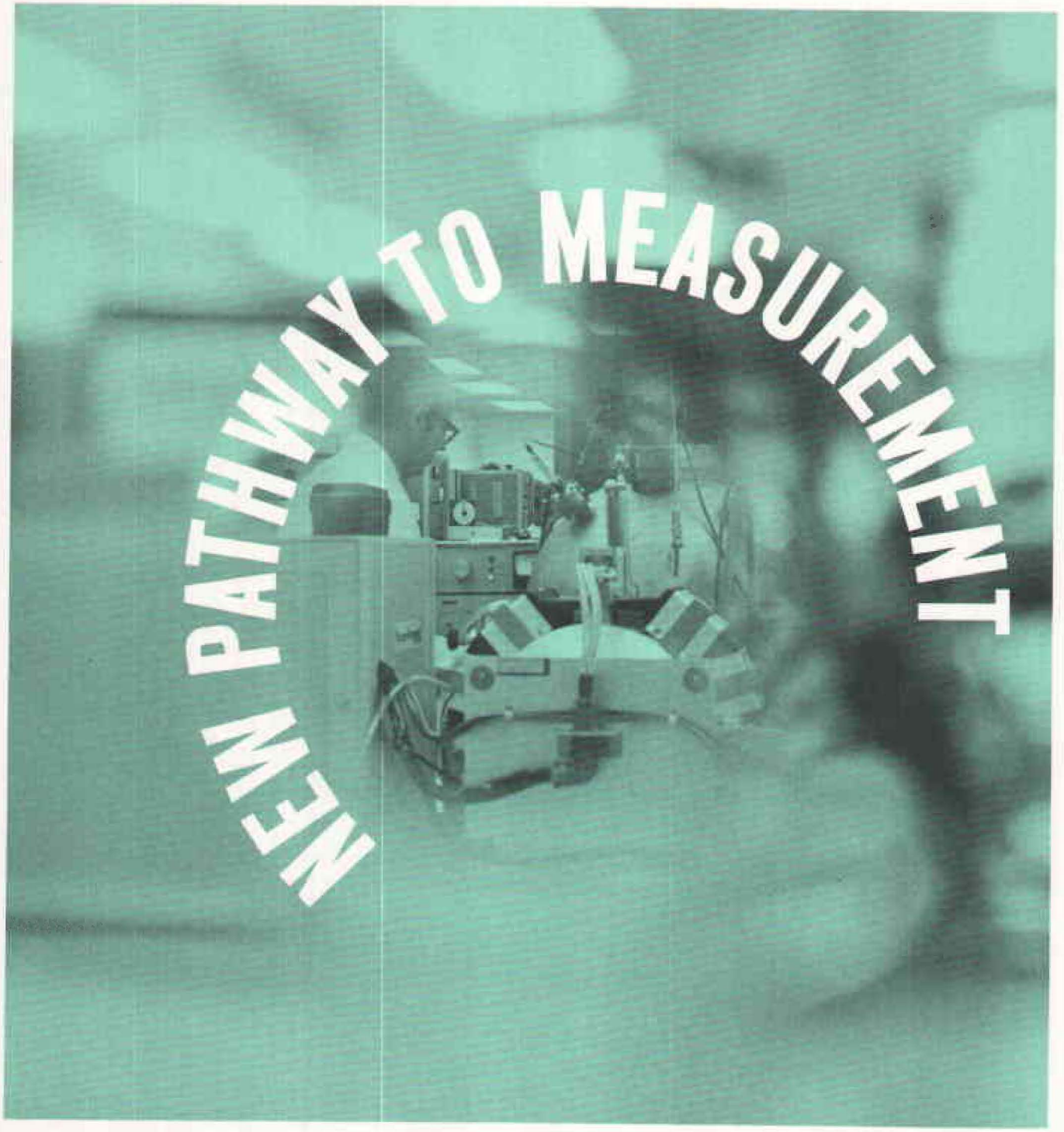


(pages 10–13)

Measure

For the men and women of Hewlett-Packard/MAY 1972

Readying the first of the *next* 4,000 computer units to be produced at Cupertino facility are, from left, Russ Scadina and Tony Cisneros; at rear is Willie Austin, test line supervisor.

HP's minicomputer has come a long way in a few years...

☐ Back in 1966 a group of men huddled around the end of a short production line at 395 Page Mill Road. Intently, they tested and retested the machine sitting on the rollers. A lot of people in white shirts came to look it over. They also tried their hand at it, asked many questions, and talked about its future.

The object of such unusual interest was HP's first production-run minicomputer, a Model 2116A. Now, early this month, a very sophisticated descendant—a Model 2100A—was scheduled to become the 4,000th minicomputer shipped from HP's Bay Area facilities.

The scene has shifted a bit, of course, from Page Mill Road in Palo Alto to the Cupertino plant a dozen miles to the south. But some faces are the same. Willie Austin, production test supervisor, for example, was around during the creation of Number 1.

And what differences has Willie noted between now and then? "Our computers are much smaller now yet a lot more powerful and give more performance per dollar of cost. And we'll have the next 4,000 units off the line in far less time than the first." ☐

(See pages 7–9 for a report and graphic impression of a very promising HP computer market.)

the

4,000th

Roundup at Rancho Bernardo

☐ Who are those guys out there poking sticks into the scrub brush? Why is that rattlesnake getting excited? Hey, who fired that rocket? Did that fellow say they'd released a coyote this morning? Good heavens, what's that little mouse doing in a parachute?

OK, San Diego Division, *what's going on down there?*

What's going on is the "lunch crunch bunch," a trio of machine shoppers at the Rancho Bernardo plant who believe that lunch time can be a bore. The three machinists—Dave Kelly, Bob Wigand and George Lyons—have apparently dedicated themselves to the abolition of noontime boredom. Hence the coyotes, the rockets and the rattlers.

They have fun, no doubt about it. But it really goes beyond that. In fact, it turns out that Kelly and Co. are wildlife conservationists at the grassroots level. Those snakes, coyotes, owls and bobcats they catch on the sprawling Rancho Bernardo range, just beyond the boundaries of the HP plant site, are never harmed. Instead they are measured, marked or banded, recorded for science and then set free.

Any traps used are visited religiously three times a day, or deactivated, so that captives spend as little time in them as possible. In addition, the traps are padded to prevent injury. In the case of snakes, professional equipment is employed in snaring and handling. No chances are taken, and no incidents have occurred.

In going about this business, the HP threesome works closely with a San Diego State College biologist, Dr. Harold Coulombe, and a wildlife study program sponsored by the California Fish and Game Department. The three of them began taking an interest in wildlife as youngsters growing up in the San Diego area. Kelly's involvement really firmed up when he took on the raising of some wolf cubs for the San Diego Zoo.

"The idea," he says, "was to study them with the goal of restocking them in certain wilderness areas where they have been just about wiped out. The timber wolf is the most maligned animal in history. Almost everything written about them is a lie or a myth—the Red Riding Hood story. The ones we worked with are actually very friendly and gentle—and highly intelligent. But they've been hunted so hard that

Success! Roger Dodger became very meek and submissive on capture, perhaps figuring he was a goner. Even when released later he couldn't seem to get it through his head that he was free to go.

Checking concealed trap in the wilds of Rancho Bernardo are Dave Kelly, Bob Wigand and George Lyons as part of a project to study the ranging habits of coyotes. Great care and cunning are required. Says Kelly, "They're so smart. If there were two animals left in the world—a coyote and an elephant—the coyote would figure out some way to eat that elephant."

Meanwhile, he was measured thoroughly, checked for disease, and treated for any cuts or bruises that may have been caused by fighting the trap. Jaws of traps are filed flat and covered with special rubber hose to hold coyotes without cutting off all circulation (if a leg goes numb, coyotes have been know to chew it off to get away).

What's this around my neck? Roger Dodger doesn't know what to do about telemetry transmitter collar—or his new-given freedom. But he soon did his disappearing act and is now back in his old haunts. But to future generations of coyotes—and conservationists—he may well become a hero.

Team of San Diego State College biologists track Roger Dodger through radio beeps his collar emits. Study shows that Roger doesn't hunt at night, doesn't run with a pack, and moves over a wide range of country. Aim of project is to develop programs of predator management as opposed to predator control through extermination.

(continued)

roundup

very few survive at large in the U.S.—perhaps a few dozen in the wilds of Minnesota and Michigan.

"One researcher tracked down every available report of wolf attacks on humans and found that only two had any truth to them, and he learned these two animals had rabies."

Coyotes came into the picture when the researchers wanted to test the feasibility of using a telemetry collar in their range studies. Most notably, the HP team captured Roger Dodger, a wily coyote who now has a $250 telemetry collar around his neck permitting radio tracking by the San Diego scientists.

As Bob Wigand recalls, "It was discovered that very little documentation existed on the coyote. But he was blamed for everything that got killed—sheep, chickens, cattle—and for spreading rabies. Well, our project eventually showed this just wasn't true, and it helped put an end to the killing of coyotes in San Diego County by government hunters. They had been spending more than $90,000 a year supporting four hunters whose role was to protect ranchers and farmers against livestock losses estimated at less than $30,000 a year.

"Now maybe there's a chance the coyote will survive and that we can learn to tolerate and appreciate him—and the other species of wildlife as well." □

All due respect is given to three-foot rattlesnake captured on Rancho Bernardo. Dave Kelly and Bob Wigand later reported they had marked one of the rattles of the snake by injecting HP recording ink, in order to study its migratory habits. They hope to recapture him next spring and learn how well their coloring can survive the snake's annual shedding of skin.

Artic wolf extends trusting paw to Dave Kelly. Dave and Bob Wigand participated in raising wolves on behalf of San Diego Zoo. Wolf cubs were brought up in their homes and turned out to be very gentle and intelligent animals.

But at times the machine shoppers feel a need to express themselves in more carefree fashion. Such is the case here where a rocket lofts an encapsulated mouse one mile in the air and then softly ejects him for a landing via parachute. Who said lunchtimes had to be dull?

Dick Phillips of Data Systems uses timesharing to administer one of the two Bay Area HP timeshare systems.

Preaching what we practice

☐ No one likes to be thought of as a guinea pig. But that's not a bad description of how HP views itself in the computer time-sharing business. Although the company developed its versions of time-sharing largely to meet market needs, it tested systems in its own operations. That makes them tried and tested in one of the most demanding environments.

But just what is time sharing? The montage overpage is an attempt to dramatize several important aspects of one of HP's answers, an HP 2000 Time-Shared System. The equipment consists of two computers, a disc drive and magnetic tape memory. Plugged into this central system via phone lines are dozens of input/output terminals. Thirty-two users can, and do, perform distinctly different tasks simultaneously.

The great variety of uses is suggested in the outlines: order processing, sales analysis, text editing, artwork generation, financial reporting, production scheduling, engineering and software development, classroom instruction, management training, records keeping, and—on and on and on . . .

The photos were all taken within HP organizations in the San Francisco Peninsula area. Two HP 2000C systems are presently in use here, one at the Stanford plant and the other at Cupertino, where it was developed. More than 400 users keep these systems busy from morning to night, seven days a week. They use a variety of terminals ranging from standard tele-printers to portables, plotters, CRT displays, and combinations of these.

Users can operate these wherever a phone line is handy. Because of this, time-share terminals are likely to be found almost anywhere—office areas, labs, classrooms, production floors, and even in the home. Imagine, to do your homework properly you now have to fit a computer terminal in your briefcase!

But even more startling is how far and fast HP has come in the use of computer devices. Today, company users of time-sharing, computed-based systems, computer desktop calculators, and central batch processing equipment approaches one out of every ten people. Ten years ago not one in a hundred had seen, let alone operated, a computer.

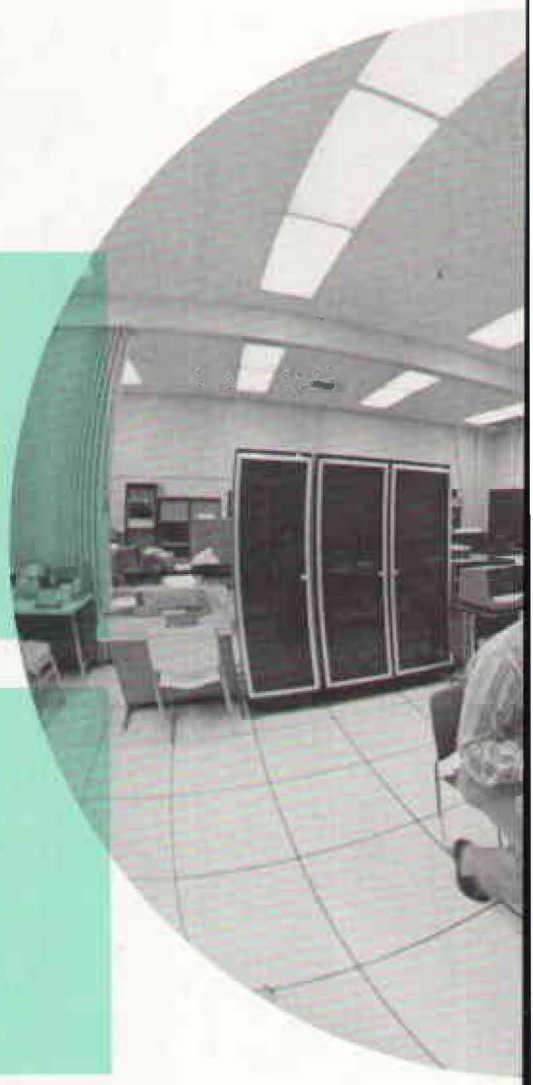
(continued)

ARTWORK GENERATION
(Leslie Montfort, Microcircuits)

MASTER SCHEDULING
(Walter Kilik, Microcircuits)

SHIPMENTS REPORTING
(Bev Vale, Corp. Finance)

SALES ANALYSIS
(Roger Costa, Santa Clara)



The 32 squares on these pages represent the number of computer terminals that can operate simultaneously via phone lines off of one HP central timeshare system (seen in circle). Hundreds of HP users keep two such systems busy night and day.

CASH FLOW FORECASTING
(Glenne Young, Corp. Finance)

COST EVALUATION
(Dave Hedge, Santa Clara)

PROGRAM DEVELOPMENT
(Rich Nelsen, Corp. Systems)

EQUIPMENT RENTAL ANALYSIS
(Ed Smith, Data Products Group)

TARGETING
(Sue Connerley, Corp. Accounting)

CIRCUIT DESIGN
(Bob Tillman, Microwave)

TRANSFORMER DESIGN
(Mary Newell, Mfg. Division)

TEXT EDITING
(Jim Kinney, Corp. Communications)

PLOTTING FINANCIAL DATA
(Doreen Morris, Corporate)

IC LAYOUT
(Jim Nolt, Microcircuits)

MANAGEMENT REPORTING
(Bill Riffle, Corp. Finance)

Sharp new focus

☐ When you talk to someone in the field of optics these days, be prepared to listen to an enthusiast, because optical science is in the throes of a crackling revolution brought on by optoelectronics, lasers and holography. The latter two, for example, are Nobel Prize-winning developments in physics that are helping to push the frontiers of optics light years beyond its traditional role as an extension of the human eye. No longer does it seem to be just a servant of other sciences. Now it has its own unique contributions to make—including significant contributions to our own field of measurement.

The company's commitment to optics technology is a fast-growing one. This can be seen in such recent product ventures as HPA's light-emitting diodes displays that have taken over the well-remembered Nixie tubes; in Loveland's distance-measuring instrument that has taken so much of the toil and tedium from field surveying; and Santa Clara's laser interferometer system that has brought a new order of precision to the measurement of minute distances.

An important contribution to the company's success in optics has come from the Precision Components Manufacturing team at Santa Clara Division. Originally known as the Crystal Lab, it still is the company's center for the production of quartz crystals needed for quartz oscillators and thermometers. Now it's also in the business of producing optical devices and glass components used in the newer optics-based instruments.

The Precision Components team feels its professional and production capabilities could be of service to other HP organizations which may be doing or seeking optical work outside the company. That's one reason for looking over the following photographs. Another is that the people and processes involved are interesting in their own right:

Laser mirrors to be used in an HP laser interferometer system are polished to high clarity in the optics polishing room. Here, Bob Karnatz lubricates the process. Previously, other departments in Precision Components had cut and shaped the raw optical materials—glass or crystal—using skills and techniques developed in working with quartz crystal over the past decade. Buck Austin, a veteran in the field, is production engineer.

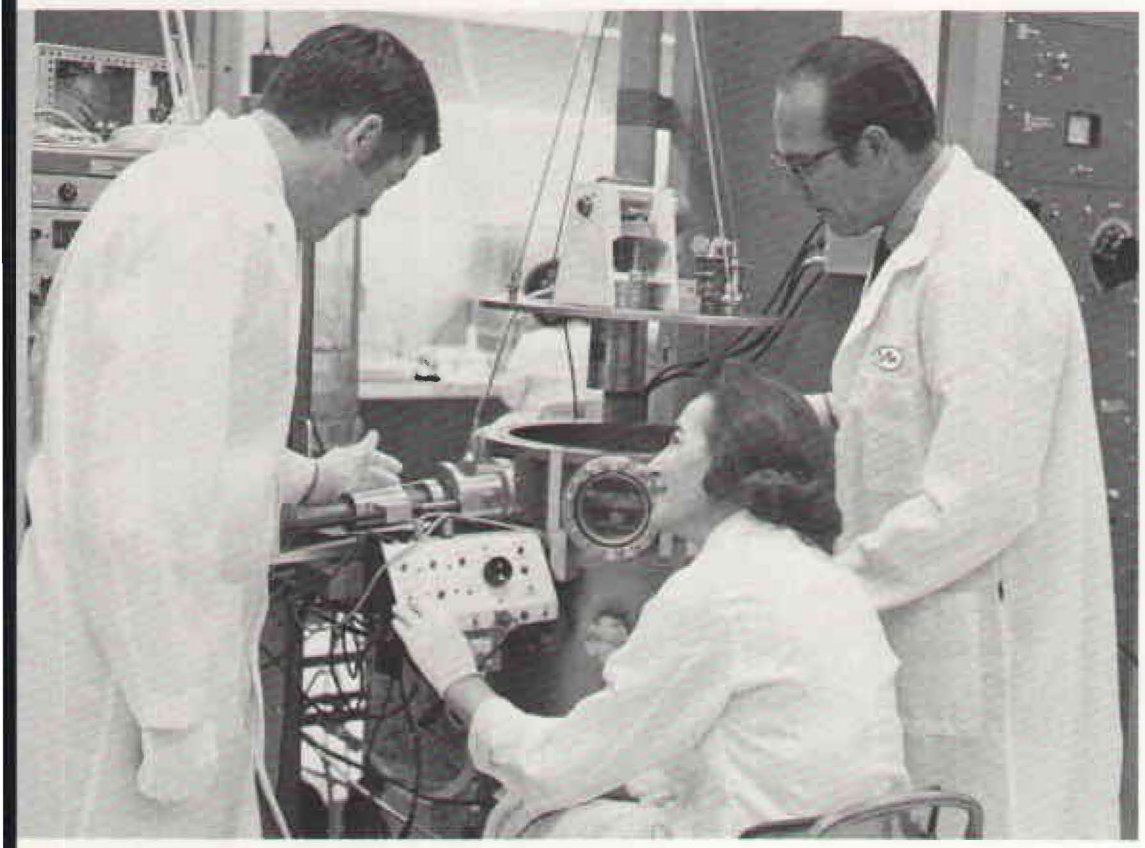
(continued)

on optics

X-rays are being used here by Thelma Apodaca to determine the exact "orientation" of raw quartz crystals, that is the angle at which the atomic planes were built up during crystal formation. The quartz can then be cut accordingly. The crystals being tested here are intended for HP's frequency standards that employ coated quartz crystal wafers as stable resonators. The ring on Thelma's right index finger is to detect possible X-ray leakage.

focus on optics

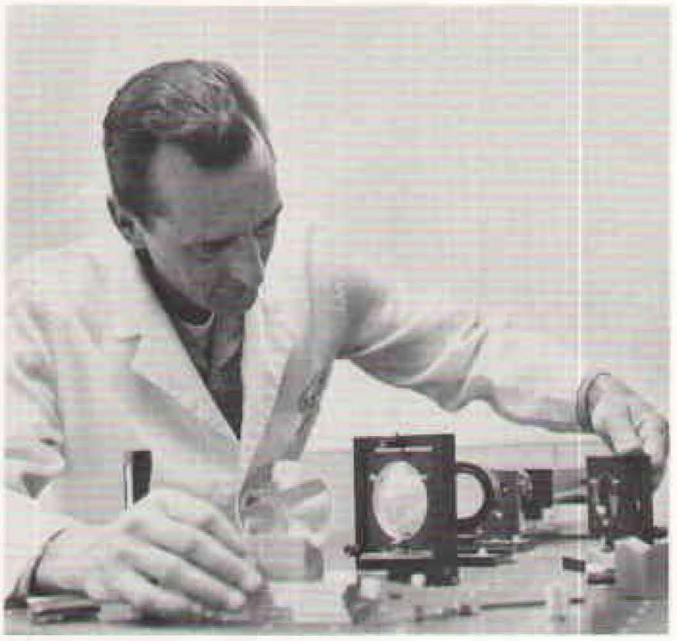
What looks like a deep-sea diving chamber is actually an optical coating system. Major parts of it were developed by Jim Collin, manager of Precision Components, in order to meet HP's special coating needs. Monitoring the vacuum process is Ben Quesada. Coatings play vital role in optics such as creating polarizing or non-polarizing action.



Components team checks operation of the mechanical arm that manipulates crystals during coating process in vacuum chamber. From left are Dale Hansen, who heads optics area, Elfriede Gmelin of the crystal department, and Jim Collin who manages the 45-man Precision Components facility. Dale came to HP about a year ago as a recognized optics specialist to help HP produce its own optical products. According to Jim, the optics shop is now a first-class outfit producing products tailored to HP at lower cost than obtainable outside.

In Q. A. metrology area, Ed Knezivech uses interferometer technique to determine flatness of surface of cube corner. Every optics product is similarly checked prior to final assembly and shipment.

Holding what appears to be an Olympic torch is Jerry Black who heads the glass-blowing department. Actually the glass item is a laser envelope produced at Santa Clara for the HP laser interferometer (the flame is safely in the background). The department produces a variety of glass products including very sophisticated work for HP rubidium standards.



HP's strong move into the optics field is suggested by this view of the optical final assembly area. In the foreground are beam splitters, "magic cubes" and "top hats"; a so-called "internal interferometer" is being assembled by Dan Connell. All are important optical components in the HP laser interferometer system.

From the president's desk

As our company has grown over the years, the product line has become more complex and we have an intricate and often overlapping set of customers. I thought it might be of some interest and value if I tried to sort out our products, our markets, and our customers, and because there is quite a bit of ground to cover, my letter will run longer than usual. However, I hope you will find it informative and useful.

First, and foremost, we are in the business of measuring something—basically an electrical quantity. We measure voltage, frequency, resistance, and current. We supply signals to check receivers and we make broadband receivers to measure signal strengths. We make pulse generators and oscilloscopes to view them with. We also make instruments to plot how one function varies with respect to a second, and others to plot how a signal varies with time. Another of our product lines is that of power supplies—both large and small.

As our customer needs become more complex, we put various combinations of all these together to make instrument systems. Often the complexity of these systems requires that they be controlled by a computer (which, as you know, we also make). All of these products, with the exception of the computer, are designed and manufactured by the Electronic Products Group. In all, these classes of products represent about two-thirds of our total business. They are produced not only in seven or eight HP plants in the U.S., but also at HP plants in Scotland, Germany, and Japan.

Computational equipment is another important area for us. Up until recently we simply made a mini-computer, but with the announcement of the Model 3000 we have moved up to a medium-sized unit that can stand alone, or can be used to control a number of mini-computers. It is a very flexible and modern unit. We are in the desk-top calculator business with two basic models—one using algebraic notation and the other a more conventional language. In addition, we are now in the scientific pocket-sized calculator field, one in which as of yet we have no competition.

Thus, we now probably have the broadest spectrum of scientific computational products of any company in the U.S. ranging from devices from under $400 to units in the range of $100- to $300-thousand, depending on the complexity of the system. To support this computational hardware, we make a number of important peripheral devices ranging from tape drives to disc memories to card readers and plotters.

We also have quite a few people actively involved in the field of software, the instructional sets that allow a computer to perform its desired function.

A special use of such software is in the field of computer-aided education. Early experiments with this application were carried on in East Palo Alto where we donated a system to the Ravenswood School District. This program was so successful that it was a significant factor in the recent sale of several major systems to the Los Angeles City Unified School District.

All of these computational products are the responsibility of the Data Products Group. They are manufactured in at least four of our plants in the U.S. as well as the plants in Scotland, Germany, Japan, and the recently opened facility in Grenoble, France. In total, this product line accounts for some 15 to 20 percent of our business.

Two other important areas for us are the application of electronics to medical instrumentation, and instrumentation for chemical analysis. Medical electronics is a vital and growing field. We are primarily in the diagnostic part of the business with particular emphasis on measurement of the heart and its function. Chances are that if you had an electrocardiogram lately, it was taken on an HP instrument. We also make equipment to monitor the critically ill, to help a surgeon in open heart surgery, and to monitor a person recovering from a heart attack. The HP fetal heart monitor is also a valuable instrument for the medical profession, and I have heard from a number of HP people whose wives have benefitted from the use of this monitor at the time of childbirth.

With the recent acquisition of a small company, Vertek, we will be able to make measurements on the functioning of the lungs. With the increasing incidence of lung cancer and emphysema, this is an important new area of health monitoring and is closely linked to our work with the heart.

Medical electronic equipment also can be coupled with a computer to assist in some measurements. As an example, we can now feed the output of an electrocardiograph (by phone line if necessary) into a computer and in a matter of seconds obtain an analysis of the cardiogram that can materially help the doctor in his diagnosis. The central responsibility for all of these medical products is assigned to the Medical Electronics Division in Waltham, Massachusetts. HP medical products are also made in Germany and Scotland.

Our principal product in the field of chemical analysis is the gas chromatograph. This is a fancy name for an instrument that can sort out the various components of a chemical mixture, and thus tell something about the material under test. These instruments are used on a routine basis in many chemical labs, but are also important in petroleum refining, measurement of residual pesticides, and more recently in drug-abuse work.

Within the last year we have perfected a very sophisticated device called ESCA (Electron Spectroscopy for Chemical Analysis). This is a very important new tool that will

allow chemists to learn a great deal about what happens in the first few millionths of an inch on the surface of a material. This and several equally complicated analytical tools are made in Palo Alto, but the center of HP's analytical responsibility lies with the Avondale Division in Pennsylvania.

Finally, there are a few highly specialized products that do not fit readily into any of the above categories. One is a device that will allow a surveyor to measure distance up to two miles, with an accuracy of a tenth of a foot, by merely bouncing a light beam off a mirror. For shorter distances, this instrument can provide an accuracy of a hundredth of a foot.

At the other extreme of distance measurement, we make a laser system that can routinely measure to one millionth of an inch.

We also produce precision clocks that are so accurate they were recently used in an experiment to prove a theory postulated by Einstein that, if a person flew fast enough, the scale of time would be changed.

Common to many of these HP products are a variety of sophisticated and precision components and parts of our own design and manufacture. Some of these are almost exclusively for our own use, while others are produced almost entirely for outside customers. Such devices range from very high-performance microwave transistors, to light-emitting displays—from transducers for measurement of displacement and velocity, to super-accurate digital thermometers.

Thus you can see that our product line places us clearly in the measurement business, including the capability of computation. It is a very broad line that touches almost every facet of our economy.

In describing this broad range of products, I have in a sense also described the markets in which we operate. But who are our customers? I will try and break the question down in two ways. First, on a domestic-international basis.

About 40 percent of all our products are sold in countries other than the U.S. Of this amount, about one-quarter are manufactured abroad and three-quarters in the U.S. Many of the components and fabricated parts that appear in HP equipment manufactured abroad are actually produced at HP plants in the U.S. Thus is would be safe to say that one of every three HP jobs in the U.S. is dependent on our overseas markets.

This is an important number to remember at a time when some self-serving groups in the U.S. are trying to put shackles on international trade. I can assure you that if the U.S. takes unilateral action to restrict this international trade, reciprocal action will be taken against U.S. products. This will not only jeopardize jobs within the U.S. but will be a staggering blow to the already critical balance-of-payments problem that faces our country. The importance of well thought out, realistic import-export regulations cannot be over-emphasized.

Now, let me define our customers another way. I am often asked about the extent of our business with the U.S. government. First, some figures as to the size of our government business. Of total orders received by the company in fiscal 1971 ($397.4), 25.4 percent, or about $101 million, is traceable to U.S. government spending. Of this amount, orders received directly from government agencies totaled $53 million and orders from private firms indicating government funding amounted to $48 million.

U.S. government-related business, as a percentage of our total business, has been declining in the past several years. In 1967, for example, the government share was nearly 40 percent compared to last year's 25 percent. It is interesting to note that over the same period our international business has risen from about 25 percent to 40 percent.

In analyzing this 25 percent of our business, about 10 percentage points is derived from direct sales to the Department of Defense, about 9 percentage points from DOD subcontractors, and about 6 percentage points from non-defense components of the government. In all three of these categories the vast bulk of these sales is represented by purchases of standard HP catalog equipment.

In considering our government business, it is useful to recall a major management decision that we made in the early days of the company. That decision was that our interests and capabilities were in the field of electronic test and measurement and that we should, therefore, design and build test and measuring instruments that were general-purpose in nature and available to a broad range of customers. If these instruments were useful to the government, all well and good. But our goal has never been to design or produce any product exclusively for government use. In general, government contract work tends to be a feast or famine situation, and Dave and I decided that we did not want to run a "hire and fire" operation, but instead wanted to build a strong, loyal, stable work force.

As our product line indicates, throughout the years we have directed our energies toward developing high-technology, scientifically oriented instruments and systems to serve customers in both the public and private sectors. Almost every product we make is listed in our catalog, and government agencies, government contractors, and our 30,000 commercial customers all buy from this catalog. We will, if asked by a customer, provide modifications to instruments—such as painting cases special colors, or "ruggedizing" them to provide extra protection against temperature extremes or water exposure. But these modifications do not change the basic design or purpose of the instrument, and we perform these modifications for any of our customers.

What is true of our product line is also true of our research and development activities. In the past five years, for example, the government sponsored research we have conducted (all in the area of materials technology) has represented about one percent of our research and development efforts.

We have always worked well with the government, and consider it an important customer. Not only because of the supportive role our products play in national security efforts, but also because our instruments and systems increasingly are being used in the laboratories, field units, and offices of non-military government agencies—agencies which are performing many vital domestic services for the people of America.

Bill Hewlett

News in Brief

Automatic Measurement Division will be consolidated later this year in a new facility located in Sunnyvale, California. The new building and 20-acre site were acquired from Fairchild Camera and Instrument Corporation last month for $3.6 million. Shown here is the main entrance area of the 165,000-square-foot plant located some three miles from HP's Cupertino facility. Present plans are to move AMD operations to the Sunnyvale plant in late summer. Buildings formerly occupied by the division in Palo Alto will be used by other HP divisions in need of space.

Hewlett-Packard has acquired Vertek, Inc., a small medical electronics firm in Burlington, Vermont. Vertek manufactures automated pulmonary function test equipment and had sales of $600,000 last year. The Vermont company will be integrated into HP's medical instrumentation operations. Its equipment is used in routine clinical tests and mass screening programs for detection of pulmonary disease, such as lung cancer and emphysema. Other products are used in respiratory intensive care.

Measure

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