that insure reliable operation of Teledyne relays*

aircraft hydraulic and pneumatic equipment. The Sprague line of mobile jet engine starters, in use for many years throughout the world, was supplemented this year by the introduction of a pneumatic jet engine starting system, for permanent facility installation. Used at new jet air terminals and for air terminal modernization programs, the starting equipment is located in a permanent installation in the utility area of the air terminal. From the utility area the compressed air is piped underground to as many starting pads as desired.

In support of the manned space flight program we were selected by the Boeing Airplane Company to supply the remote control pumping system for testing the servoactuators on the Saturn V rocket engine. Our proven ability to handle systems for contaminant-free liquids under high pressures was a major factor in obtaining this program.

In another development this year, Sprague Engineering built and delivered its first hydrofoil passenger boat. Now in use at Sea World Marine Park in San Diego, this 34-foot excursion craft is the only hydrofoil operating on the West Coast which is Coast Guard approved for carrying passengers. A total of three of these hydrofoil boats have now been delivered. We have also contracted with the Coast Guard to install a set of foils on one of their 30-foot patrol boats.

Following the success of the Sea World hydrofoils, we have begun construction of two 58-foot seventy-passenger hydrofoil ferrycraft for the Woods Hole, Martha's Vineyard and Nantucket Steamship Authority of Massachusetts. To be utilized for scheduled ferry service, it is expected that these hydrofoils will operate at approximately 40 knots, reducing travel time to about 25 per cent of its present value.

## INSTRUMENTATION AND COMPONENTS

### Electronic Components

During the year our precision components division placed special emphasis on advanced rotary and rectilinear switch assemblies for use in liquid oxygen and gaseous oxygen rocket engine fueling systems. Units of this type are being supplied for the Rocketdyne F1 and J2 rocket engines. These switches fully meet the stringent reliability requirements dictated by NASA Saturn specifications.

During 1964 we completed qualification and shipped production quantities of our 100-pole, double-throw switch. We developed this switch for The Martin Company for use on the Titan III missile as a telemetry signal transfer switch. Each of the more than 40 switches shipped contains 100 of Teledyne's ultraminiature TO-5 relays.

We are continuing to expand our TO-5 relay manufacturing capability. To broaden the TO-5 product line, we have recently introduced two additional TO-5 configurations: a magnetic latching version, and a 40 milliwatt ultrasensitive model. Development is also near completion on a double-pole double-throw TO-5 relay. The TO-5 relays remain the smallest available, and with the increased number of models available constitute the industry's broadest line in the ultraminiature class.

The Mechatrol line of synchronous motors, servo motors, gearhead motors and metal film potentiometers acquired in November 1964 further enlarged our activity in the components field. Typical users of Mechatrol components include the Atlas, Pershing, Polaris and Titan missiles; the B-52, B-58, F-104, F-105, F-106 and F-110 aircraft; and the Discoverer, Tiros and other space vehicles.

### Optical Components

Teledyne Optics' first full year of operation since its formation in 1963 showed good progress. The division now has the largest infrared optics manufacturing and test capability in the western United States. Teledyne's infrared optics are utilized in most of our armed forces' arsenal of heat seeking missiles. Development work for the Ford Motor Company's Aeroneutronics division on the optical requirements for the Shillelagh missile was completed late this year, and it is anticipated that production requirements will be released in 1965. Initial quantities of the win-

*Looking into an optically polished silicon dome which transmits infrared radiation but reflects visible light*

dows for the Apollo space vehicle were produced this year, and production of Apollo windows is continuing.

Our phasolver discs, utilizing a complex evaporated metal pattern on a close tolerance glass disc to form a high resolution angular transducer, are in production at Teledyne Optics. Telescopes for NASA's Orbiting Astronomical Observatory will be pointed and programmed in angle by the phasolvers.

## Fluid Systems Components

The Linair Engineering division of Teledyne, one of the nation's leading suppliers of hydraulic and pneumatic fittings for aircraft applications, expanded into the industrial fluid fittings market this year.

In addition to strengthening our position in the military and commercial aircraft fitting market, during the year nearly ten per cent of the fittings shipped were for industrial application, a new product area for Teledyne. A substantially increased market penetration for our industrial product line is anticipated for 1965. We intend to introduce a new and fully patented industrial-type fitting, in which significant improvements have been made over competing products. The fitting is expected to have eventual use in aircraft as well as industrial applications.

An important advance was also made in the development of fittings for space applications. We were recently awarded a large contract for a new type fitting designed for use in ground support equipment on the Saturn space vehicle. Selection of Teledyne for this program was significant, since it may well become the only fitting to be used in this application.

An agreement has been made with Lakeland Manufacturing Company of Cleveland, Ohio, whereby Lakeland will manufacture our newly developed and patented precision flaring machine for space-type fittings. Sales will be made by both Lakeland Manufacturing and Teledyne to those companies requiring a precision tube flare. To the best of our knowledge, this equipment is the only unit that will meet NASA requirements for tube flares used in space vehicles.

## Information Display Equipment

During 1964 Teledyne entered the field of visual information display equipment, through the acquisition of Radar Relay, Inc. Encouraging progress is being made at Radar Relay in working toward commercial application of its products. As an example, the division recently contracted to provide the complete warning and advisory system for the Douglas DC-9 short-range jet transport. Programs of this type are expected to produce significant increases in our commercial sales over the period of the next few years.

Among the technical developments which took place in this division during 1964 was the development of a new type of four-color miniature switch-indicator. The new switch is the smallest of its kind on the market. It has captured the interest of manufacturers of such equipment as computers, ground control equipment, and aircraft, and is beginning to produce quantity orders.

Under license from the Douglas Aircraft Company, our Radar Relay division has continued the development of a new method of providing advisory or warning information. Known as Auditory Information Display (AID), the system selects the appropriate prerecorded warning message and plays it to the operator of an aircraft or control station to alert him in the event of a malfunction. Tests have shown that human response to an audible warning is as much as six times faster than the response to a lighted indicator.

Working with the Amelco Semiconductor division of Teledyne, Radar Relay has now improved the AID design to a point which should place us in an excellent competitive position. Our in-house capability in microcircuits and integrated circuitry has helped bring about improved performance characteristics with less size and weight at lower cost. The AID development is now under consideration by the Navy for use as a retrofit on its fleet aircraft. It is also being considered for the TFX aircraft, and for use on commercial jet transports.

## Explosive Ordnance

During 1964 the McCormick Selph division made a number of significant moves to strengthen its position in the ordnance industry. One of the more important milestones was the division's entrance into the field of specialized design and development of sophisticated instrumentation equipment. Our first product in this market is a spark trace velocity measuring system for shock tunnels, for use by NASA's Ames Research Center. The system measures gas velocity at speeds up to ten times the speed of sound. A second item of instrumentation now being supplied is a thermocouple input simulator. The simulator is being used to check out recording systems used for documenting temperature measurement. It also has application to hypervelocity wind tunnels, rocket thrust test stands, and other areas in which large numbers of pressure, thrust, or temperature transducers are used. We expect to expand our efforts in this field of instrumentation for velocity and temperature measurement.

Our ordnance system research and development capability is reflected in a product improvement contract received from The Martin Company. The contract calls for major improvements in the Pershing missile ordnance system hardware. Through the introduction of heliarc welding techniques and the use of stainless steel a new and greatly improved hermetic design was evolved. The Martin Company is now testing prototype quantities, and we expect to go into production soon on the coming year's requirements.

Work on the F-111 (TFX) aircraft contract is now under way and on schedule. The contract calls for the design, development and manufacture of explosive separation devices for the crew escape system. This involves the use of high explosives to separate the aircraft cockpit, or pod. The requirement is accomplished by explosively cutting the aircraft skin in a predetermined pattern and by simultaneously detonating explosive bolts which will sever the structural members. The operation is highly critical, and must be effected without damage to the pod, which remains sealed for the protection of the two man crew inside. This is the first such explosive system intended for use in tactical aircraft.

McCormick Selph continues to occupy a strong position in the production of high density components. During the year we produced over two hundred thousand explosive actuators alone. The quality of this volume production can be measured by the fact that we were one of the first recipients of the Gemini-Titan II NASA award. The award was made as a result of our explosive pressure cartridge being certified as "Critical" for the man-rated launch vehicle. To date there has not been one failure in the 30,000 parts fired.

## SEMICONDUCTOR DEVICES AND INTEGRATED CIRCUITS

Sales of our semiconductor division increased markedly during 1964. The growth took place primarily in field effect transistors and digital integrated circuits, and a strong marketing position has been established in both product areas. The increased sales have been realized in the face of a price decline of approximately a factor of two in injection type transistors, differential amplifiers, and field effect transistors, and a factor of approximately ten in digital integrated circuits. Thus our unit production of semiconductors more than tripled, and as a result of improvements in production efficiency the division continued to show satisfactory profits.

During the year the semiconductor sales organization was strengthened and expanded. The number of field salesmen in our own employment was doubled. The number and quality of manufacturers representatives and distributors was increased. The internal sales support organization was reorganized on a product basis to better service customers and the field sales organization.

Substantial progress was made during the year in reducing the cost of manufacturing our products. As volume has expanded, yields have been stepped up through increased use of production tooling, and increased training of personnel. Improved equipment

*Silicon wafers in diffusion furnace are processed at white hot temperature*

has been introduced in the diffusion area, and furnaces with more precise temperature control are being used on critical operations. New methods and equipment for semiautomatic testing and sorting of dice are now in use. In assembly, new lead bond equipment has been installed which operates at a faster rate. In the electrical testing of the product, equipment has been acquired which classifies the discrete devices with respect to all of their more important parameters in one testing operation. Similar equipment for digital integrated circuits has been designed and is now in use. The new test equipment and procedures have drastically reduced the cost of testing our products.

Amelco Semiconductor has become a leading manufacturer of highly reliable semiconductor components. This leadership has been gained through superior product designs and the employment of an advanced reliability program. Beginning with the stringent quality requirements we impose upon our suppliers, the reliability program culminates in the careful monitoring, evaluation, and control of our manufacturing process.

The product evaluation portion of our reliability program employs sampling of devices selected at random from our product lines. These samples are subjected to a thorough testing program in our complete and modern environmental laboratory, which simulates all conditions of actual use. As a result of the stringent process controls and resulting device reliability, we have been selected as a qualified supplier on the Titan, Star, Mariner, Polaris, Nimbus, OAO, Gemini, Pershing, TFX, Apollo, LEM, and other programs.

Our research and development program continued to be very active during the year. New products were introduced in each of our major product lines. Significant among these new products were:

1. To the injection-type transistor line, Amelco added its first high speed switches. This family of devices meets the specifications of such popular types as the 2N2368, 2N2369, 2N743 and 2N744, among others.

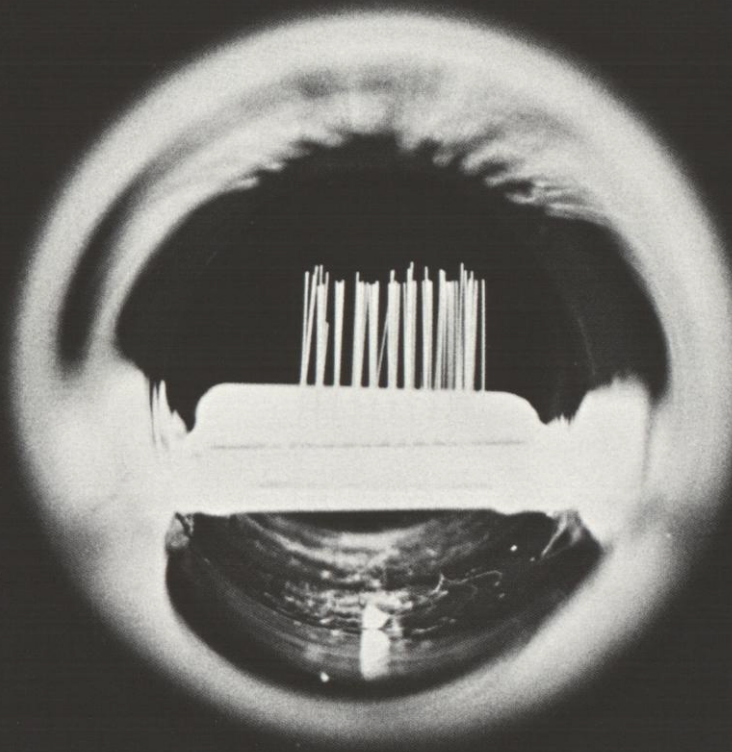
2. In the digital circuit area, a number of additions have been made to the OMIC direct-coupled transistor logic line, and the low power DTL line has been broadened and offered for general sale in the past year.

3. A line of diffused analog circuits has been under development; the first two of these, a full two-stage differential amplifier and a high performance operational amplifier, are now in production.

4. The FE-100 and FE-400 field effect transistors were offered for sale. The performance of these devices is superior to that of the FE-200 and FE-300, which were introduced in the prior year. The FE-100 is a small geometry device designed for low leakage and low capacitance. The FE-400 is a larger geometry device designed for high drain currents and high transconductance.

5. A number of field effect special assemblies were introduced for the first time in the past year. Among these are field effect differential amplifiers, in which two field effect transistors matched for gain and input impedance are mounted in the same package. Our SA2345 cascoded field effect amplifier, designed to have very low input capacitance and very high output resistance, was introduced. A special analog switching circuit was also announced. Used in multiplex switching, the circuit consists of an assembly of a field effect transistor, a pnp transistor and other components.

6. A silk screen thin-film process was successfully developed this year. The process involves silk screening resistors and interconnections on a ceramic substrate to which discrete transistors and capacitors are added. We are currently delivering a variety of custom thin-film circuits of this type. The process is particularly suitable for small volume orders which do not warrant the cost of developing a full set of diffused circuit tooling. In addition, the process is capable of achieving higher frequency performance than can be realized with fully diffused circuits.



## TELEDYNE, INC. AND SUBSIDIARIES

### CONSOLIDATED BALANCE SHEET
October 31, 1964

### ASSETS

| | | |
|---|---|---|
| **Current Assets:** | | |
| Cash | | $ 1,214,974 |
| Receivables (Note 2)— | | |
| Accounts receivable, less reserve | | 5,552,224 |
| Reimbursable costs and fees under defense contracts | | 5,100,968 |
| Inventories, at the lower of cost (first in, first out) or market, less progress billings of $6,202,318 | | 12,243,321 |
| Prepaid expenses | | 477,467 |
| Total current assets | | $24,588,954 |
| **Property and Equipment, At Cost:** | | |
| Land ($1,724,600, including $1,507,000 representing cost of land held for expansion) and buildings | $ 3,097,680 | |
| Equipment and improvements | 7,128,456 | |
| | $10,226,136 | |
| Less—Accumulated depreciation and amortization | 3,042,177 | 7,183,959 |
| **Other Assets:** | | |
| Cost of purchased businesses in excess of book values at dates of acquisition (not being amortized) | $ 2,645,587 | |
| Other | 621,015 | 3,266,602 |
| | | $35,039,515 |

*The accompanying notes are an integral part of this balance sheet.*

## LIABILITIES

| | | |
|---|---|---|
| **Current Liabilities:** | | |
| Notes payable (including $3,773,403 payable to bank) | | $ 4,107,160 |
| Current portion of long-term debt | | 1,427,036 |
| Accounts payable | | 2,973,577 |
| Accrued liabilities | | 1,668,338 |
| Federal income taxes (Note 5) | | 192,523 |
| Total current liabilities | | $10,368,634 |
| **Long-Term Debt (Note 2)** | | 7,431,479 |
| **Subordinated Debt (Note 2)** | | 2,500,000 |
| **Minority Interest in Subsidiary** | | 26,250 |
| **Deferred Income (Note 6)** | | 1,040,952 |
| **Shareholders' Equity:** | | |
| Preferred stock, $1 par value—authorized 500,000 shares; outstanding 74,168 shares Series A (Note 4) | $ 74,168 | |
| Common stock, $1 par value—authorized 1,500,000 shares; outstanding 1,050,996 shares (Notes 1, 2, 3, and 4) | 1,050,996 | |
| Additional paid-in capital | 7,125,295 | |
| Retained earnings (Notes 2 and 4) | 5,421,741 | 13,672,200 |
| | | $35,039,515 |

## TELEDYNE, INC. AND SUBSIDIARIES

### CONSOLIDATED STATEMENT OF INCOME

For the Year Ended October 31, 1964

| | |
|---|---|
| **Sales** | $38,187,127 |
| **Cost of Sales** | 28,847,557 |
| Gross profit | $ 9,339,570 |
| **Selling and Administrative Expenses (Note 1)** | 5,620,693 |
| Profit from operations | $ 3,718,877 |
| **Interest Expense** | 739,489 |
| Net income before Federal income taxes | $ 2,979,388 |
| **Provision for Federal Income Taxes (Note 5)** | 1,538,000 |
| Net income (excluding reduction in Federal income taxes) | $ 1,441,388 |
| **Reduction in Federal Income Taxes** due to carryforward of losses incurred by purchased companies prior to dates of acquisition (Note 5) | 1,104,000 |
| Net income including reduction in Federal income taxes | $ 2,545,388 |

Costs and expenses for the year include provisions of $757,000 for depreciation and amortization of property and equipment.

### CONSOLIDATED STATEMENT OF RETAINED EARNINGS

For the Year Ended October 31, 1964

| | |
|---|---|
| **Balance, October 31, 1963:** | |
| Previously reported | $2,602,283 |
| Retained earnings of pooled companies (Note 1) | 745,428 |
| | $3,347,711 |
| **Add or (Deduct):** | |
| Net income including reduction in Federal income taxes | 2,545,388 |
| Adjustment of provision for Federal income taxes in prior years | (332,000) |
| Cash dividends paid by pooled company prior to date of pooling | (54,409) |
| Cash dividends paid on preferred stock | (71,944) |
| Net income of partnership withdrawn by partners prior to pooling | (13,005) |
| **Balance, October 31, 1964 (Note 2)** | $5,421,741 |

*The accompanying notes are an integral part of these statements.*

## CONSOLIDATED STATEMENT OF ADDITIONAL PAID-IN CAPITAL

For the Year Ended October 31, 1964

| | |
|---|---|
| **Balance, October 31, 1963** | $5,084,386 |
| **Add:** | |
| Difference between fair value and par value of common stock issued in connection with the acquisition of a business (Note 1) | 1,169,522 |
| Difference between par value of common stock issued in connection with poolings of interests and capital stock and additional paid-in capital of pooled companies, less costs incurred of approximately $241,000 (Note 1) | 730,240 |
| Difference between sales price and par value of common stock sold under stock option plan (Note 3) | 141,147 |
| **Balance, October 31, 1964** | $7,125,295 |

*The accompanying notes are an integral part of this statement.*

ARTHUR ANDERSEN & CO.

To the Stockholders and Board of Directors,

TELEDYNE, INC.:

We have examined the consolidated balance sheet of TELEDYNE, INC. (a Delaware corporation) and subsidiaries as of October 31, 1964, and the related statements of income, additional paid-in capital, and retained earnings for the year then ended. Our examination was 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, 1964, and the results of their operations for the year then ended, in conformity with generally accepted accounting principles applied on a basis consistent with that of the preceding year.

ARTHUR ANDERSEN & CO.

Los Angeles, California,
January 22, 1965.

## NOTES TO CONSOLIDATED FINANCIAL STATEMENTS

October 31, 1964

**NOTE 1. Mergers and acquisitions—**

During the year ended October 31, 1964, the Company issued common stock in exchange for all the outstanding capital stock or net assets of several companies. These transactions have been accounted for as poolings of interests, and the results of operations of these companies for the year ended October 31, 1964, have been included in the consolidated statement of income. Had the 1963 results of operations of companies pooled in 1964 been included in the Company's 1963 consolidated statement of income, previously reported net income of $1,280,296 including Federal income tax reduction would have been approximately $1,400,000.

During the year, the Company also purchased the net assets of a business, and the results of its operations since the date of acquisition are included in the consolidated statement of income.

Subsequent to October 31, 1964, the Company issued 186,359 shares of common stock for the purchase of net assets of Servomechanisms, Inc. and United ElectroDynamics, Inc. The accounts of these companies have not been included in the accompanying consolidated financial statements. The results of their operations will be consolidated only for periods subsequent to dates of acquisition.

The minority interest ($23,670) in the net income of a consolidated subsidiary for the year ended October 31, 1964, has been included in selling and administrative expenses in the consolidated statement of income.

*Continued*

**NOTE 2. Long-term and subordinated debt—**

LONG-TERM DEBT—

At October 31, 1964, long-term debt consisted of the following:

| | |
|---|---|
| 5¾% bank note payable in installments to 1969, secured by proceeds of defense production contracts (a) | $7,000,000 |
| 5% trust deed note payable in installments to 1967, secured by land and buildings (b) | 1,350,000 |
| Other (including $274,689 secured by land and buildings) | 508,515 |
| | $8,858,515 |
| Less—Current portion | 1,427,036 |
| | $7,431,479 |

(a) Receivables of $4,725,000 at October 31, 1964, were assigned to secure this note and other indebtedness.

(b) At October 31, 1963, the long-term portion of this note was classified as a deduction from the property securing the loan.

SUBORDINATED DEBT—

At October 31, 1964, subordinated debt consisted of the following:

| | |
|---|---|
| 5¾% Convertible Subordinated Notes, payable in annual installments of $83,333 from May 1, 1966 to 1977 with the balance due May 1, 1978. These notes are redeemable at the Company's option from May 1, 1966, at 105¾% of the face amount, to 1978, at face amount, and convertible at the holders' option into shares of common stock at the rate of $27.50 per share until May 1, 1968, and $35.00 thereafter (subject to dilution adjustments) | $2,000,000 |
| 6½% Convertible Subordinated Debentures, payable in annual installments of $100,000 starting February 14, 1966, redeemable at the Company's option at face amount and convertible at the holders' option at any time prior to maturity or earlier redemption into shares of common stock at the rate of $27.50 per share (subject to dilution adjustments) | 500,000 |
| | $2,500,000 |

The Company has reserved 90,910 shares of its common stock for issuance upon conversion of the subordinated debt.

Under the terms of loan agreements covering certain of the foregoing indebtedness, the Company has agreed to maintain minimum amounts of working capital and consolidated net worth, plus subordinated debt, and not to pay any dividends or redeem (except as specifically permitted) any of its capital stock unless the total of such dividends and redemption does not reduce consolidated tangible net worth below $2,800,000 or exceed 50 per cent of consolidated net earnings since October 31, 1962. These requirements were complied with at October 31, 1964, and at that date retained earnings of approximately $1,650,000 were not restricted under terms of the agreements. The loan agreements also provide certain restrictions with respect to borrowings, purchase and sale of assets or capital stock, and require that the company utilize proceeds from any subsequent sales of long-term debentures or capital stock to liquidate the 5¾% note payable to bank.

**NOTE 3. Stock options—**

At October 31, 1964, 130,010 shares of common stock were reserved for issuance to key employees under a restricted stock option plan. Options to purchase 61,006 of these shares (of which 27,755 were exercisable) at prices from $1 to $48 per share were outstanding at that date.

**NOTE 4. Preferred stock—**

The outstanding Series A preferred shares are entitled to voting rights, cumulative annual dividends at the rate of $1 per share, and preference of $30 per share ($2,225,040 in total) in event of liquidation. They are redeemable in whole, but not in part, at $33.33 per share at the Company's option at any time subsequent to June 1, 1965, and are convertible, at the holders' option into common stock on a share for share basis at any time prior to five days before the date fixed by the Company for redemption. The Company has reserved 74,168 shares of its common stock for issuance upon conversion of the preferred stock. No cash dividends may be paid on common stock until all accumulated dividends on preferred stock are paid or provided for.

**NOTE 5. Federal income taxes—**

Consolidated Federal income tax returns of Teledyne, Inc. have not been examined by the Internal Revenue Service although such returns for the years ended October 31, 1961 and 1962, are currently under review. In the opinion of Company counsel, the operating loss carryforwards (substantially all of which apply to losses incurred by consolidated subsidiaries prior to dates of acquisition) are available to be utilized to reduce taxable income earned by consolidated companies for periods subsequent to acquisition.

**NOTE 6. Commitments and contingent liabilities—**

A substantial portion of the facilities and equipment used by the Company (including equipment with a net book value of approximately $882,000 which was sold and leased back during the year) is held under long-term lease agreements. The excess of the cash proceeds over the book value of equipment sold and leased back has been classified as deferred income in the accompanying balance sheet and is being amortized as a reduction of lease rental costs.

Future rentals of approximately $9,900,000 (including approximately $2,100,000 payable in the year ending October 31, 1965) are payable under terms of lease agreements which expire at various dates to 1983.

TELEDYNE, INC. 12525 SOUTH DAPHNE AVENUE, HAWTHORNE, CALIFORNIA