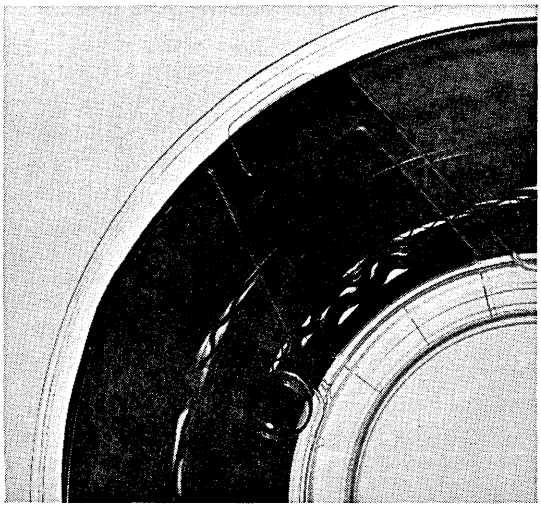
July, 1964

computers and automation

Quality Control by Computer in Car Assembling

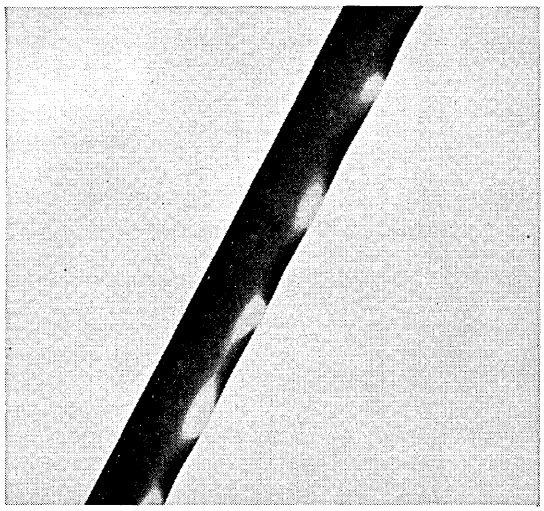
4 COMPLAINTS ABOUT COMPUTER TAPE

(And how Memorex solves them!)



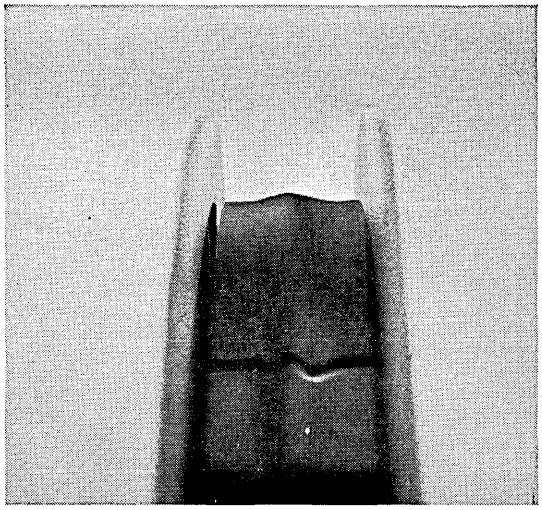
Complaint. Cinching during shipping, use or handling results when reel is wound under improper tension or exposed to temperature extremes.

Solution. Precision winding, special packing and careful shipping are examples of attention to detail that insure cinch-free delivery every time.



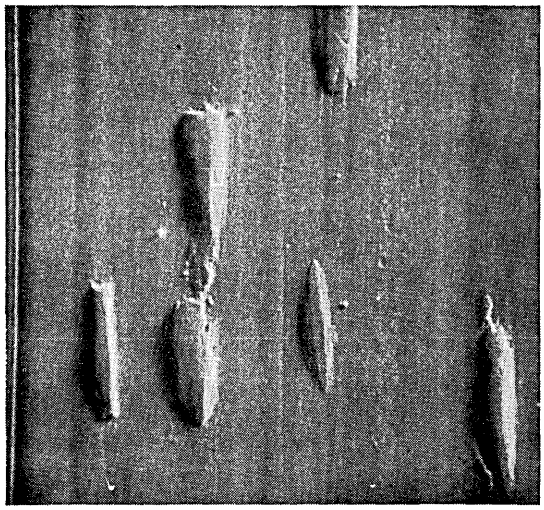
Complaint. Wavy edge caused by improper slitting.

Solution. Specially designed Memorex slitters and microscopic edge inspection of every reel prevent wavy edges. Fifty-one other quality control checks (many performed only by Memorex) guarantee every Memorex reel pre-test perfect.



Complaint. Semi-permanent ridging and loss of contact caused by microscopic scratches produced in manufacturing or use.

Solution. Memorex-designed manufacturing facilities include equipment unique to the industry which eliminates all fixed friction surfaces that potentially produce scratches.



Complaint. Dropout-causing clumps of redeposited coating (50X magnification).

Solution. Memorex has developed coating formulations and processing methods to achieve superior bond between coating and base, extra toughness, high flexibility, and a smoother surface. Result: Memorex tape is essentially redeposition-free.

Memorex tape is premium tape. No need to pre-check it. You can place Memorex computer tape directly in service—reel after reel.

Memorex certification means what it says: Memorex computer tape is error-free. Extra care, extra steps and scrupulous attention to every detail make it that way. We know the importance to you of having a tape you can depend on.

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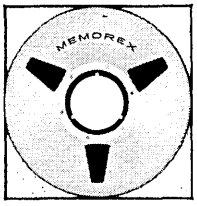

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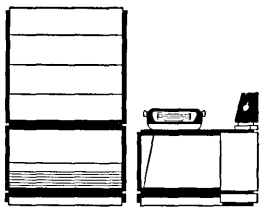
MEMOREX

PRECISION MAGNETIC TAPE

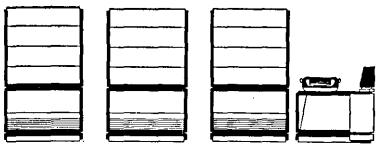
NEW COMPUTERS/NEW PRICES

At Spring Joint Computer Conference 3C introduced DDP-224, faster than the DDP-24. Multi-processor options were also announced. At the same time a Van-Mounted DDP was unveiled. Prices on the 24 were reduced May 1 to reflect production economies. With this advertisement, 3C announces the DDP-24A (modified I/O capabilities) and previews the DDP-24P. portable version of the 24, small enough to pass through submarine hatches. Extensive software and user services are basic to all models. Write for complete details.



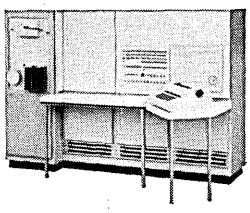
DDP-224
New 24-bit word DDP-224 features: 1.9 μsecs (0.8 access) memory cycle, and powerful command structure, 260,000 computations per second. Transfer rates up to 325,000 words per second. 3.8 μsecs add. 6.46 μsecs multiply. 17 μsecs divide. 4096-word memory expandable to 32,768. Typical add time with optional floating point hardware 7.6 μsecs (24-bit mantissa, 9-bit characteristic). Fully program compatible with DDP-24.

$ 96,000



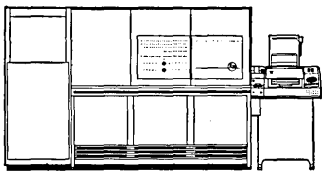
DDP-224 MULTI-PROCESSOR
Fully buffered control unit, access distribution unit and time multiplex unit make it possible to combine several DDP-224's into integrated large scale computer systems with functionally common and/or private memory, control arithmetic, system input/output facilities and peripherals.

Priced in multiples of the DDP-224.



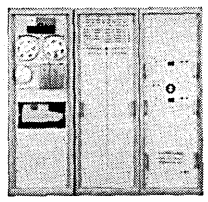
DDP-24
The DDP-24 general purpose computer with indirect addressing, hardware index register and I/O character buffer features parallel machine organization, powerful instruction repertoire, sign/magnitude arithmetic, and easy expansion. Up to 100,000 computations per second with 5 μsec access.

$ 79,000



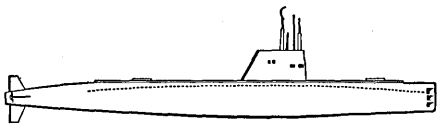
DDP-24A
A version of the standard DDP-24 which substitutes teletype paper tape and teleprinter I/O for the paper tape reader, punch, and I/O typewriter. Same mainframe features.

$ 69,000



DDP-24 VM
The Van Mounted DDP-24 is a rugged, compact, fully mobile general purpose digital computer; functionally identical to the 24 with paper tape reader, punch, and specially mounted I/O typewriter.

$ 87,000



DDP-24P
The Portable DDP-24 is being manufactured to offer full computer capability in an ultra-compact configuration to meet demands for shipboard, airborne and other applications requiring portable computer installations.

Pricing and proposals on RFQ.

3C DDP's have been delivered for real-time simulation, on-line data conversion, open-shop scientific and engineering computations, speech simulation and analysis, high energy physics research, ground support check-out, and integrated hybrid systems.

3C

3C DISTRICT SALES OFFICES: NEEDHAM, MASS.; SYRACUSE, N.Y.; COMMACK, L.I., N.Y.; LEVITTOWN, PA.; CLEVELAND, OHIO; SILVER SPRING, MD.; DES PLAINES, ILL.; ORLANDO, FLA.; ALBUQUERQUE, N.M.; PALO ALTO, CALIF.; LOS ANGELES, CALIF.; HOUSTON, TEX.; HUNTSVILLE, ALA.

COMPUTER CONTROL COMPANY, INC.

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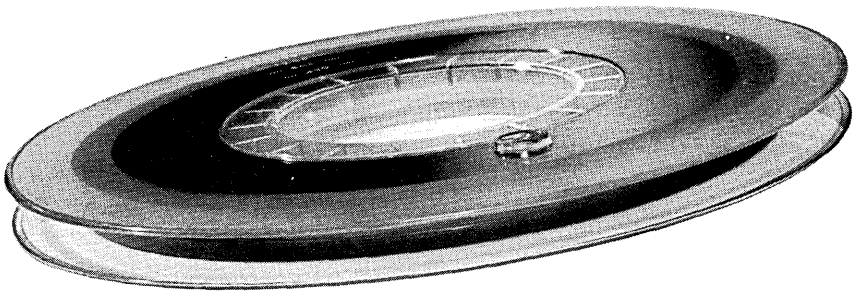
This is Computape reel #8741-11



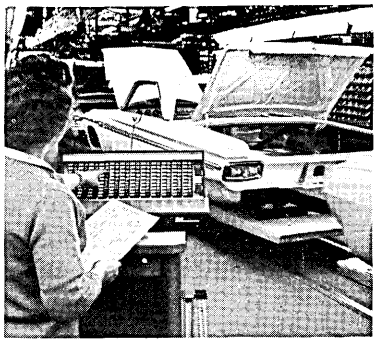
Case History: Reel #8741-11 was part of an order shipped to the Engineering Department of a leading University. There it was selected at random and subjected to a continuous wear test. In 268,853 passes no permanent dropouts were experienced.

Exceptional? Yes, outstanding . . . But another example of the longer wear qualities of Computape. Longer wear, less static build-up, greater reliability than ever before.

Test it yourself. Against any other tape.

COMPUTRON INC.
122 CALVARY STREET, WALTHAM, MASSACHUSETTS

Our front cover shows the application of a computer to real-time control of quality in cars as they are being assembled. For more details, see the story on page 37.



computers and automation

JULY, 1964 Vol. XIII, No. 7

computers and data processors: the design, applications, and implications of information processing systems.

In This Issue

In Every Issue

COMPUTERS AND AUTOMATION IS PUBLISHED MONTHLY AT 815 WASHINGTON ST., NEWTONVILLE 60, MASS., BY BERKELEY ENTERPRISES, INC. PRINTED IN U.S.A. SUBSCRIPTION RATES: UNITED STATES, $15.00 FOR 1 YEAR, $29.00 FOR 2 YEARS, INCLUDING THE JUNE DIRECTORY ISSUE; CANADA, ADD 50c A YEAR FOR POSTAGE; FOREIGN, ADD $1.50 A YEAR FOR POSTAGE. ADDRESS ALL EDITORIAL AND SUBSCRIPTION MAIL TO BERKELEY ENTERPRISES, INC., 815 WASHINGTON ST., NEWTONVILLE, MASS., 02160. SECOND CLASS POSTAGE PAID AT BOSTON, MASS.

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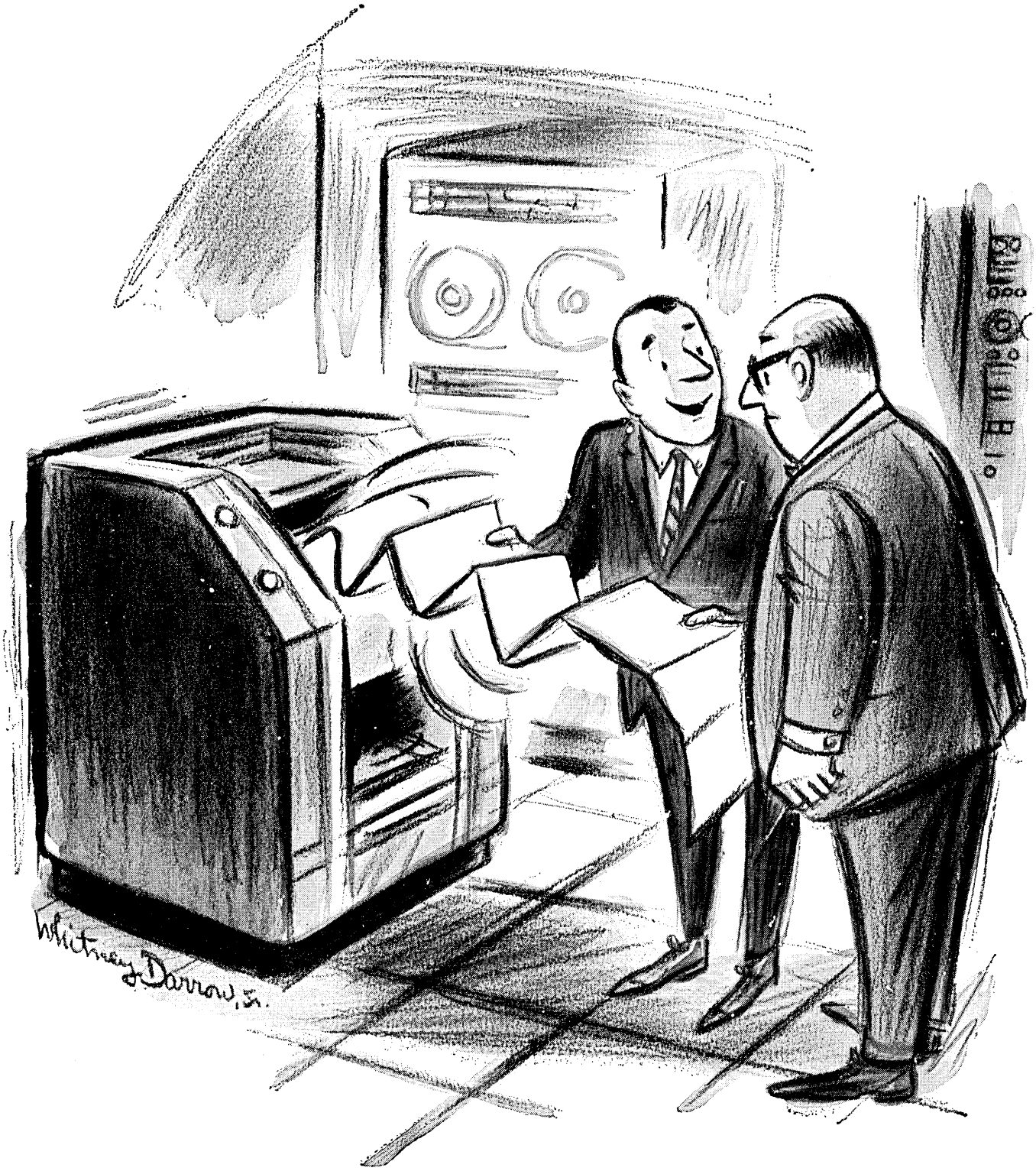

"It says it's exactly one year old and wants a new supply of tapes of MYLAR® for its birthday."

What a coincidence . . ."Mylar"* is having a birthday, too. It's ten years old. In the decade since it was first introduced as a base for recording tape, "Mylar" has consistently been the most used, most trusted tape base for all EDP applications. And why not? "Mylar" is strong (a tensile strength of 20,000 psi), stable (unaffected by temperature or humidity changes) and durable (can't dry out or become brittle with age). Celebrate the birthday of "Mylar" by giving yourself the gift of reliability. When reliability counts, count on "Mylar".

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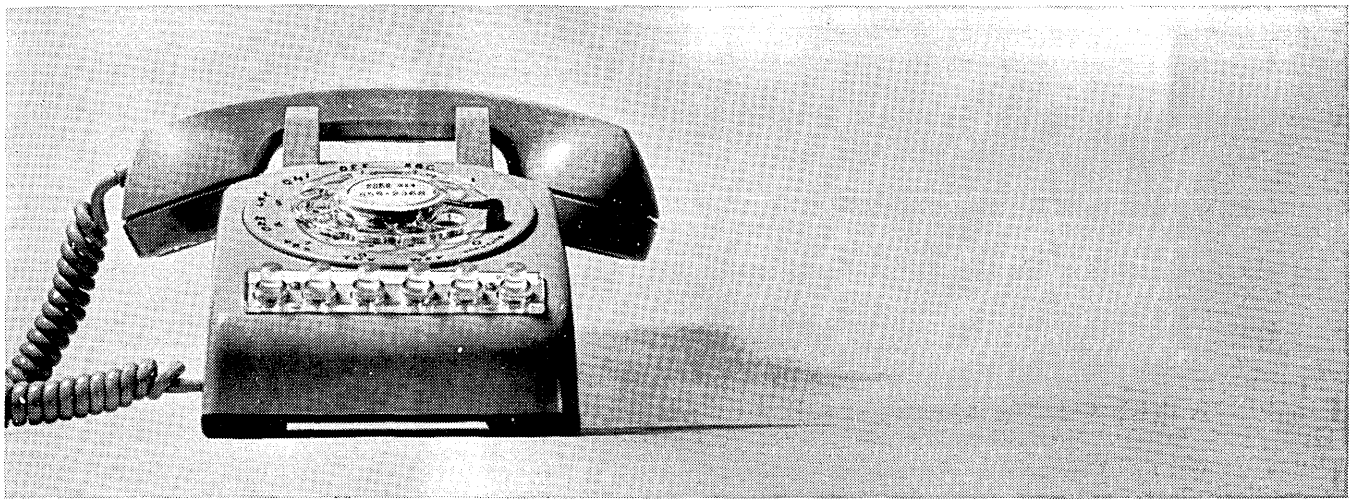
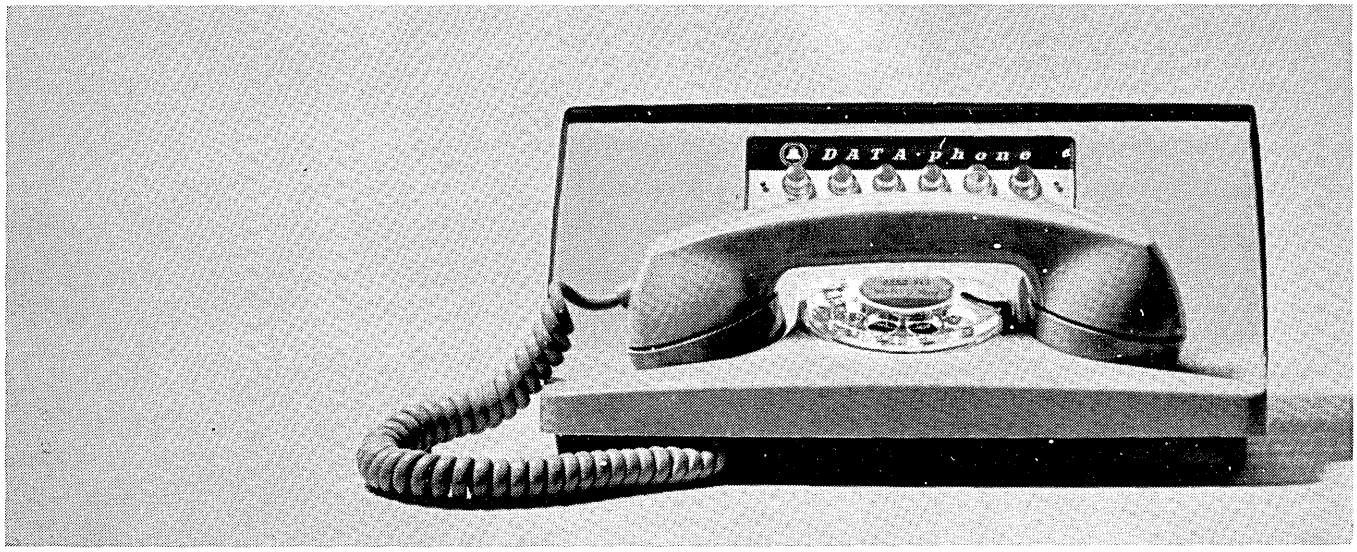


What's the connection?



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DATA-PHONE data sets are for *machine talk* . . . for transmitting inventories, payrolls, sales figures, receivables and other business data at speeds of 100 to 2700 words per minute.

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FORUM ON THE SOCIAL IMPLICATIONS OF COMPUTERS AND AUTOMATION

c & a
EDITORIAL

There is growing realization that the United States and many other countries of the world are faced with an unprecedented problem of enormous importance:

The Social Implications of Computers and Automation

We, the editors of this magazine, believe that the combination of computers and automation is placing before men in the United States and in the world the possibility of one of the greatest opportunities for good that has ever existed, and also one of the greatest potentials for social disaster—if this powerful new force is not intelligently guided.

The technical capacity for abundance, peace, and fruitful leisure has arrived; is human wisdom to use it also available?

To focus on the social implications of computers and automation, and what to do about these implications, we are setting up a special forum on this subject in these pages.

Among the persons whom we have invited to start off this discussion, a continuing dialogue, is Dr. Herbert W. Robinson, President of C-E-I-R, Inc., Washington, D. C., whose organization has computing centers in many cities.

We should like to invite all those persons who have something of importance to say on this subject to contribute their ideas to this forum.

Some of the contributions to this new forum will be articles, perhaps 1000 to 1500 words, in which thoughts and ideas may be developed and argued at some length. Others of the contributions may be simply a few paragraphs or sentences, which contain remarks or comments of significance to the thinking that needs to be done.

We believe that the 30,000 people in the electronic computing and data processing field who read "Computers and Automation" each month should be in the vanguard of those persons who come to grips with the social implications of computers and automation and who take the major steps towards socially beneficial solutions.

We hope that this forum will aid our readers' influence in the shaping of this vast new force towards the greatest possible advantage of all of humanity.

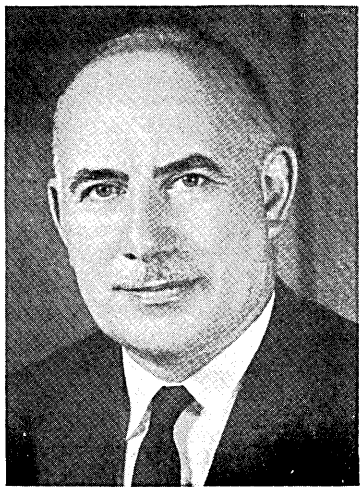
Edmund C. Berkeley
EDITOR

SOCIAL IMPLICATIONS OF COMPUTERS AND AUTOMATION

Dr. Herbert W. Robinson
President, C-E-I-R, Inc.
Washington, D. C. 20006

Although, to many, computers and automation represent a new unemployment threat of awesome dimensions, this basic problem has been with man since time began. Every labor-saving innovation, even the most primitive plough, has seemed to be an enemy to those engaged in the particular activity involved. One can imagine a pessimist in 1946 pointing out (with complete statistical accuracy) that (a) there was then a labor force of 61 million people, 2½ million of whom were unemployed, (b) over the next 17 years, on account of automation, output per man would increase by 65% so that a 35½ million labor force could produce the same output, and (c) in the same period 40 million new workers would enter the labor force. Hence, how could mass unemployment possibly be avoided? The answer is of course that over the 17 years 1946-1963 our economy has actually spent the income generated by the increased productivity, and the labor force has automatically been sucked into employment. On the whole our economic system *does* work (although it is true that we experience today somewhat higher percentage levels of unemployment than in 1946). Another more vivid example of the apparent anomaly that drastic increases in productivity per head need not lead to mass unemployment is the industrial revolution of the eighteenth century. Following the invention

DR. HERBERT W. ROBINSON, President of C-E-I-R, Inc., got his doctor of philosophy degree from Balliol College, Oxford, England, in 1939. His career in government service began in 1939 as assistant to Lord Cherwell, advisor to Prime Minister Churchill of Great Britain, and ended as deputy division director in the Defense Production Administration of the United States in 1953. He has been president of C-E-I-R (Corporation for Economic and Industrial Research) since then. He is a member of many societies including the Royal Statistical Society, and author of numerous publications.



of the steam engine and the exploitation of coal and steel, employment in the British Isles boomed. In fact, it became so great that by the early nineteenth century it had even drawn children by the millions into the labor force in the coal mines and textile mills, a sign of labor shortage rather than of under-employment. Fortunately, today, we will never again permit economic forces to produce such socially undesirable results.

The basic fact is that if the whole society views the potential of automation to increase output per head as a *boon* rather than as a threat to employment, we have within our grasp a golden age of prosperity for America. The greatest danger is that fear of unemployment will inhibit us from enjoying the full fruits of this tremendous technological advance. Although it represents a new "industrial revolution" it cannot possibly occur overnight. The speed with which the advance occurs will be controlled mainly by the tremendous investments required to automate our major industries. There is only so much saving in the economy and therefore only so much investment in new automation that can be financed. Moreover, the new technologies demand large increases in highly skilled occupations, and there is a limit to the rate at which qualified personnel become available. These limitations themselves bring the problem down to manageable proportions.

A fundamental error which plagues our thinking when discussing automation is an implicit and erroneous assumption that there is a fixed number of jobs and that any reduction in the number of people required to produce a unit of output will automatically throw people out of work. This is equivalent to saying that the society only demands a certain fixed income and that if we can produce this income with less people less will be employed. What is overlooked here is that man's wants are *unlimited* and we all desire to have the greatest income possible. If, then, we assume that society wants as much income as possible, then, regardless of how few people are required per unit of output, all the people will always be employed. This is, of course, only theoretically true, and frictions and limitations within our economy always prevent full employment being achieved in practice, sometimes to such a degree that we experience a recession or even a depression. But certainly the forces at work tend very strongly in the direction of bringing everyone into employment.

To those who deplore automation on the grounds that they do not believe we can spend or even want the income it can generate, I would simply ask the question, "Where are the millions of families in the United States who do not know how to spend additional income?" Indeed, are not the vast majority full of plans, hopes, and aspirations that are unrealizable today simply because they do not have the income to spend? In reality the average American family prefers more income to more leisure if the choice is clearly put. Very few families are at a level of income where they really prefer increased leisure to increased income. At the very least the increased income is needed to *fully* enjoy the leisure already available with the 40-hour week, the annual vacations, and the retirement ages we have today.

The fear of inability to absorb the output of automation becomes ludicrous if one contemplates for a moment the mass of poverty in the United States. What must a family at the lowest level of living in the slums of New York, Chicago, or St. Louis feel, when it hears our statesmen debating whether we might not be in danger of producing more than we can consume? Simple arithmetic will show that merely to bring all families in the United States to a minimum income level of say $7,500 per annum will require all the automation of which we are capable for decades to come. If we also look beyond our own shores to the underdeveloped countries of the world, seething with poverty and frustration and lured by the siren-song of Communism, the idea that we can produce too much seems an insult to the intelligence. For our own selfish political reasons, if for no other, the U. S. is bound to have to contribute greater quantities of its resources to assisting the underdeveloped countries of the world achieve some economic progress. There is a ready home for all the excess production we can possibly produce.

Looked at in this way then, automation is a wonderful new revolution promising mankind benefits equivalent in scale to those brought about through the industrial revolution 200 years ago. To fully exploit the economic potential available for a more secure and prosperous world requires, however, one vital ingredient—good management. The whole problem is one of mobility of labor, training at all levels, and above all more intelligent and effective management by government, labor, industry and business cooperating as a unified team. Government must acknowledge the problem and become a dynamic catalyst to speed up the adjustments needed to fully exploit the potentials of the new industrial revolution. The Office of Manpower Automation and Training is an excellent step in this direction but its efforts to date have been puny compared with those actually required. Labor, for its part, must decide what it *really* wants and whether automation is an enemy or an ally. To my mind it is an ally that can secure for labor and our American society tremendous advances in living standards and culture. The challenge to the management of our labor unions is to identify the right policies and goals for which organized labor should strive and to work with government and industry to solve the problems involved rather than to run away from them by merely obstructing automation.

For industry and business the challenge is even greater. Management must analyze in detail the impacts of automation on the future, and plan its investment programs intelligently and imaginatively to secure the full fruits for the whole economy. Revolutionary changes in organization, operations, systems, procedures and personnel policies within companies and industry must be accomplished through the most careful detailed analysis and planning. Training and education become of crucial importance for management of American industry and business in such an environment. The whole nation literally must roll up its shirt sleeves, go to school, and get down to detail if it is to put automation to work in a free enterprise system such as ours. We will get nowhere by yielding to fear and retreating before the formidable task involved, but if all concerned develop appropriate objectives, imaginative policies, and above all detailed plans, we can quickly enter an era of prosperity such as would have been undreamed of even one generation ago.

A SOCIAL APPLICATION OF COMPUTER POWER TO IRRIGATION DAMAGE

Irrigation damage severely affects 6½ million acres in the Indus Valley in West Pakistan. Here the population is increasing at the rate of 10 more mouths to be fed every 5 minutes and where, every 5 minutes, an acre of land is being lost through water-logging and salinity.

The Indus and its tributaries created the soils of the Punjab and the Sind. In the alluvial plains which they laid down, one of the earliest civilizations flourished, the relics of which are still to be found at Harappa and Mohenjo-Daro, settlements which existed 5,000 years ago. In the nineteenth century, the British began a big program of farm settlement in lands which were fertile but with low rainfall. Barrages and distribution canals were constructed, and those engineering works have been massively extended,

and the irrigation system intensified, since Pakistan became independent. The 23 million acres watered by canals is the largest single irrigated region in the world.

Today the system, and the livihoods of the 30 million people who depend upon it, are seriously threatened. Over 40,000 miles of canals have been dug into the surface of the Indus plain. Apart from the water which is spread over the fields, some 40 per cent of the water in the unlined distribution canals seeps underground and does not find its way back into the river, to be drained into the sea. The result is that the water-table has risen. Before the canals, the water-table was generally well below the surface. Only in some areas close to the river was it between 5 to 15 feet. After 70 years of irrigation, the picture has changed completely. The water-table of large areas has risen close to the surface, and low-lying areas have become water-logged, drowning the crops. In other parts, the water creeps continually upwards from the water-table to the surface, where it evaporates, leaving its dissolved salts to accumulate in the top layers of the soil, poisoning the crops. At the same time, the irrigation regime, which uses on an average 1½ feet of water a year, spreads the surface water, with its own dissolved salts, so thinly that it evaporates, leaving a crust of salt.

This combination of water-logging and salination is producing deterioration at the rate of about 100,000 acres a year. In one district of the Punjab, the extent of water-logging and salination is already more than 50 per cent of the culturable land.

This serious situation led President Ayub Khan of Pakistan to ask President Kennedy of the USA to send a group of scientists to study the problem. A panel of 20 specialists was appointed from many disciplines, in the natural, agricultural, engineering, and social sciences. The specialists did the studies in the field, and referred the complex calculations to the electronic computers and a team of graduates at Harvard. The answers at which they arrived showed the difficulty and the expense of repairing the damage. The proposals involve vertical drainage, using tube-wells and electric pumps to bring the underground water to the surface, where it can be used for irrigation and to sluice the dissolved salts in the surface layers back underground. Evaporation from this system will help to lower the water-table.

The panel, however, urged that the water-logging and salination problem should not be considered merely in terms of reclamation, but should be combined with measures to increase agricultural productivity. The scheme proposed, reclamation and farm improvement, is estimated to take 25 years and to cost over two billion dollars.

—From "Science and Technology for Development. Report on the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas. Volume I. World of Opportunity." United Nations, New York, 1963, pp. 5-6.

TEN REVOLUTIONS IN ONE

The plain fact is that history's most profound revolutions have been underestimated, and they have been underestimated by their contemporaries. In fact, I think people underestimate the Negro Revolution taking place in this country. I think the Congress of the United States is underestimating it, I think that practically every civic leader in America is underestimating it, because possibly we're too close to it; *but* it is here, just as surely as the computer revolution is here. All of history is full of the wreckage of nations, societies, classes—which underestimated the nature and power of revolutions.

I do hope this audience will not underestimate the power and the nature of the revolution that you have cut loose—this the computer age—for you are in the vanguard of this revolution.

You know, it is about 10 revolutions "wrapped into one."

The Computer Revolution is economic, it's socio-psychological, scientific, technological, military, informational, managerial, international, educational; yes, it is all of these—and profound in its impact on public policy. . . .

Educationally the computer is changing the world so rapidly that it requires rededication to a learning process which is lifelong. . . .

—From the luncheon address of Senator Hubert H. Humphrey at the Spring Joint Computer Conference, Washington, D. C., April 23, 1964.

NEW DEVICES AND SYSTEMS PRODUCE A SHARP SLOWDOWN IN WHITE-COLLAR HIRING

The table below shows the slowdown in the growth rate for all white-collar jobs:

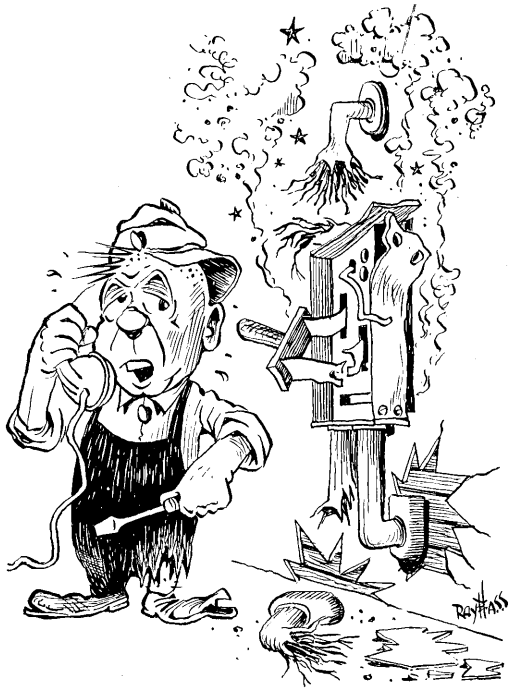
Average Yearly Gain 1950 to 1960	*Gain in 1962*	*Gain in 1963*
2.81%	2.6%	0.9%

There is abundant evidence that automation—and its accompanying efficiencies—is primarily responsible for the slower growth rate in office employment.

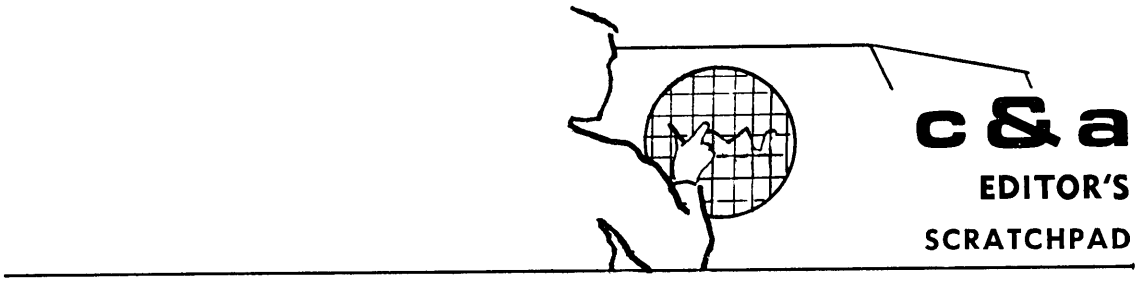
"New machines and new systems have enabled us to bring at least a temporary halt to the long and steady rise in our office employment," says Fred Oswald, a personnel vice president of Manufacturers Hanover Trust Co., large New York City bank. The bank's employees fell to 10,080 in 1963 from 10,345 in 1962, in spite of continuing climbing business. . . .

—Based on the report "Office Automation" by T. Stanton, in "The Wall St. Journal," May 5, 1964.

COMPUTER UNEMPLOYMENT



"Hello, Daily Tribune? Here's a headline for you — one man just put four computers out of work!"



SOMETHING NEW FROM THAT FADED 1401?

We are pleased to present in this issue two important articles that examine one of the major new market areas in the computer field... the Used Computer Market. These reports offer some of the answers to the question of what will happen to your faithful yet sluggish model XXX computer when it has served its time and is replaced by the speedy new model ZZZ.

Of course, the key variable shaping the future of this market is how many replaced computers will actually find their way into the used equipment market. Since only between 25% and 30% of the computers in use in this country are owned by their user, the policies of the manufacturer determine to a considerable extent the supply and demand factors that will affect the models and prices of equipment you can buy in the used computer market.

The computer with the largest number of existing computer installations is the IBM 1401, with a population currently estimated at about 7000. In fact, from the time installations of its new System/360 computers begin in late summer of 1965, to the end of 1968, IBM can expect to have about 5000 used 1401 data processing systems returned from customers who currently have this equipment on a rental basis. This huge inventory of leased equipment, currently generating more than $20,000,000 per month in revenue, itself exceeds in income generating power all the computer installations of any of IBM's competitors.

Since most of the returned systems will have averaged about four years of installation time on a paying basis, IBM will have already earned back their investment in development, production and selling costs on these systems as well as its standard 40% return on this investment. However IBM is carefully studying ways to produce additional revenues from this equipment in the form of products that would not be directly competitive with its existing product line.

We understand that IBM's most likely move here is to incorporate the circuits in the central processor of the 1401, and its internal storage, into a new small computer designed for business applications, and planned for introduction next year. This computer, when surrounded with new low-cost peripherals for handling cards and paper tape now under development at IBM, will rent for $600 and $900 per month. Prototype models of this new small computer are believed to be operating at IBM's General Products Laboratory in San Jose, Calif. According to an executive at that location, the use of the parts from returned 1401 processors in a new small computer is "a distinct possibility. It is common knowledge that the circuit cards in the 1401 are standard products, and can be reconnected in many ways... you can draw your own conclusions."

In introducing such a machine IBM would not be the first computer manufacturer to repackage used computer hardware and give it a new name and a lower price. The first units of Burroughs' recently announced B100 computer series are composed of returned B200 processors surrounded by some low-cost peripheral devices. Control Data has recently made some slight modifications to its 160A computer and relabeled it the 8090 control computer. The company plans to build 8090's from the ground up as well as refurbish used 160A's as they become available. The 8090 sells for only $29,000 compared to about $70,000 for a 160A when new.

The introduction of this machine would also be IBM's first entry into the very small general purpose computer market ($500 to $1200 per month)... an area currently finding many homes for computers made by Friden, General Precision, Burroughs, Clary, and Monroe. Only IBM's 6400 magnetic ledger card machine shares part of this market. Buying such a small computer is normally the first step into the computer field for the organization who has confined its data processing operations to the punched card calculating equipment. A capable computer in the $600 to $900 a month range using punched card equipment would conceivably have a market in the next five years for between 5000 to 7000 machines among the estimated 23,000 punched card installations in the United States. An indication of this market potential was highlighted recently when Burroughs announced that it had obtained over 600 orders, worth $15,000,000,

for its low cost E2100 computer ($535 per month) within three months of its announcement date.

Since IBM will have already written off most of the development and production costs for this new small computer, it should be able to offer a computer with a data processing capability that enjoys a marked superiority to other low cost computers on the market in this price range.

MERGERS SIGNAL INCREASED COMMITMENT TO THE COMPUTER FIELD FOR TWO MAJOR CORPORATIONS

Martin Marietta recently signalled a major attempt to broaden its position in the computer field by announcing that an agreement has been reached in principle by which the assets and business of the Teleregister Corp., and the 90% MM owned Bunker-Ramo Corp. will be combined.

Under the proposed program, Teleregister will issue an additional 4,939,000 shares of stock, of which 1,400,000 shares will be sold to Martin Marietta and Thompson Ramo Wooldridge for cash at $15 per share or $21,000,000, and the balance will be issued to acquire all the assets of Bunker-Ramo. Ownership of the enlarged firm will be vested 34.7% with existing Teleregister stockholders, and the balance with MM and TRW. MM's 90% ownership of Bunker-Ramo will mean that it will retain 58.8% ownership in the new enterprise.

Bunker-Ramo was formed earlier this year by the combination of the Computer and Numerical Control Division of TRW and the Electronic Systems and Products Division of MM. B-R currently has over 1200 scientists and technicians on its staff, and is a world leader in the development of on-line process control computer systems.

We find the new arrangement not unexpected... John Parker, President and Chairman of Teleregister, has been a board member of MM for several years, and is a close friend of MM President George Bunker. Parker has actively been seeking an affiliation with a larger company for Teleregister since the lack of an adequate marketing force has hindered his company's growth in recent years.

Teleregister of late has been making a distinct move toward becoming a peripheral equipment supplier for EDP system builders... their window machine for savings banks is being incorporated into proposals by RCA, Univac, GE and Honeywell... their model 100 and 200 CRT displays have received favorable attention from O. E. M. 's, e. g., Univac is using several in their service centers. The merged firm should be able to move toward complete system development in several markets with the East Coast group (Teleregister) specializing in peripheral equipment and the West Coast group (B-R) developing the central processors.

Immediate advantage to MM of the new enterprise: a strengthened position in bidding on command and control systems for national defense, space exploration, and airway control, through Teleregister's lengthy experience in on-line information systems.

Union Carbide Corp. made a quiet but significant move into the computer field by acquiring Data Systems, Inc., the Detroit-based builder of a small, general purpose digital computer selling for about $12,000.

Data Systems was established in Grosse Point, Michigan in May, 1962. Its sole product to date, the DSI 1000 computer, is a serial address, binary, stored program machine. The computer, which is small enough to fit into a file drawer, can be purchased as a single unit for incorporation into a control system designed by the customer. However, 11 peripheral devices are available to provide a complete computer system for specialized applications. Primary market for the DSI 1000 has been as a system control element in process control, communication control, medical electronics, and system checkout applications.

Data Systems will operate as a separate subsidiary of Union Carbide, but as with other electronics activities at UCC, DSI will be under the guidance and control of the corporation's Linde Division. We have learned that UCC will step up the sales promotion activities of DSI considerably in the months ahead, and may have an expanded version of the DSI 1000 ready for introduction by mid-fall.

SOME THINGS TO LOOK FOR...

We understand that IBM has developed a version of its 7094 computer using the same hybrid circuitry found in the System/360 ... but is delaying the announcement of it to see how many existing 7090 series users are willing to shoulder the huge reprogramming costs involved in moving to the System/360. Computer is tentatively designated the 7095.

Watch for major expansion of Control Data's 3600 family, both fore and aft ... the 3100, 3300, and 3800. The 3100 will be in the $3000 to $4000 per month range for basic systems, and should stack up as a good competitor in the small scientific computer market being served by the SDS-930, the DDP-224, the PDP-1, the H-300, and historically, the IBM 1620. Control Data is also expecting to announce an expanded version of its giant 6600, called the 6800 ... which appears to be the company's answer to the model 90 of the System/360.

General Electric is also expected to enter the small scientific computer market shortly with a 205 computer ... a 4K version of the 215. The minimum configuration of the 205, with a paper tape reader/punch and a console typewriter, will be only $1700 per month. GE is obviously eyeing the IBM 1620 user as a major prospect for this new machine.

A SURVEY OF INPUT/OUTPUT EQUIPMENT

Norman Statland
John Hillegass
Auerbach Corp.
Philadelphia, Pa.

This article continues a series of important reference reports on computing equipment and techniques. Previous articles have been "Methods of Evaluating Computer Systems Performance," February, 1964, page 18, and "Decision Tables and Their Application," April, 1964, page 14. Further articles in this series will report on high-speed printers and optical character-recognition equipment.

As computer technology progresses and the utilization of EDP systems by business increases, companies are becoming more discriminating in their choice of a computer system. There is a realization by those who are knowledgeable—and surveys indicate the number of such individuals is growing—that the variety and relative merits of the available peripheral devices are extremely important in the selection of an effective computer-system configuration. Indeed, the decisions regarding these devices frequently are the most significant decisions in computer system purchases.

Many types of peripheral equipment are in use with the digital computer today: magnetic tape transports, card readers and punches, punched-tape readers and punches, high-speed printers, magnetic character readers, and the more advanced devices such as optical character readers and display units. Each type has definite characteristics that make it especially suitable for certain applications. Plainly, it is necessary to evaluate each class of device and the wide range of features associated with each product in the class before making an actual decision.

We will briefly describe the current state-of-the-art of these devices, restricting ourselves, for the purpose of this article, to those more commonly used.

Equipment Types and Characteristics

Magnetic type transports are the prime input/output devices being utilized today for large data volume applications. There are several reasons for their widespread popularity. Except for magnetic disc storage,* magnetic tape comes closest to the data-handling rates of modern computers, and it permits large amounts of information to be stored compactly. It is comparatively inexpensive and economical to use, in that it can be erased and reused many times (tape manufacturers estimate 20,000 to 50,000 passes). Magnetic tape transports can perform both input and output functions, and some units can read backward as well as forward. In addition, magnetic tape can be used as a medium of communication between computers and other peripheral devices.

Two major disadvantages persist, however, in the use of magnetic tape as a computer input/output medium. Manual encoding of source data directly onto tape has not proved practical; and data recorded on tape cannot be read by humans. It is essential, therefore, to have data

* See "Appraisal of Random Access Equipment," N. Statland and J. Hillegass, *Datamation*, Dec., 1963.

transcription facilities available prior to tape input and following tape output from the computer.

Punched cards, punched tape, or magnetically- or optically-sensed paper documents may provide source data for the input transcription. The output transcription is usually from magnetic tape to printed documents or punched cards. A number of special-purpose units have been specifically designed to meet the needs of transcribing data to and from magnetic tape. But small general-purpose computers, such as the IBM 1401 and Control Data Corporation 160-A, are now being used to control the transcribing functions in most large installations since they cost only slightly more than special purpose, plugboard controlled units and can also be used to perform other functional tasks.

Several different methods are used in magnetic-tape transports to drive the tape past the read-write heads and to permit rapid starting and stopping of the tape despite the inertia of the storage reels. Specifically, the tape may be driven past the heads by a pinch roller, by a vacuum capstan, or by a clutch-operated capstan. Vacuum columns, mechanical tension arms, or storage bins are used alone or in combination in the take-up systems that damp the inertial effect of the tape reels. Magnetic-tape transports commercially available have peak data transfer rates with a range of about 2,000 to 600,000 alphanumeric characters per second; most units are in the range of 20,000 to 100,000 characters per second. Recording densities range from 100 to 3,000 frames per inch. Start and stop times from 1.5 to 10 milliseconds are common with a median of about 3.5 milliseconds. Tape width is usually ½, ¾, or 1 inch; the number of channels recorded across the tape ranges from 7 to 32, although the former figure is predominant. A reel, as a rule, holds 2,400 to 3,600 feet of tape and is capable of storing from 2 million to 50 million characters, depending upon recording density and block lengths. Fixed length blocks were used by most early magnetic tape transports, but almost all recent systems can handle blocks of widely varying lengths.

The IBM 729 series, Models II, IV, V, and VI, are the most widely used magnetic-tape transports available today. These units utilize pinch-roller drives and vacuum-column buffers. Tape-movement speeds are 75 to 112.5 inches per second; recording densities are 200, 556, or 800 characters per inch; and peak data-transfer rates vary from 15,000 to 90,000 characters per second. Six data channels and one parity channel are recorded on ½ inch wide tape. Variable-length blocks are separated by ¾ inch blank spaces, called "inter-record gaps." A "dual-gap" read-write head permits data to be read and checked for correct parity immediately after it is recorded, so that recording errors can be detected and corrected at the time of occurrence.

Magnetic tape transports that can read tapes recorded by an IBM 729 unit have been termed "IBM-compatible," and several manufacturers are now producing tape transports that fit this classification. (However, two computer systems having "IBM-compatible" tape transports will not necessarily be compatible with one another in respect to word length, data format, or character coding.)

Basic mechanical limitations, and the innate physical characteristics of magnetic tape itself, limit the possibilities of further performance improvement in magnetic-tape transports with the standard techniques in use today. There exists, however, considerable room for reduction in cost and improvement in both reliability and simplicity of operation. Additional developments may be expected in low-cost tape transports of moderate performance and in cartridge-loaded units, such as the IBM Hypertape Drive. Where high data transfer rates and rapid access to particular items of data are needed, other devices, such as magnetic disc files, will largely replace tape transports. In all probability, though, magnetic tape will continue to be a major input/output medium for all except the smallest computers.

Card Readers and Punches gained an early pre-eminence as computer input/output equipment because most early computers replaced or augmented punched-card tabulating installations. Another factor was the high degree of flexibility inherent in a punched card. A punched card can be key-punched manually, verified, interpreted, sorted, collated, reproduced, mark sensed, and, ultimately, read or punched by a computer as a discrete document. Despite this versatility, some drawbacks do exist. Erasing or correcting the punched data is difficult, and there is a fixed upper limit on the amount of information that a card can hold. The commonly used 80 and 90 column cards hold only 80 or 90 alphameric characters (or 960 or 540 binary bits).

Nonetheless, the punched card is still an outstanding source document and is useful as an external storage medium for permanent records, as well. In most large scale systems, however, card-to-tape and tape-to-card transcription operations are performed off-line, because the data transfer rate of card readers and punches is relatively slow, as compared to magnetic-tape transports. Therefore, all input to and output from the main computer is on the faster magnetic-tape medium.

Broadly speaking, the card readers and punches used in off-line transcriptions are similar to, or the same as, those used in on-line operations. From a cost and scheduling standpoint, though, it clearly would be advantageous to eliminate the need for off-line data transcriptions. The development of computers with multiprogramming capabilities (which reduce the importance of high speed input/output for any single program), plus improvements in both the speed and reliability of the card punches and the readers themselves, may increase the use of on-line card input and output in even the largest computer systems.

Most card readers and punches in use today, like their forerunners—the gang punches, sorters, and collators—use a mechanical picker knife and pinch rollers to feed the cards. Wire sensing brushes read data from the cards and die punches record it in the cards. The majority of card readers and punches read or punch one card row at a time. The IBM 1402 Card Read-Punch embodies all these conventional principles, developed to a high degree. It combines an 800-card-per-minute reader and a 250-card-per-minute punch in a single unit. A file feed on the reader allows up to 3,000 cards to be loaded at a time, and both the reader and the punch can be loaded and unloaded while in operation. The 1402, in line with current trends, has no plugboard control panels. Therefore, all editing and format control must be handled by the stored computer program.

High performance card-reading equipment has evolved primarily through the development of vacuum and belt feeds, photoelectric reading stations, and improved card handling and mechanical construction techniques. Asynchronous feeds permit more efficient handling of the cards by initiating card feeding as soon as the appropriate instruction is given, thereby omitting the need to wait for a fixed point in the reader's clutch cycle. Cards are frequently read serially by column, thereby reducing the number of photocells required. Reading by column rather than by row also simplifies code translation and buffering requirements. The NCR 380-3 and the Philco 258, both rated at 2,000 cards per minute (or 2,667 characters per second for fully punched cards), are the fastest card readers currently available as standard equipment in U. S. computer systems.

The comparatively slow electro-mechanical movement of the die punches has greatly limited the output speeds of card punches. Progress here has been unimpressive; only a modest increase in speed over the traditional 100-card-per-

minute punch has been achieved. The fastest commercially available punches are the Burroughs B 304 and two UNIVAC models, all rated at 300 cards per minute. Soroban Engineering, Inc., is working on a punch head that punches four columns at a time and achieves a peak speed of 450 fully punched 80 column cards per minute.

Because of the low speeds generally available in card punches, system analysts usually try to reduce the required volume of punched-card output. Nevertheless, card punches will probably receive increased use in the creation of re-entry documents produced by the computer, used by the consumer, and then re-entered into the computer system as input transaction records.

Punched Tape Readers and Punches rival, and in some ways surpass, punched card equipment in suitability for external communication and data-entry purposes. Although less widely used than cards in commercial electronic data processing systems today, punched tape seems to be gaining ground, largely because of strong marketing emphasis on punched tape as a "common language" medium for communication among business machines of widely varying types—from cash registers and accounting machines to computers. Among small-scale scientific computers, punched tape continues to be the primary input/output medium.

Punched tape, like punched cards, can be produced by manual keystroke operations, can be verified, interpreted and reproduced. It can also be read or punched by a computer. But, because of the continuous nature of the medium, punched-tape data files cannot be sorted or collated off-line, as discrete card records. Nor can records be added or deleted as easily as with the punched-card medium.

On the other hand, the continuous nature of punched tape provides some distinct advantages over cards:

- Tape record lengths are fully variable; there is no restrictive upper limit as on punched cards and little, if any, space is wasted when the records are short.
- Punched-tape handling equipment can be relatively simple and inexpensive, making it practical to produce tape records as a direct by-product of transactions on cash registers, adding machines, typewriters, and many other business machines. These point-of-entry tape records can greatly facilitate the preparation of computer input data and the development of effective "integrated systems."

Punched tape (often called "paper tape") may be made of oiled or unoiled paper, acetate, Mylar, or Mylar-aluminum laminates. Data is recorded on the tape by punching round holes into it. In the case of "chadless" tape, the holes are not fully punched out but are left attached to the tape, forming flaps. The tape can then be interpreted (i.e., imprinted with the symbols represented by the tape codes), but requires a machine different from the one used with the "chad-type" tape.

Punched tape is most frequently handled on reels, but unreeled strips of tape and fanfold tape stored in canisters are also used. Edge-punched cards—cards with codes identical to those used on tape punched along one or more margins—provide an interesting combination of some of the advantages of both punched tape and cards.

Nearly all punched tape in use at present is either 11/16 inch, 7/8 inch, or one inch in width and has 5, 6, 7, or 8 data channels plus a sprocket channel. The most commonly used tape sizes are the five channel, 11/16-inch wide tape used in Teletype systems and eight channel, one-inch wide tape.

The sprocket channel is composed of holes smaller than the other channels and is used to feed and/or clock the tape. Recording density is ten frames per inch of tape in nearly all cases. When seven- or eight-channel tape is used, one channel is usually assigned as a parity channel, permitting a check on reading accuracy. Horizontal parity checking of five- or six-channel tape codes normally is not possible.

Among punched-tape readers in use today, speeds range from 10 to 2,000 characters per second, and in a few units, bi-directional reading is possible. Mechanical readers, which employ sensing pins or brushes, have performed reliably at speeds of up to 100 characters per second. For higher speeds, photoelectric sensing techniques are usually employed. Speeds above 1,000 characters per second are unusual because of the mechanical problems involved in transporting and handling tape at the necessary velocities of over 100 inches per second.

While numerous manufacturers have introduced punched-tape readers, few have made significant contributions to the state-of-the-art. Two exceptions are the reflected light and anemometer sensing techniques developed by Omnitronics and Soroban, respectively. A key factor in the evaluation of punched-tape transport mechanisms is their ability (or lack of ability) to stop between characters. If a reader lacks this capability, inter-record gaps will usually be required to prevent loss of data.

Tape-punching equipment in present use is completely mechanical and therefore subject to the same mechanical limitations on die-punch movement as are card punches. The most widely used punch for on-line computer applications is the Teletype BRPE unit, which performs reliably at a peak speed of 110 characters per second. The fastest commercially available tape punch is the 300-character-per-second Soroban GP-2, which, when given careful maintenance, has established a reasonably good reliability record.

No discussion of punched-tape equipment would be complete without mention of the Friden Flexowriter. This low speed but remarkably versatile unit is an electric typewriter with an integrated ten-character-per-second tape reader and punch. When used on-line with a computer, it can provide input via tape or keyboard, and output via tape and/or printing. Off-line, a Flexowriter can be used for manual tape punching, tape reproduction, and tape listing, and is a key device for source document preparation in many integrated data-processing systems. Units that perform functions similar to those of the Flexowriter have recently been introduced by several other manufacturers.

Printers have undergone a radical transformation in their role as computer output devices. The most common use for early computers was in scientific applications with a limited volume of output. Modified electric typewriters capable of printing one character at a time, at a speed of about 10 characters per second, could handle the entire output adequately. Electric typewriters still serve as the primary output device for many small-scale scientific computers and as console input/output units in many larger systems.

However, as the value was realized of utilizing computers to solve business problems, output volumes increased significantly, necessitating the development of much faster printing devices. Consequently, high-speed line printers now provide the primary means of making data available for scrutiny by humans after it has been processed by the computer.

Existing high speed printers can be divided into two basic types:

- Impact printers, which print by means of a mechanically driven type bar or wheel pressed against paper and ribbon.
- Non-impact printers, which form an image on some medium, generally by electrical charges. The image is then developed, fixed, or rendered opaque to produce a visible record.

An overwhelming majority of the high speed printers in

use in data processing installations today are impact printers, and these can be further sub-divided according to the method of printing they employ:

- Stick printers—The single-element stick printer provides printed output at speeds intermediate between typewriter and line-printer speeds. Typically, stick printers employ an eight-sided metal printing element with eight characters embossed on each face, providing a total of 64 printable characters. One character is printed at a time, and the entire printing assembly moves horizontally across the platen from one position to the next. The best-known example of a stick printer is the IBM 370, used in the RAMAC 305 systems. This unit has a peak speed of about 30 full 80-character lines per minute.
- Type-bar and wheel printers—Many line printers, especially the earlier (and slower) ones, utilize a separate type bar or wheel containing all the characters of the print set at each printing position. An entire line is decoded and each bar or wheel is independently positioned. Then, hammers at each printing position are actuated simultaneously, forcing the paper into contact with an inked ribbon pressed against the outlines of the embossed characters. Speeds of the type bar and wheel printers range from 50 to 150 lines per minute. The IBM 403 and 407 are "classic" examples of the type bar and wheel printers, respectively.
- Matrix printers—A number of high speed printers employing matrix-type heads have been designed in an effort to circumvent the mechanical limitations on physical character positioning and hammer movement. Each head consists of a group of fine wires arranged in a rectangular matrix. Characters are formed by electromechanically actuating selected individual wires, which strike the inked ribbon against the paper. Speeds of 500 to 1,000 lines per minute have been achieved. Experience with matrix printers (notably the IBM 720 and 730 models) has been characterized by frequent maintenance and service problems and by printed images of relatively poor quality. No matrix printers of the impact type are currently being marketed in the United States.
- "On-the-fly" printers—High printing speeds are achieved in "on-the-fly" printers by rapid hammer action against continuously moving type elements. This basic principle applies whether the type element is of the solid drum, multiple wheel, or chain type, and most modern high speed printers fall into one of these categories. During each print cycle, all the characters in the print set rotate past each printing position. A fast-action hammer presses the paper against an inked ribbon and the type slug at the instant the selected character is in position. Currently available "on-the-fly" printers can print from 150 to 1,200 alphameric lines per minute, with most units falling into the 600 to 1,000 line-per-minute range. Vertical spacing is usually controlled by a punched tape loop, and skipping speeds range from 14 to 75 inches per second. The number of print positions range anywhere from 80 to 160, but usually is 120.

A noteworthy recent addition to the "on-the-fly" class of printers is the IBM 1403 Model 3, which is a modification of the horizontal-chain printer used in IBM 1401 computer systems. The 1403 Model 3 utilizes a train of type slugs moving through a continuous horizontal channel and is capable of printing 1,100 alphameric lines per minute.

There has been a noticeable trend away from plugboard control panels among "on-the-fly" printers, so that all print editing and format control must be performed by the stored computer program. A one-line buffer usually is used in the printer or its controller to facilitate printer control and timing.

The possibility of any dramatic improvement in the performance of impact printers in the foreseeable future is remote. Most of the efforts over the past two years have been in the direction of improving reliability, print registration, and quality. The increased use of optical character recognition techniques in the future will demand printing of a consistently high quality, so that documents produced by line printers can be re-entered into computer systems by means of optical readers after use by persons outside the system.

Non-impact printers capable of printing 5,000 or more lines per minute have been developed during the past five years. These units incorporate a variety of electrical and chemical processes to imprint character images on the paper. Non-impact printers, however, cannot produce simultaneous multiple copies; nor can they produce printing of a sufficiently high quality for use in routine business documents. These are their main disadvantages to date.

The demand for printers that are better able to keep pace with the data-handling rates of modern computers probably will result in improvements in the non-impact printers and a pronounced shift in emphasis from mechanical to non-impact printing techniques.

Magnetic Character Readers can greatly reduce the need for manual keystroke operations in the preparation of computer input data. Fundamentally, the difference between the two techniques is that magnetic ink character recognition (or MICR) requires that all characters to be read must be imprinted with special magnetic ink, whereas optical techniques can read any printed characters (including those imprinted with magnetic ink). MICR was developed earlier and is the more widely used of the two techniques at present. Nevertheless, the greater flexibility of optical recognition will probably result in a gradual shift in its direction.

MICR has been used mainly in the banking field and received its greatest push forward when the American Bankers Association recommended magnetic ink, in Type Font E-13B, as the common language for checks. Some commercial applications, such as the processing of coupons and other re-entry documents, have also been developed, but MICR's prime use is still in the area of finance.

The greatest problems seem to lie in the magnetic-ink imprinting process, rather than in the recognition process. Imperfect printing and damaged documents (mishandled prior to MICR processing) cause fairly high rejection rates and necessitate clerical processing of the rejected material.

MICR reading heads produce electrical signals when magnetically-coated areas are passed beneath them. Wired recognition circuits analyze the signals and compare them with stored "truth tables" to determine which recognizable character—if any—has been sensed. Type Font E-13B's unique appearance resulted from efforts to give each numeral or special symbol the maximum number of features necessary to distinguish it from all other members of the character set. The "different" appearance of such numerals has caused problems in their recognition by human beings.

Most of the MICR reader-sorter units available today are designed for use on-line with a general-purpose computer and some can be used off-line for sorting of magnetically imprinted documents. Burroughs, Ferranti-Packard, General Electric, IBM, and NCR are currently producing units capable of handling from 750 to 1,600 check-sized card stock or paper documents per minute, with one line of Font E-13B magnetic ink imprinting on each document.

Each unit has a number of sorting pockets, ranging from 2 to 18, and documents are usually transported to the selected pocket by a chute or belt mechanism. Some readers

can be loaded and unloaded while in operation. Most readers check for invalid or unrecognizable characters and incorrect field lengths. Documents containing errors are usually routed to a reject pocket. Type Font E-13B contains only ten numerical characters and four special symbols. No MICR reader capable of recognizing alphabetic characters is available at this time, perhaps because of the limited demand for such capability.

Optical Character Readers are the newest of the input/output devices. Although they are not yet being used to any great degree, they offer many potential benefits. Because optical character readers permit normal printed alphanumeric inputs into the machine, they facilitate the use of turnaround or re-entry documents. They promise to reduce the manual keystroke operations which are now required in the preparation and verification of computer input data. These keystroke operations currently constitute the largest bottleneck and major trouble spot in most electronic data processing installations, because of the incidence of errors introduced by manual transcription.

The basic function of optical character readers is to read information from printed documents, translate each individual character into a suitable code, and either transmit the coded information directly to a computer or transcribe it onto punched cards, punched tape, or magnetic tape. Until 1961, Farrington Electronics, Inc., was in the enviable position of being the only major producer of optical-scanning equipment available to commercial users. Since then, however, a number of other companies have entered the field.

Several different character scanning methods have been introduced, but the predominant technique (and only one that has been used for a long enough time to establish a record of satisfactory performance) is stroke analysis. In the Farrington system, the character is scanned and converted to a pattern of electrical signals which are received by a special-purpose unit that has a wired recognition program. The device searches for various strokes or bars of a character and records what it finds. Working from a stored "truth table," the device decides whether or not the particular combination of strokes constitutes a recognizable character; if it does, the character code is transmitted to the output device.

Existing optical character readers are designed to handle a variety of source documents, including cash-register tapes, punched cards, and paper documents up to 10 by 14 inches in size. Document-handling facilities include automatic spooling devices for film and tape; document hoppers, which provide automatic feeding; and multiple stackers, which permit segregation of unreadable documents. The set of recognizable characters may consist only of the numerals 0 through 9, or it may include alphabetics and/or special symbols. Some readers can read only one line per document, while others can read a variable number of lines at variable vertical spacings.

An optical page reader developed by Farrington is capable of reading full typewritten sheets, including upper and lower case letters as well as numerals and punctuation marks, at the rate of 200 characters per second. Advertised reading speeds of other existing optical character readers range from 72 to 2,400 characters per second. Document-handling speeds of the units that read card stock or paper documents range from 100 to 1,200 documents per minute.

The effective operation of a character-sensing system depends upon its ability to cope with variations in the quality of printing. When conventional type fonts are used, printing must be of consistently high quality or some characters will be unrecognizable. The solution of this problem seems to lie in the development and widespread adoption of an optimum type font, whose distinguishing features can be reliably recognized even when the print quality is relatively poor. The Selfcheck font, developed by Farrington and available with some IBM printing equipment, is a step in this direction.

A computer's input/output control facilities may be located within the central processor, in specialized or general-purpose input/output control units, or in the input and output devices themselves. These control facilities may need to perform any or all of the following functions:

- Code translation—Often the data code utilized within the computer differs from that used in the input/output medium. For example, for punched-card output, a six-bit internal code denoting a character may have to be altered to a pattern of holes in one, two or three of the 12 punching positions in a card column.
- Format translation—Transfer of data in the majority of input/output devices (e.g., magnetic tape transports), is in parallel-by-bit, serial-by-character form, where as a full word at a time is accepted or transmitted by most core memories. The control unit, in these instances, must assemble groups of characters to form full computer words during input operations and reverse the procedure during output operations. This process of assembly and disassembly is usually accomplished in one of two ways: (1) buffered transfers; and (2) word-at-a-time transfers. In the first method, a buffer register capable of holding a full block of input or output data is used; this is particularly common in high-speed printers. The printer buffer is filled at the computer's internal transfer rate and holds one line of data until the printer, which handles data at a rate slower than the computer, has completed its print cycle and is ready for the next line. This frees the central processor to compute or initiate other input/output operations.
  Word-at-a-time transfers, the second method used to compensate for the speed differences between the central processor and the input/output devices, is more flexible and is gaining popularity. Here the transfer of a single word (or character) to or from internal storage is initiated whenever the character becomes available from an input device or is required by an output device. Generally, only one or two storage cycles (from 1.5 to 20 micro-seconds for typical core memories) are needed for each one-word transfer. Internal processing is interrupted more frequently, but for shorter intervals of time, than when the buffered transfer method is used. The central processor is frequently engaged in input/output control functions for less than 1% of the total time required for the input/output operations.
- Control of simultaneous operations—In the newer computers, the large discrepency between data handling rates of internal storage units and input/output devices is used to permit the simultaneous operation of a number of input/output devices. Although this simultaneity increases utilization of the computer's processing capacity, it should be remembered that full utilization of these capabilities usually requires complex and time-consuming programming.
  Several methods exist to accomplish simultaneous operations. The most frequently used method permits each input/output control unit to handle one (or sometimes two) input/output operations at a time; the resulting demands of several controllers

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Inter-Office Correspondence

Date June 1, 1964

From: Tom Haseltine

To: Bill Hurst

Dear Bill:

Have you seen a copy of the EDP Industry and Market Report yet?

I happened to get hold of the first issue a couple of months ago. It looked interesting, so I took one of their six month trial subscriptions for $29...and am I glad I did!

The editors of this sheet have been well ahead of the field in reporting new technical and business developments in firms which we deal with frequently for products or services in our EDP activities.

For example, they had the first detailed description of the costs and technical capabilities of the IBM System/360 on March 23rd, over two weeks before the bosses found out about it on April 7th.

And do you know about the performance specs and market prospects for the Control Data 3100, the GE 205, the Honeywell 1200, the RCA Series 28?...all computers which have not yet been announced to the general public...yet I've learned about them already from recent issues of this report.

In addition, this report provides thoughtful analyses of important firms in the computer and EDP field, indicating their sales and profit prospects...interesting information in case you are thinking of investing some of your nest egg in the companies in this mushrooming field.

There's lot more information in these semi-monthly newsletters, but I am sure you can get a sample issue yourself by writing the editors at the International Data Publishing Co., P.O. Box 1, Newtonville, Mass., 02160. I'd give you one of my issues to read except I've already had them cut apart and pasted in my reference file.

Best wishes,

Tom

THE USED COMPUTER MARKET — 1964: A BROKER'S VIEW

George H. Heilborn
Information Processing Systems, Inc.
New York, N. Y.

Probably one of the most important aspects of the computer industry in the decade of the 1960's will be the development of a "secondary" market in EDP systems—that is, the trading and sale of used computer equipment. Just as the ship and aircraft markets (to say nothing of the automobile market) depend on the continuing value of used capital equipment to other organizations, so will the expansion of the used computer market open up other sales possibilities for new equipment and provide new opportunities for economical use of EDP equipment to both new and old users.

It is estimated that the computer market is now supporting sales (including sales value of equipment rented) of at least one billion dollars a year. Of this amount, about 15%-20% is bought outright, with the rest being leased. Even most of the leased equipment is eventually purchased by the lessee or another firm. Because of the recent growth of computer sales, and the rapid pace of technology in the field, there has been virtually no development of a market in used EDP equipment. Gradually, however, major firms are beginning to see the significance of the savings possible in this area, and it can be expected that there will soon be an active market in used computers.

Because of the fact that commercial computers are effectively only a decade old, very few of them have so far been written off as useless by their original owners. Moreover, from 1953 to 1958, the relatively small number of computers sold were exclusively vacuum-tube machines. While doing a good job for the original user, they had serious disadvantages against a transistorized machine as used equipment. Particularly if one considered moving and reinstalling the machine, major costs had to be incurred in dismantling, providing facilities at the new site, including power and air-conditioning, and reinstallation. Last, but not least, maintenance on the older vacuum-tube machines is relatively expensive, and in certain cases, the original manufacturer is no longer willing or able to provide such service. These capital and maintenance costs often were (and are) more important in considering the installation of a used vacuum-tube system than the purchase price of the machine itself.

Economic Life

Now, however, the field is maturing somewhat, both with respect to used computers and the technology of the machines themselves. The transistorized systems, which were introduced by all the large manufacturers in 1958-60, are not only much more economical in installation and maintenance, and (for the same speed and capability) cheaper, but will also have a much longer *economic* life than the first generation of machines. The operational word here, of course, is *economic*. Any computer, including the original large-scale vacuum-tube machines, can probably operate indefinitely, with proper maintenance and under continuous use conditions. However, it is not economical to operate even a fully-depreciated machine if this means paying a premium in power consumption, air-conditioning, maintenance, and possibly restriction of productive capacity, over the rental or purchase-and-maintenance cost of a new machine. For the same reason, the system's value to another user is severely limited by the same economic restrictions. This applies particularly to large-scale vacuum-tube machines, and to a less extent to the smaller and more popular ones.

It can be said with a high degree of confidence, however, that the transistorized machines now being sold will have a useful and economically productive life well into the late 1960's and beyond. Very popular models of current medium and small scale computers have sold as many as several thousand systems, and the newer systems coming onto the market to reach still other potential customers will doubt-

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THE USED COMPUTER MARKET: HOW IBM SHAPES IT

Nicholas H. Dosker, Jr.
DA-PEX—Data Processing Equipmen Exchange Co.
Louisville, Ky.

The used computer market is taking shape as a new dimension, in keeping with the explosive growth of the total computer market. Since IBM is the dominant manufacturer with about 75% of the total computer market, and since most competitive computers are being sold or leased as new at this time, the focus of this article is principally on the used market patterns that are forming as a growing volume of transactions in used IBM equipment take place especially this year. There are some principal guideline factors to be considered by those who expect to make transactions in this used equipment market.

The Used Computer Market

To begin with a definition, the used computer market is a growing market where late-model used computers and card unit-record peripheral equipment can be bought or leased at attractive prices lower than new list prices. Buyers of used computers and punched card equipment are sometimes hard to find when selling a computer, especially on short notice. The used computer market is nevertheless a lusty infant whose growth will be automatic as an increasing number of "technologically obsolete" computers come into this market following new, late-model deliveries.

The used computer market became possible for practical purposes, on January 25, 1956, when the U. S. Dept. of Justice consent decree with IBM took effect. Then users became able to buy machines as well as rent them; approved firms were licensed to manufacturer cards and control panels; extensive cross-licensing of the IBM basic patent pool as of that time occurred, and thus made it possible and practical for other manufacturers to make and offer peripheral or the full-scale equipment for compatible use with IBM machines. Finally, after about three years, a 30% reduction of "option to buy" prices took effect.

The used computer market exists now principally because of the IBM consent decree, and also because of the present rapid introduction of the new computer models such as the IBM System/360 series, the Honeywell 200, and the new entries from Control Data Corp., General Electric, RCA, Burroughs, and UNIVAC Sperry-Rand.

Buying or Leasing a Computer

There is a long-standing industry debate about the relative merits of buying or leasing computer systems or card unit-record equipment. There are interesting conclusions reached in the article, "A Survey on Computer Use by Large Companies" by Messrs. Bock, Jacobs, and Whitaker, professors at Northwestern University, Chicago, Ill., published in the October 1963 issue of "Data Processing for Management." This article was based on a mail survey including questions about (1) the principal accounting applications in use on computers and (2) whether the firm had leased or had purchased computers. The survey was sent to the 500 largest corporations shown in the annual list of FORTUNE magazine. 370 firms replied (a 74% response); and 254 or 69% of the respondents had purchased computers—in other words, had voted with hard cash for buying computers as the best policy for them.

Classification of Used Computers

The basic classification of used computers determining price depends on machine, model, features, and age. These are rendered specific as follows:

a. *Machine Type Number*—such as 1401.
b. *Model Number*—such as Model 2.
c. *Feature Numbers.* These are specified by four-digit numerical code numbers for each feature added to a basic machine or computer system.
d. *Machine Serial Number.* Each machine or computer unit has an individual serial number of five numerical digits, such as 02173.
e. *Age Suffix Code.* This is a suffix code to the machine

serial number. It contains two alphanumeric characters. The first character designates the month; the second character designates the year that the machine left an IBM factory as either new or factory re-built. The age as shown by the suffix code is one of the most important factors to help determine an "option to buy" price from IBM, or a sale or purchase price in a transaction for a used computer. It also determines the monthly IBM maintenance contract cost.

The age suffix coding shown in Table 1 and Table 2 was obtained from IBM and should be correct for most units presently in use, subject to some minor exceptions because of older machines that were coded prior to 1940 with double numeric suffixes.

Table 1

FIRST CHARACTER—MONTH CODE

Character	*Month*	*Character*	*Month*
A	January	J	July
B	February	K	August
C	March	L	September
D	April	M	October
E	May	P	November
F	June	S	December

Table 2

SECOND CHARACTER—YEAR CODE

Last Digit of Year	*Decade 1940-49 (Alphabetic)*	*1950-59 (Alphabetic)*	*1960-69 (Numeric)*
0	A	M	0
1	B	N	1
2	D	P	2
3	E	R	3
4	F	S	4
5	G	T	5
6	H	W	6
7	J	X	7
8	K	Y	8
9	L	Z	9

Many configurations of IBM computer systems are in use and available. Time, talk, and paper are all conserved if the descriptive numbers outlined here are used to describe a machine or system in a buy or sell transaction. For example, in 1401's card systems can be basically described with model numbers A1 to A6, to cover 1000 core storage capacity varying from 1400 positions through 16,000 positions of core storage. An expanded 1401 card system has model numbers B1 through B6. A1401 729 Tape-Card system carries model numbers C1 through C6. A1401 729 Tape-Oriented system has model numbers D1-D6. A1401 7330 tape oriented system has model numbers D11-D16. A1401 7330 Tape/card system has model numbers E1-E6. A1401 Disk Storage/card system has model numbers F3-F6. A1401 Disk/card/729 tape system has model numbers F13-F16. A1401 Disk/card/7330 Tape system has model numbers F23-F26. Many features are available to add flexibility to a 1401 system; for example, the Multiply-Divide feature has as its feature number 5275.

Maintenance of a Used Computer

If a company is considering buying a used computer, one of the most important questions is maintenance of the computer. Used market experience has shown that buyers consider the present and future maintenance of a used computer to be a vital matter.

By far the overwhelming majority of machine and computer maintenance on user-owned equipment is performed by the IBM Customer Engineers under monthly maintenance contracts or on a "Time and Materials" basis. In a few of the large cities at the present time, maintenance service on IBM equipment is also offered by independent service firms or some of the private leasing companies. A few owner-users have employed their own full-time qualified technical maintenance engineers; or large firms have made arrangements to have a man trained for this duty where a substantial quantity of equipment is in use in a headquarters or in a multi-office firm. Nevertheless, at this time in the computer industry, IBM, with its extensive national coverage in depth from over 200 branch offices, is the yardstick and is practically the sole source for qualified technical maintenance. They excell in experience, excellence, and geographic coverage.

Monthly maintenance contracts for IBM machines and systems are apparently available to any owner of a IBM machine at reasonable and non-discriminatory prices and terms, except that, in the terms of section VI (b) of the consent decree, ". . . If any such machine shall be altered, or connected by mechanical or electrical means to another machine, in such a manner as to render its maintenance and repair impractical for IBM personnel having had the standard training and instruction provided by IBM to such maintenance and repair personnel, then IBM shall not be required to render maintenance and repair service for such IBM machine." The same section goes on to say that IBM will offer to sell, repair and replacement parts and subassemblies for any tabulating machines or electronic data processing machines manufactured by IBM so long as IBM has such parts and subassemblies available for use in its leased machines. Such monthly maintenance contracts are offered at standard prices, which increase intervals of at three years in machine age, as determined by the machine (or computer system component) unit number modified by its model number.

Time and materials maintenance service is also available to machine owners. Prior to November 1963 the basic IBM charge for this kind of service by an IBM Customer Engineer was at the rate of $11.25 per hour of time plus parts cost, together with additional charges for night work, weekends, and for travel outside a reasonable distance from any IBM branch office. Since November 1963 the IBM Customer Engineer hourly rate has been $14.50 plus additional charges where applicable.

Recent used-market experience seems to indicate that if a used IBM machine, computer system, or peripheral machine unit moves from a user in a secondary sale, where it has been under a full IBM monthly maintenance contract service level, and if it is sold subject to a live monthly maintenance contract, then a buyer may in most cases acquire that maintenance contract at the standard cost for the machine number, model number, and age, as shown by the age code, with nominal charges to prepare the machine for shipment and for installation at a new location.

In some cases IBM equipment has been maintained under a time and materials arrangement. In such cases, if the owner requests an IBM Customer Engineer Inspection report just in advance of a used equipment transaction and if this report can be made available to the used equipment buyer (together with a firm IBM repair estimate for any repairs necessary to make it qualify for a future standard IBM monthly maintenance contract), then its degree of operating condition can be better proved to a buyer, and probably a better relative price secured for it.

A buyer of used equipment will have a greater confidence in the future operating condition of a used unit which can be sold subject to the assumption of a live monthly maintenance contract. Used market experience shows that buy-

ers prefer a close advance estimate of all the costs necessary for a used machine or system to be in reasonable operating condition soon after delivery.

Many older machines, especially some that have been under time and materials only, may not meet operating and maintainability tests without substantial repairs; this condition would then be reflected in the used market price for that machine. Most machines which have had an average single shift use and full IBM maintenance contract service, however, should meet these tests if they are of moderate age, as are the majority of equipment in current use.

Used Computer Availability Date and Lead Time

Very few computer purchase transactions are the result of snap decisions. Most advance planning for a change in computers seems to be on the order of one or two years or longer, modified by the introduction of basic new computer models, their features, delivery dates, prices, and the lead-time required for machine language programming. An exception is a situation where additional computer capacity is required without a basic change in machine language programming format, such as a second or third computer system which uses a compatible machine language and is similar or identical to equipment presently in use.

Used computer market experience seems to indicate that much better prices and terms, in the fluid context of this market at the present or near future time, can be arranged by the owner who makes known, at least to a broker specialist or dealer, his buy or sell requirements in the used market at least 90 to 180 days or more in advance of the estimated transaction time or availability date. Since such plans might frequently be subject to change, firms who desire to investigate this new dimension of a used computer market can do so through a growing number of broker specialists and dealers, and keep their identity in a confidential status until a transaction is nearly complete, or at least until a truly interested, well rated buyer is brought forward. This method will frequently bring buyers and sellers together with the best possible dispatch because of the active buy and sell listings maintained by such specialists, their knowledge of this market, well developed market contacts, and the undiverted thought and energy which is applied to this specialty portion of the market. Also by using this method, transaction screening time is reduced for corporate personnel who usually have full-time primary management or programming duties and responsibilities for present computer utilization and results on a tight deadline basis.

Trade-In Values

Market experience on used computers up to the present time indicates that the values offered by IBM are almost always below the sale value of a given unit in the used market. For example, recent reports from users who were shopping the market indicate that the trade-in value offered by IBM for a two-year-old 1401 system might at best be of the order of 35% of new list price. Experience and reports from users indicate that such trade-in allowances are scaled downwards in ratio to machine age and degree of technological obsolesence to nothing for machines that are not in a production status.

In key peripheral equipment, for example, 077 collators are no longer available from IBM for either rent or purchase and have no trade-in value, but they continue in demand in the used market, and IBM seems willing to maintain and repair them on a contract or time and materials basis as indicated by the circumstances in each instance.

The other computer manufacturers will undoubtedly formulate a policy for used equipment and trade-ins when the problem arises for them. At this time most of them are selling hard for the best share of the new computer market and these questions won't be much of a factor to them and their customers until another major new model computer cycle is completed or well underway.

Advance knowledge of the city or even the state location of a unit offered for sale is of value for an estimate of the freight which is usually paid by the buyer.

Protection for Possible Damage in Transit

Every computer shipped should carry additional insurance coverage equal to the purchase price value.

It was remarked above that it was important to sell a used unit or system subject to either a live maintenance contract or an IBM CE inspection report made a short time before the sale. Having a live maintenance contract or this kind of inspection report with advance repair estimate can provide a valuable yardstick for repair or replacement valuations and a method of fixing responsibility for the degree of any damage suffered in transit if this question should arise.

Prices and Technological Obsolescence

IBM has firm prices with discounts only for a few customers like the Federal Government agencies and universities. While all these prices are subject to change without notice, as a practical matter the major change in recent years took place on November 1, 1963, and was a change in the "option to buy" price formula under which a depreciated price was calculated when a user desired to buy equipment which had been on rental. From January 25, 1956, the date of the consent decree, until November 1, 1963, IBM equipment could be purchased by a rental user after a minimum one year rental contract on a basis of 10% off the list price for each full year of machine age down to a minimum price of 25% of the new list price at about 7 years of machine age.

On November 1, 1963, this was modified. Current "Option to Buy" prices for users from a rental status are calculated at 10% off list per full year of age for punched card unit record machines down to the following minimums: for newly manufactured machines 45%, for factory re-conditioned machines 35%, and for machines not in production 25%.

A more significant change was made for "Systems" equipment which includes all transistorized computers, their component units, and all late-model equipment above the punched-card unit-record design level. For 1401's, for example, the "option to buy" prices are now computed at 5% off list for each full year of age for the first four years, and 10% off list per year beyond four years of age down to minimums of 65% for newly manufactured equipment, 55% for factory re-built equipment, and 45% for units which are no longer in production.

Since the principal original source for computers or punched card equipment for the used market is from users where "Technological Obsolesence" has taken place with the introduction of later model equipment, the prices and terms quoted by IBM to users who exercise "Options to Buy" their rental equipment have a large influence on used market prices together with the terms under which IBM will allow a secondary used customer to assume a live maintenance contract with nominal installation charges and without major repairs to qualify for a future maintenance contract at the standard IBM monthly rates for machine age.

Used computer price levels are and will be in a state of flux until the dust settles from the recent IBM System/360 series announcement. During this state of flux only an educated guess is possible. For near-term delivery for used IBM 1400 series and 7000 series computers owners are ask-

ing prices that reflect about 10% discount per year of age. In old-fashioned "horse trading" style, buyers start with lower offers until a meeting of the minds is reached. Transactions are being closed; contingent on some special factors in certain cases, it seems reasonable to say that for a 2-year-old system a price in the area of 70% to 80% is about average currently. This price level will probably move lower as the 360 announcement dust settles, and as new model computer orders are placed in greater volume, and the used market price patterns become more clearly defined.

Technological obsolesence, and its effect on used market prices for some older computers, is best illustrated by some typical price levels for the old IBM 700 series (vacuum-tube computers) and 650 series equipment. These are being offered at prices in the area of 10% or less of new list, with a few takers. Some of the very early vacuum-tube type computers have changed hands for use as spare parts at really low prices, like 1% or 2% of list.

Machine Language, Compatibility, and Machine Language Translators

According to the well-informed *EDP Industry and Market Report,* published semi-monthly at Newtonville, Mass., the recently announced IBM System/360 series will use a new ASC11 character code and a programming command structure which are not directly compatible with currrent IBM computers' mode of operation. Thus, although the new System/360 has many admirable features such as increased speed, memory capacity, compact size, and modular flexibility, this program incompatibility with current IBM computers as well as the matter of approximately two years delivery lead time should be considered carefully in judging the advantages of a used computer purchase. According to this source, IBM is offering a "1401 Emulator" or computer simulator only for the smaller size model 30 and 40 computers in the 360 series. This allows these processors to accept a present 1401 program and interpret it in 360-System processing steps through the use of a special read-only storage unit. It is reported, however, that processing efficiency in models for which this emulator is available is cut in half when handling 1401 programs in this manner. The recent *EDP Industry and Market Report* further says that "The rapid appearance of computers with 1401 program translators and 1401 simulators such as the H-200, GE-415, and B-200 series and the impending entry into the 1401 replacement market by UNIVAC and RCA with special equipment and programming aids during 1964 is causing many 1401 users to consider carefully the relative advantages of converting currently to a competitive system rather than waiting 18 to 20 months or longer for a System/360 which might be behind the state of the art when ready for delivery." Among the computers being ordered by users surveyed by the *EDP Industry and Market Report* editors soon after the IBM System/360 announcement were the UNIVAC 1050, the H-200, the Control Data 3200 and the GE-415.

In the present circumstances, used IBM 1400 and 700 series computers that are "technologically obsolete" for one user still represent a very "advanced state of the art" to many other users at the prices for which this equipment is and will be available now and in future months and years.

1964 is indeed a turning point in the development of the American computer industry, including the emergence of a used computer market. The market is an entirely different, more competitive market than in the years prior to 1956; a wider range of choice is now available to computer users than ever before, in greater depth—sizes, configurations, prices, and features offered. An active market for used computers is being increased by a growing number of broker specialists, associate brokers, dealers, and private leasing companies, and a growing number of customers, among present users for additional equipment capacity and among new users, many of whom can now justify computer equipment for the first time at the lower purchase prices available in the used market.

Responsible men and women who make the computer and data processing buying decisions, or who have the responsibility to secure the best sale price for used excess equipment, should try to stay informed about developments in the used business equipment market so as to serve the best interests of the firms they represent.

THE USED COMPUTER MARKET — 1964: A BROKER'S VIEW

(Continued from page 22)

less mean a continuing rapid expansion of the EDP market for the next several years.

Purchase vs. Rental

However, as the market for EDP equipment stabilizes, it becomes clear that it is more and more economical to purchase equipment rather than lease it, especially where a multiple-shift operation is anticipated. Companies which want to get the financial benefits of leasing more and more tend to do so through a leasing company, which buys the equipment from the manufacturer, thus permitting multiple-shift operation for a known and predetermined monthly rental, rather than pay the manufacturer's extra-shift rental. Ownership of the machine may in some cases go to the renting company at the end of the lease, or the lessee may continue to lease the system at a small monthly rental at the end of the original lease term.

Even used equipment can, of course, be rented through the agency of a bank or leasing company. For corporations with established credit, this is a sound and relatively economical way to obtain the benefits of both rental and purchase of used equipment.

The Federal Government has recognized the advantages of buying rather than leasing EDP equipment, and most Federal agencies are now undertaking a review of their existing and proposed leases and purchases to assure that the Government makes the most economical possible lease/buy decision.* It is estimated that the percentage of purchased machines in the Federal Government will double, from 15% to about 30%, in the next fiscal year alone.

Many companies, however, have been deterred from purchasing equipment when they take a good look at the pay-out calculations. For one thing, it has generally been necessary to assume that the machine would be valueless at the end of the 5-6 year depreciation period usually used. The primary reason for this is that there has been no market mechanism for disposing of used equipment, and hence no measure of value. Secondly, the trade-in sched-

* See "Hearings before the Subcommittee on Census and Government Statistics of the Committee on Post Office and Civil Service, House of Representatives," Oct. 2, 3, 5, 1962, June 11, 13, 24, 1963, July 9, 15, 1963. (Available from Govt. Printing Office.)

ules of the manufacturers suggest that the equipment's real value decreases very rapidly. This has strongly encouraged users to rent, and relieved the manufacturers of much of the responsibility of selling used systems. (A used *rental* system, when returned to the manufacturer, can be re-rented at the same price, assuming the machine is still in production.)

At the same time, the manufacturers, particularly IBM, have set relatively high prices on the used equipment which is offered, as long as that type of system is still in production. Again, this discourages the major computer user from the purchase of equipment.

The Equipment Broker

As a result, a new approach must be recognized in the used EDP systems market—that of the equipment broker. He is basically the market's mechanism for evaluating the marketability and price of used equipment. The function of a broker, of course, is to know the market value of computers, who is selling, how to sell the equipment, and who might be willing to buy a particular system. Being familiar with a variety of users, and not committed to any particular line of systems, he can frequently be the source of sound and unbiased advice on the economics and possibilities of buying and selling computer systems.

On the one hand, there is now a method for a computer owner to determine the residual value of his equipment, and thus allow intelligent planning and lease/buy decisions. He also has available a market mechanism for disposing of used equipment. On the other hand, the buyer is provided with a means of obtaining additional computer capacity at a greatly reduced cost. This may occur through the supplementing of his existing installation by adding peripheral equipment, or an additional identical system, or by replacement of his existing system by a larger, and conceivably, newer, computer. A particularly important potential buyer of used EDP equipment is the large institution which utilizes a number of computers now, wishes to enlarge its capacity, and is willing to consider a used system. Often, such an organization will have the trained operators and finished programs which allow it to make use of the additional system immediately, without the "hand-holding" necessary in the case of a user new to EDP systems.

Another advantage which might be noted in the purchase of used equipment is that, very often, a large number of programs, both manufacturer- and user-developed, are available by that time, often simplifying the task of putting the machine to work profitably in a short period.

It should not be thought that the development of the used computer market in this fashion is to the complete disadvantage of the computer manufacturers. Insofar as it permits the current owner to purchase a brand-new machine, which he might not have done given only the manufacturer's standard trade-in on his existing equipment, it helps sell more modern equipment, even though existing equipment is as little as two years old. In addition, the existence of a used computer market is to the advantage of a user considering changing manufacturers, where he ordinarily could expect no trade-in on his current installation. It also broadens the number of users of EDP equipment, some of whom cannot afford new systems. In this way, potential customers for new equipment, a few years later, are created.

Prices

Prices on the open market for used equipment are determined by a number of considerations. Among these are, obviously: the manufacturer's trade-in schedule; the price for which he is willing to sell used equipment; the costs of installation and maintenance for that particular system; and its age. Less obvious considerations include: whether the equipment is still in production or not; the exact equipment configuration (a system for a certain purpose, with an unusual equipment configuration and set of options, is obviously more difficult to sell, and of less value on the open market, than a more conventional and widely useable configuration); and the capabilities of newer equipment in the same speed and price range. It is not true, as some computer owners believe, that "the age of my system doesn't matter—it does just as much work as it ever did." First, the age matters because of the relationship to trade-in value. In addition, no matter how well the machine still works, if a new one of the same speed and capacity can be bought for half the price, the old one's value is diminished to at least the same extent. In fact, in the small-scale market, fairly versatile computers are now available for as little as $20,000 to $25,000 (new), and somewhat higher if punched card input-output equipment is desired

An excellent illustration of these principles, together with typical calculations, may be found in the article "The Case For Buying A Used Computer," **Computers and Automation,** Nov., 1962 p. 41. It should be pointed out that the time periods used for payout and depreciation may be greater or less than those used in the above article, depending on the type of system used.

In that article, three disadvantages of purchasing used computers are given:

1. reduction of contact with the computer profession;
2. loss of technical prestige;
3. loss of ability to do a few "frontier" problems.

These particular items, of course, tend to be of more importance in the technical and scientific computation area, than in the field of business data processing. This is especially true if the used machine is an additional machine in a complex data processing installation, which more often than not tends to be the case.

There are, of course, other disadvantages from the point of view of the buyer of data processing equipment. If he is purchasing a used installation, he must basically take what is available—he does not have the complete freedom of choice that he would have ordering new equipment from the manufacturer. He can, naturally, mitigate this to some extent by trading in some of the equipment he has purchased to the manufacturer, and ordering additional new or used equipment from him. The necessity for doing this, however, shows up in the price the buyer is willing to pay the current owner for the equipment. Also, while main frame processors will probably not change a great deal in the near future, the rate of development of peripheral equipment is still not stable. Another point is that the maintenance cost for peripheral equipment is more age-dependent than that for the all-electronic items of equipment.

Savings

The point, of course, in buying used EDP equipment is *savings.* There are clearly financial benefits possible in the use of modern EDP equipment which is two or three years old. Considering the capital investment required for a medium- or small-scale data processing system, the saving of even a fraction of the price of new equipment may mean a difference in capital outlay of one to several hunderd thousand dollars. Savings of this order of magnitude clearly call for serious management attention to the benefits to be obtained by the purchase of used EDP equipment.

A SURVEY OF INPUT/OUTPUT EQUIPMENT

(Continued from page 20)

for access to the computer's internal memory are interwoven by the input/output control circuitry or program. The peripheral units with the highest data handling rates are usually granted top priority, while the central processor is allowed access to the internal store only when no input/output unit demands access.

As a rule, each control unit is permanently connected to one or more input/output units, but greater flexibility is provided by some computer systems. Examples of this flexibility can be found in the new RCA 3301 and Honeywell 200 systems, in which any input/output channel can handle any one peripheral operation. Some small-scale computer systems offer a fair range of simultaneity by providing individual buffers for a card reader, card punch, and/or printer. Others afford little or no simultaneity.

Conclusion

During the next few years much of the progress in computer-hardware development will be centered on improving the speed and reliability of peripheral equipment. Not only will there be a larger variety of input/output devices, but they will be less expensive, more versatile, and will make possible increased utilization of the computer capabilities we already possess. Refinements are regularly being made on present input/output equipment, and the so-called exotic devices are rapidly increasing in practicality and effectiveness.

DRAMATIC INPUT DEVELOPMENT

"It'll be an epic — it's going to be a multi-million dollar production! I want you to match merge Shakespeare, Beethoven and Michelangelo!"

CUMULATIVE SAVINGS

Nationwide Leasing Co. ComputerLease - 8 Year Term

vs

Manufacturer's Rental - 8 Years

$308,068 Computer

Basic Rent Per Year Exclusive of Maintenance*	1 Shift	1½ Shifts	2 Shifts
a) Manufacturer's rental**	$ 69,672	$ 83,604	$ 97,536
b) Nationwide Leasing Co.	48,910	48,910	48,910
Year	Cumulative Savings:		
1	$ 20,762	$ 34,694	$ 48,626
2	41,524	69,388	97,252
3	62,286	104,082	145,878
4	83,048	138,776	194,504
5	103,810	173,470	243,130
6	124,572	208,164	291,756
7	145,334	242,858	340,382
8	166,096	277,552	389,008
Additional Investment Tax Credit	14,374	14,374	14,374
Real Dollar Savings through ComputerLease***	$180,470	$291,926	$403,282

* Maintenance cost would be the same under either program since equipment is purchased from manufacturer. Hence maintenance cost has been omitted from both rentals.

** As supplied by manufacturer.

*** Additional cost of Insurance and Personal Property Tax not taken into consideration since accurate determination impossible without specific data on Insurance and Tax Rates.

THE ECONOMICS OF LEASE VS. RENTAL OF COMPUTERS

Robert Sheridan, President
Nationwide Leasing Company
Chicago 4, Ill.

The growth of the used computer market depends on how many people purchase their own computers; and the leasing arrangements of the independent leasing companies make this possible with small capital outlays at any one time.

Will you continue to rent your EDP equipment?

The majority of EDP systems are being rented from manufacturers today. There is, however, a clearly discernible trend to acquiring computers through leases with third party lessors. In scattered instances computers are also being purchased outright in managements' desire to reduce the cost of computer use.

Technical obsolescence has been the compelling power behind the predominance of manufacturer rental plans. The cycle of technical obsolescence, lengthening rapidly in the past few years, was further extended with the recent announcement by the last of the majors that its "third generation" models were available. This new plateau of technology should enable computer users to plan on a significantly longer useful life. In addition, the growing use of the "building block" technique, which preserves past programming, further slows the cycle of obsolescence.

Will this trend grow with increasingly greater speed or will there be a return to rentals?

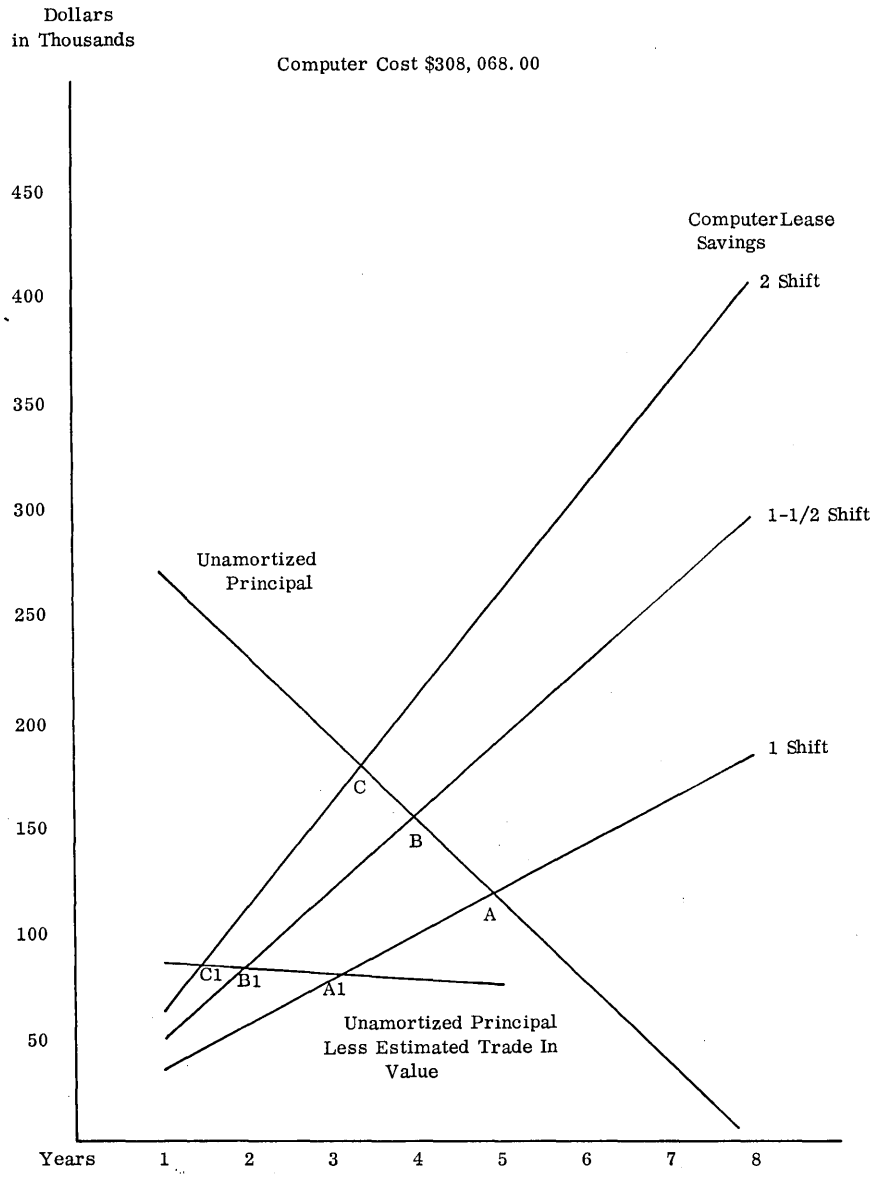
Decline in Rentals

All indications point to a rapid decline in the popularity of rentals. Computer rentals grew primarily because of the low level of reliability in the early days of the art and because of the rapid rate of development of improved models. Hence the promise of drastic reductions in time and cost of accounting and research functions was not adequate to overcome the fear of being "locked in." The 30-day cancellation privilege offered by the manufacturers became the ideal solution in this conflict of motives.

Pattern in Development of New Equipment

Computers are proving to be no exception to the general pattern of the development of new equipment; after the initial period of experimentation and rapid improvements, replacement cycles slow down and the pendulum begins to swing in the opposite direction, that of retaining obsolete equipment in service too long.

Today's computers are reliable, flexible, adaptable to many diverse tasks and hold promise of extended useful life. This condition calls for a new approach to paying for



Points A, B and C show the time at which savings in rental equal cost for substitution depending on amount of computer use. Points A1, B1 and C1 show the much earlier break-even point of Computer Lease when trade-in values are considered. Identification of manufacturer and systems has been omitted.

computer usage, an approach which provides (1) lower annual cost, (2) lower total cost, (3) a flexible replacement opportunity, recognizing the possibility of interim technical advancements, and (4) unlimited usage within the base cost. Current tax laws, in addition, dictate the need to provide the full benefit of the 7% investment tax credit.

This was the reasoning that underlay the development of a variety of leasing arrangements by specialized leasing companies.

An Illustration

An illustration of a specific situation my firm was involved in recently shows the considerable cash savings possible once the above principles are applied. In this situation, we were asked to submit a proposal for a system with a total cost of $308,068 (including taxes). For purposes of direct comparison of the cost of usage, maintenance and service charges, which would be identical under both plans, have been deleted from all cost cited.

The manufacturer's annual rental for one shift use (176 hours per month) was $69,672. Nationwide's rental, on the other hand, was $48,910, based on an eight-year lease. This is a cash difference of $20,762 per year. In addition, our leasing plan passed on the full 7% investment tax credit to the lessee, whereas the manufacturer passed on only 2⅓% (since the rental plan is based on a five-year useful life to the manufacturer). This means a further cash difference of $14,374. Thus in the very first year, the lessee received an immediate cash savings of $35,136, over 10% of the cost of the equipment.

In the first five years of the plan—the critical period—cumulative savings amount to $118,274, composed of annual rental savings, plus investment tax credit. If the lease is maintained for the full eight years, cumulative dollar savings based on one-shift use come to $180,470.

The decisive importance of unlimited use is illustrated if a two-shift use of the equipment is assumed. Our particular leasing arrangement charges a single fixed rental no matter how much the equipment is used. Thus for two-shift use, the same rental cited above—$48,910 per year—applies. Under the manufacturer's schedule, however, two-shift use means a higher rental—$97,536 per year. This means a saving of $48,626 per year. For five years the savings on rentals amounts to $243,130, for eight years the total is $389,008, or more than the original cost of the equipment. To this must be added the difference in investment tax credit of $14,374.

These (potential) savings are so large as to be quite impressive to management.

If they are true, why isn't everyone jumping on the bandwagon? What's the catch?

Dividing Line

There is no catch, *but there is a dividing line.* In our case the dividing line is five years. The savings accrue to those companies that *can foresee a useful life of five years or longer on a one-shift operation.* For a one-and-a-half shift operation, *the dividing line is 48 months.* For two shifts, *the dividing line is 40 months.* These periods will vary slightly depending on the makeup of the system.

In other words, these extremely large savings are the reward that falls to managers who accurately foresee that their use of computers will expand and that the equipment they acquire in 1964 or later will, in fact, have a useful life (in terms of potential applications) that is longer than five years.

However, this does not mean that the company that leases is "locked in" for the full term of the lease. Most leasing arrangements contain a standard "right of substitution" clause, which permits a lessee to replace obsolete equipment with up-to-date equipment. Under this clause, the lessee may at his option buy out his equipment from the lease without penalty. He may then, of course, trade in the old equipment against new machines with his new lease based on the net price of the new equipment.

Maximum Savings

Once the decision is made to go for maximum savings, the question that is posed is the classic one that pertains to all types of equipment: shall we buy or lease? To this question there is the simple answer:

1. If you have the funds available and no better (i.e., more profitable) use for these funds, then buy. If your funds can earn more employed in your business than a lease costs, or in purchase of equipment with a faster return of investment than eight years, then lease.
2. If you must conserve your working capital and the equipment is a sound investment, then lease.
3. If borrowing from your normal sources in order to purchase equipment will restrict your operations or your credit lines in any way, leasing will keep your normal credit lines open without restriction on management.

CALENDAR OF COMING EVENTS

July 13-15, 1964: 1964 Rochester Conference on Data Acquisition and Processing in Medicine and Biology, Univ. of Rochester, Whipple Auditorium, Rochester, N. Y.; contact Kurt Enslein, 42 East Ave., Rochester, N. Y. 14604

July 20-21, 1964: 2nd Annual Conference of the Computer Personnel Research Group, New York University, New York, N. Y.; contact Robert A. Dickmann, Chairman, Computer Personnel Res. Group, c/o Johns Hopkins Univ. Applied Physics Laboratory, 8621 Georgia Ave., Silver Spring, Md.

July 20-24, 1964: 1964 Nuclear Radiation Effects Conference, Univ. of Washington, Seattle, Wash.; contact John C. Mitchell, Unit 2-53010, LTV-Vought Aeronautics Div., Ling-Temco-Vought, Inc., P. O. Box 5907, Dallas, Tex. 75222

Aug. 12-14, 1964: 1964 UAIDE (Users of Automatic Information Display Equipment) Meeting, International Hotel, Sepulveda and Century Blvds., Los Angles, Calif.; contact M. Hoffman, Program Chairman, 1964 UAIDE Annual Meeting, Dept. 716-61, Atomics International, P. O. Box 309, Canoga Park, Calif.

Aug. 25-27, 1964: ACM Annual Meeting, Sheraton Hotel, Philadelphia, Pa.; contact H. Bromberg, Conference Chairman, C-E-I-R, Inc., Benson East, Jenkintown, Pa.

Aug. 25-28, 1964: 1964 Western Electronic Show and Convention (WESCON) and IEEE Summer General Meeting, Los Angeles Sports Arena and Hollywood Park, Los Angeles, Calif.; contact WESCON, 3600 Wilshire Blvd., Los Angeles, Calif.

Aug. 30-Sept. 5, 1964: Symposium on Sensitivity Analysis of Nonlinear Systems, Dubrovnik, Yugoslavia; contact John E. Gibson, EE Dept., Purdue Univ., Lafayette, Ind.

Sept. 9-11, 1964: 12th Engineering Management Conference, Pick-Carter Hotel, Cleveland, Ohio; contact Norman Lieblich, Dynatrol, Inc., 95 Liberty St., New York, N. Y. 10006

Sept. 14-16, 1964: 8th National Convention on Military Electronics (MILECON), Washington-Hilton Hotel, Washington, D. C.

Sept. 14-18, 1964: 4th International Conference of Analog Computing, College of Technology, Brighton, England; contact The BCS/AICA Honorary Secretariat, Ferranti Ltd., Kern House, 36 Kingsway, London, W. C. 2, England

Sept. 14-19, 1964: Symposium on Component Parameters and Characteristics, Stockholm, Sweden; contact Prof. Herman R. Weed, EE Dept., Ohio State Univ., Columbus 10, Ohio

Sept. 17-18, 1964: 7th Annual Northwest Computing Conference, Univ. of Washington, Seattle, Wash.; contact Robert K. Smith, Northwest Computing Association, Box 836, Seahurst, Wash.

Sept. 21-24, 1964: Symposium on Digital Process Control, Stockholm, Sweden; contact W. E. Miller, G.E. Co., One River Rd., Schenectady 5, N. Y.

Sept. 21-24, 1964: 1964 IFAC/IFIP Conference, International Conference on Application of Digital Computers for Process Control, Stockholm, Sweden; contact IFAC/IFIP Conference 1964, Swedish Conference Office, Box 320, Stockholm 1, Sweden

Sept. 23-25, 1964: 1st International Congress on Inst. in Aerospace Simul. Facilities, Paris, France

Oct. 4-9, 1964: National Symposium on Space Electronics, Dunes Hotel, Las Vegas, Nev.; contact Charles H. Doersam, Jr., Grumman Aircraft, Eng. Corp., Elec. Bldg. #5, Bethpage, N. Y.

Oct. 5-7, 1964: 10th National Communications Symposium, Utica, N. Y.

Oct. 6-13, 1964: Symposium on Hazard and Race Phenomena in Switching Circuits, Bucharest, Roumania; contact Prof. E. J. McCluskey, Jr., EE Dept., Princeton Univ., Princeton, N. J.

Oct. 19-21, 1964: National Electronics Conference, McCormick Pl., Chicago, Ill.; contact National Elec. Conf., 228 No. LaSalle St., Chicago, Ill.

PERFORMANCE STANDARDS

Dick H. Brandon
Brandon Applied Systems Inc.
New York, N.Y.
and
Frederick Kirch
The Diebold Group Inc.
New York, N.Y.

Performance standards are yardsticks with which to measure operating performance. They provide management with control, and allow variations to be investigated and rapid action to be taken whenever performance strays from the expected yardsticks.

A distinction must be drawn between an estimate and a standard. An estimate for example, attempts to predict *actual* machine running time. A standard states what that time should be. An estimate may be adjusted for later use when the actual performance is known. A standard theoretically is not adjusted. Therefore, a major difference between the actual and the standard will result in management investigation and action.

In data processing, much as in any manufacturing process, standards may be established for both equipment and personnel performance. The methodology is somewhat different. The equipment is self-controlled, and a variation from the standard therefore does not indicate lower "equipment efficiency." It may however, indicate weaknesses in the program or a lack of operator effectiveness. Similarly, it is difficult to use time study techniques to establish standards for programming; the speed of creativity is difficult to predict.

It is necessary though to develop quantitative measures that can be applied to data processing functions. Cost accounting recommends three methods with which standards may be established. These, in order of preference, are:

- Time and motion study
- Study of past performance records
- Estimates based upon experience and judgment

The normal concept of standard costs is applicable to regular production processes but not to "job shops" or other variable processes. The data processing operation is thus left without acceptable standard costs.

A fourth method of establishing standards exists, using estimates which vary based upon parameters for specific operations. Thus, machine processing time varies with the parameter of volume, program coding varies largely with program size, and block diagramming varies with program size and logic complexity.

The major advantages of establishing accurate performance standards are that they:

- Allow reasonable accuracy in scheduling equipment and resources
- Supply management with basic cost information
- Aid in controlling costs
- Facilitate budgeting
- Allow personnel performance evaluation

Basic rules are required to provide the correct environment for establishing and using performance standards:

1. Methods must be standardized.
2. The standards program must have the understanding and cooperation of the data processing staff.
3. Rules to control quality must be established and enforced along with measures of quantity. (Otherwise, a tendency may develop for slower workers to increase output by reducing quality. It would be possible, for example, to turn a program over for production without thorough testing of all conditions. This would reduce the total time necessary to develop the program but would be at the expense of an increased number of errors in production.)
4. *Accurate* records of performance must be kept.

General Approach

Control depends largely on the feedback of information. The initial development of standards depends on the accumulation of historical information. The control cycle develops as follows:

- Development of the initial standard. On the basis of estimates, judgment, experience, or a quantitative measure based on evaluation of operating parameters, initial standards are developed.
- Schedule development. A schedule is established on the basis on *initial standards.*

- Gathering information. Detailed records are maintained on actual performance. Analyses are made of performance against projected schedules. Variations are then determined and possible causes established.
- Action is taken to account for each variation initially encountered. If a variation occurs without apparent explanation, the standard may be wrong and would then need adjustment. Otherwise action is taken to adjust performance, such as increasing incentives, or modifying methods, or increasing the amount of supervision.

A standard *should not* be adjusted because of adverse experience based on one operating group or on a single sample. A standard should be adjusted only on the basis of verified consistent variations.

Program Parameters

Experience indicates that the most meaningful parameter that can be applied almost universally to compute compiler time, for example, is *program size*. This assumes that the average number of macros, pseudo-operations, comments, or compiler-control entries will be reasonably constant for an installation. The number of comments will be dictated by the rules on program organization and the number of macro-instructions will be a direct function of standard subroutines and of programming rules dictating the particular macros to be used.

The unit in which the parameter is expressed is of little significance: it matters but little if it is in number of cards or inches of symbolic deck. However, since the parameters of a program must be estimated before the program is actually written, it is important that the unit chosen permit accurate measurement. The unit that lends itself most easily to such estimation is the number of pages of coding anticipated, generally divided by ten to facilitate handling. The following scale for example, is suggested:

Number of Pages	*Scale Unit*
01 - 19	1
20 - 29	2
30 - 39	3
40 - 49	4
50 - 59	5
60 - 69	6
70 - 79	7
80 - 89	8
90 - 99	9

The first program parameter is therefore estimated *program size*, determined before the program is actually written.

The second program parameter is *complexity*—a subjective value which can be estimated in advance by an experienced programmer. The code for complexity uses a scale of six possible complexities ranging from simple to impossible:

A .....Simple
B .....Moderately Difficult
C .....Difficult (Average)
D .....Quite Complex
E .....Extremely Difficult
F .....Impossible

In establishing a complexity code for programs to be written, two factors should be clearly kept in mind:

1. There is no direct relation between complexity and size; size must be separately estimated. Logical complexity is strictly a function of the type of program and the number of different conditions accounted for. Of course, a truly complex program would usually require a sizable number of instructions to handle all conditions. There are, however, a number of extremely complex programs such as tightly optimized subroutines, whose size is 1, yet whose complexity is D or E. Conversely, an extremely simple printer routine on a non-alphabetic machine may be quite lengthy because of editing requirements.
2. The same person should establish program complexity in all cases.

A third parameter affecting development and operating time is the *number of input-output units* used. An extremely large and complex program may use one tape for input and one for output; the set-up time for this program will be considerably less than for a simple, small program which uses the printer, six or seven tapes, and an on-line card reader. This parameter is called *input-output complexity*, and is a simple count of the number of input-output units used. It can be obtained by a rapid analysis of the program flowchart.

Each program will therefore have three parameters, expressed as X N/Y:

X is the rating of complexity (A through F)
N is the number of pages of coding, divided by ten
Y is the number of input-output units

These three parameters can be used to quantify almost every one of the values required for a program.

Development of Equipment Standards

For determining rental charges some kinds of computer use are chargeable and others are not. The chargeable uses are generally:

- Production time
- Assembly or compile time
- Testing time
- Rerun time: Operator error
- Rerun time: Program error
- Rerun time: Data error
- Demonstrations
- Training

Non-chargeable time falls into these categories:

- Production set-up
- Assembly set-up
- Testing set-up
- Scheduled maintenance
- Unscheduled maintenance
- Rerun time: Machine failure
- Rerun: Manufacturer's software error
- Idle time

Although most installations assume that there is no cost attached to the "non-chargeable time," this is a fallacy. One cost attached to non-chargeable time is the cost of labor for computer operations. A second cost is the overhead of the extra operation, which may be considerable if the extra operation forces overtime or addition of another shift. Ultimately, computer use will exceed total available time. Whether or not the machine is purchased or the manufacturer charges for set-up time, when the total of chargeable and non-chargeable time exceeds twenty-four hours in a day, the added cost incurred will be that of a second complete computer.

Standards for Productive Time in a Business Application

In a business application, productive (machine operating) time varies directly with known and measurable parameters. In a tape-limited system, productive time is directly related to tape passing time, which in itself depends on tape blocking and record length. For any given application, these factors are known in advance and may be calculated, so that day-to-day volume, or number of records are the only variables.

With manufacturer-supplied programs, such as sorts, a general timing formula is usually made available. Major

variables which affect the calculation are file volumes, record length, and blocking factors. Calculation of standard time is then fairly simple arithmetic, once parameters are known.

Development of a Schedule

On the basis of established standards, it is possible to develop a detailed daily schedule of work, either by using a computer program to calculate each detail and determine all allowances, or by using a simple assignment sheet to apply necessary standards and provide buffer times for occurrences of "non-scheduled" events such as re-run, utilities failure, and unscheduled maintenance.

Ease of schedule development is one of the basic advantages of good performance standards but a schedule is not essential to the accurate measurement of data. Nevertheless, the development of a schedule, or even of a sequence of tasks to be performed, provides good discipline for the operating staff.

Analysis of the Data

The computer may be used to prepare the necessary analytical reports, or the information can be summarized and tabulated by hand. The major objectives of analysis are:

- To compare the *actual performance* in each category with the *established standard*
- To determine the *effectiveness of personnel*
- To *account for and charge to the appropriate departments* the services supplied and to determine total rental due
- To *determine trends*, and recognize their impact on future data processing requirements
- To indicate management action where performance is not satisfactory and to optimize effectiveness of managemenet policies

To Compare Actual With Standard

To compare the actual performance in each category with the established standard requires a summary of utilization by category, the calculation of the percentage distribution of categories, and the calculation of variance from the applicable standards. The calculation of variance may be in terms of frequency, and/or time, and may be expressed in percentage points.

Standards for Programming Personnel

The methods for establishing and using standards for programming personnel are:

- List the tasks to be performed
- Group these tasks into major sets
- Develop relationships between these tasks and the time required to perform them
- Develop a schedule
- Gather data
- Evaluate the data
- Management action
- Establish measures of quality

Listing the Tasks

The basic tasks to be performed in writing a program are listed in the sequence defined by methods standards:

- Read the job specification manual
- Review the program functions
- Analyze the layouts provided
- Review the program flowchart
- Develop a macro-block diagram
- Assign block letters to distinct segments
- Develop micro-block diagrams for each of the segments
- Review the macro- and micro-block diagrams
- Translate the program logic into symbolic language
- Develop coding for the item layouts
- Add the necessary standard subroutines
- Inspect the translation
- After key-punching and necessary EAM checking, validate the preliminary listing
- Prepare the required test data
- Assemble the program
- Test the program
- Perform a production test with data supplied by the analyst
- Assist in performance of a systems test
- Prepare the program documentation
- Assist in conversion
- Update the block diagrams to include all corrections
- Turn the program over to operations

Some of these tasks take a large amount of time, like micro-block diagramming. Others are completed in a matter of hours, such as the addition of standard subroutines. The accurate development of performance standards requires grouping of these tasks into measurable elements.

Relationship of Tasks and Time

The next step in the development of programming standards is establishment of significant time relationships between the programming tasks, and the nature of the program. This is a critical function which requires the application of judgment and experience.

The initial approximation of time can usually be carried out as follows:

a. Macro-Logic

- Reading the job specification: ½ to 1 day
- Review or listing of the functions: ¼ to ½ day

(These first two items are also dependent on the size of the program. The total time lies between ½ day and 6 days. The difference is mainly a function of program complexity, and, to a less extent, of program size.)

- Analysis of layouts: ¼ day
- Macro-block diagram, program segmentation: ½ to 4 days (depends on complexity)

b. Micro-Logic

- Block diagram development: Approximately ¼ day for each block, for a simple program; up to 10 days, for a complex program
- Logic review: From ½ to 2 days

(Micro-block diagramming depends mainly on two factors: program size, and program complexity.)

c. Coding

When block diagramming has been done well, the time required for coding is proportional to program size. Between ½ and 1-½ days may be needed to complete ten pages if the program is simple. A complex program may require from 2 to 4 additional days to insure that linkage between the blocks is properly established.

d. Inspecting ("Desk Checking")

The time required is a function of size and complexity. Test data preparation is largely a function of size. The total time for both tasks usually varies between 2 and 7 days.

e. Testing

The testing function includes compilation, which may require 2 to 4 man-hours of programmer time for review and correction of errors. The program time for each test shot depends on testing practices; for illustration:

- 5 hours if testing is done at a remote computer by the programmer;
- 4 hours if testing is done at the plant location by the programmer;
- 2½ hours if testing is done by the operators following a documented test plan.

The number of test shots is also, of course, a function of program complexity and size and, in some cases, of input-output complexity.

f. Documentation

The time required to document a program is that which is necessary to produce the:

- General description
- Detailed description
- Operator's instructions
- Miscellaneous sections of the manual

The bulk of the manual will already have been completed when the block diagrams and flowcharts are up-to-date. The standard time for the above listed functions is a function of size and complexity. The number of pages needed is estimated first and the time may be estimated from this.

Development of a Programming Schedule

The first step in scheduling is to rate the programs to be developed and maintained on the basis of complexity, size, and input-output complexity.

Rating Complexity—The most experienced programmer or supervisor should rate the program based on the system flowchart. The same person should do all of the rating so that all programs are rated in the same manner.

Rating Size—The same person who rates the complexity should estimate the number of pages of coding. This rating can easily be checked against the number of pages of coding actually produced. If there is consistent error in the program size, all future programs should be corrected for this error or the estimating method reviewed.

Rating Input-Output Complexity—This rating, preferably accomplished by the same person, is a mechanical count of the number of input and output units or tapes, which the program uses. The objective is to measure the number of distinct files which the program must control.

After the rating has been completed the man-days required for each of the tasks can be calculated.

Gathering Performance Data

Data must be gathered about the actual performance of programming. Inevitably and unfortunately, this gathering requires the same detailed record-keeping as is necessary to obtain the data for equipment performance. The data gathering is now applied to the programming staff, and cannot be obtained mechanically.

There are difficulties since programmers often cannot be persuaded or compelled to take the time to keep records of their activities. Yet performance measurement data must be obtained by program, by task, and by programmer. Three kinds of performance data are needed.

Measurement of Quality—The measures which are established to evaluate the quality of performance are partially subjective, and partially objective. Subjective measures include a rating of the documentation, and an evaluation of the logical completeness.

Measuring the Validity of Standards—Data gathering should include, for comparison to the standards:

- Number of test shots
- Number of compilations
- Number of pages of documentation
- Program size

Measuring Programming Time—The time spent by each programmer on each task can be obtained in a number of ways:

- From a report of progress by program, requiring the programmer to record weekly the time spent on each task.
- From a weekly report on which the programmer records all of his time. Subsequent distribution of his time by program is then done separately.
- From a "Program Follower Ticket": When a program is assigned, a basic record and recording form is created to stay with the program until completion. This method enables detailed evaluation by program, but does not permit easy reconciliation with the total hours worked by any employee. To stay current it must remain with the work-in-progress; the manager, to make a status evaluation, must therefore go to each work station to get the latest figures.

Evaluation and Use of Performance Data

The astute manager is now in a position to analyze the collated performance information, and use it for positive management control. The objectives to be met in analysis and evaluation may vary, but generally include the following:

- Progress Reporting—By measuring over-all "efficiency" from over-all performance, it is simple to determine the exact status of the entire development program, and the completion date of particular systems, applications, and individual runs. This over-all efficiency factor can be used to modify the over-all schedule and all future planning.
- Budgetary Control—If the standard proves effective, the time and cost required to develop the remainder of the program can be closely determined.
- Personnel Evaluation—The most common reason for performance evaluation is to allow an unbiased evaluation of staff members. This is much to be preferred to intuitive evaluation, which tends to favor the extroverted programmer.
- Functional Specialization of Personnel—One of the most interesting byproducts of the use of task-oriented standards is the ability to recognize functional specialization. Many programmers prefer program testing; but almost as many consider machine operation, memory print evaluation, and all other tasks associated with testing beneath their dignity and prefer to concentrate on logical analysis. Others prefer coding; some even prefer the rapid production of good documentation.

  The development of task-oriented performance standards tends to show which programmers are most capable in each task. As a result, management may decide to establish "functional" teams, consisting of a programmer skilled in logical analysis, a good coder, a good tester, and a junior member responsible for documentation. This may prove quite economical even though communications problems may be increased.
- Program Assignment—The use of performance standards allows accurate estimation of the time needed to complete a task. If a program is required before the standard date, it is wise to assign a programmer whose efficiency is greater than standard. Similarly, an evaluation of the total time necessary to complete a series of programs may lead to the important, but often undetected, choice of the programs to be started first. This is important in a development program where the total load of required programs exceeds the time available before machine installation. Rather than eliminate the documentation function, at great risk and cost, it may be possible to delay the development of programs not immediately required, such as those to be run annually.
- Setting Meaningful Delivery Dates—The use of effective performance standards can assist in determining a realistic equipment delivery date long before the system is shipped, because the date of completion of programming will be determined!

"ACROSS THE EDITOR'S DESK"

Computing and Data Processing Newsletter

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NEW APPLICATIONS

COMPUTERS PROVIDE QUALITY CONTROLLED CAR ASSEMBLY AT CHRYSLER CORPORATION

A new computer-based quality control program is in use at three major Chrysler Corporation plants. It has been named the "Dynamic Quality Control System" and uses an IBM 1710 computer complex and 357 data collection facilities at each plant. The 1710 systems, using simply coded data sent to them via 357 data collection units strategically located along the assembly lines, provide quality status reports for all levels of management on a real-time basis.

The system has been in operation at the Plymouth Assembly Plant (Detroit) since the start of 1964 model production. It is also in use at Dodge Assembly in Hamtramck and in the Los Angeles Assembly Plant, and is now being installed in the Detroit Jefferson Assembly Plant, where Chrysler, Imperial and Dodge 880's are built. Fred M. Glassford, Chrysler Corp. vice president and group executive - car and truck assembly, said that all 1965 Chrysler-built cars will be "quality-controlled" by electronics, and all corporation car assembly lines from coast-to-coast will soon have the system in full operation.

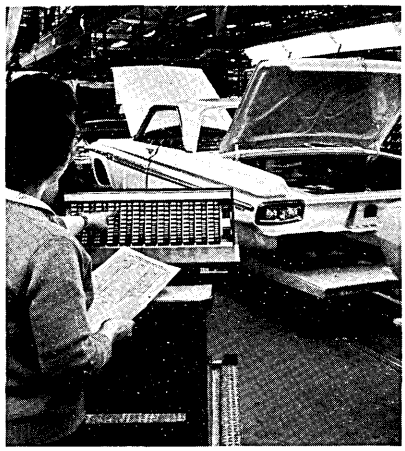
At the Plymouth Plant, there are seven electronic reporting centers on the five-mile long assembly line. As each car moves into a quality reporting station, inspectors carefully check to make sure that everything is in place and works as is intended. So intense is the survey that a tiny screw not bedded deep enough in the steel is deemed to be a defect. The inspectors circle quality code numbers on the inspection cards. (There are six cards used to record the assembly history of a car.) This information is relayed electronically to a computer in a central control room, which, in

— Central Control of the computer-based quality reporting system at Chrysler Corporation's Plymouth-Detroit Assembly Plant.

turn, reports any demerits to a correcting system before the car moves into its next manufacturing stage.

Meanwhile, the computer alerts the area where the mistake was made so that the cause can be corrected right at the source. For instance, an imperfect weld will be reported by the quality control station and the computer will alert the welding department so that the welding gun can be checked. In this manner, mistakes are corrected before they get a chance to multiply.

The method of using digits to represent parts of the cars permits inspectors to check more than 6400 parts and some 4500 welds, more quickly and easily than the few hundred they were formerly able to cover manually. The new system has a potential of being able to correct as many as 30,000 items a day with 2000 cars in the system at one time — each having 6400 parts and 4500 welds.



— Punching out the inspection report on cars coming down the line is the second step in the computer-based quality reporting system. The operator takes the card marked by the inspector, punches out the information on a keyboard located right beside the assembly lines, as shown above, and the computer in the central control station has the data from the report typed out for scanning by line superintendents in a matter of seconds.

The procedure takes place at the three stages of paint finishing, at the electrical wiring stage, metal finishing, parts and hardware, instrumentation, drivetrain, chassis and final check-out. (Each section of car assembly is divided into three stages: production, inspection and repair.) In the near future, the system will electronically control even the balancing of the car wheels and the idling of the carburetor.

The system is so efficient it not only controls quality in all the cars, but it also signals the storage bank of hardware materials, seats, upholstery, lights, engines, etc., to have them moving to the right car at the right time. It keeps track of whether the car is a hardtop, a convertible, a sedan or a station wagon so as not to cause confusion. After storing in its memory chamber the fact that something might have gone amiss somewhere along the assembly line, it inquires at the final inspection if changes and corrections were made and it reports to every supervisor on the line and to division and corporate quality control teams. "It never forgets a car", Glassford said.

LEGAL RESEARCH IN THE FUTURE

State and federal officials have had a look at how they may do their legal research in the future — by asking a computer, crammed full of law, to look up the statutes and sections relevant to any given issue.

John Horty, a lawyer and information retrieval expert who is head of the Health Law Center at the University of Pittsburg, demonstrated the first operational system for automated legal research at the IBM Education Center in Washington, D.C. He and his co-workers at the university have been developing the system for the past five years. It is now being used to store on computers all the laws of Pennsylvania, New Jersey and New York; existing federal laws; the health laws of several states, and to create a library of administrative decisions of the U.S. Comptroller General for use by the Air Force. The computing equipment used in the demonstration was an IBM 1401/1301 system.

Essentially, the way the system works is this: the laws are put into a computer for storage in their entirety. To retrieve information, the lawyer or lawmaker feeds the machine words he selects as pertinent to his topic, and the machine furnishes either the full text or citations to all laws which contain these words. For most questions, the process takes only a small fraction of the time that it would take a lawyer or law clerk to do the same job manually. (For example, the computer used in the demonstration can review up to 30,000 statutes and produce the desired citations in less than 20 minutes.)

The Pennsylvania statutes were the first to be attacked on an experimental basis. Subsequently, federal legislation was included in the retrieval system, along with all health laws of some dozen states. Financial assistance was received from the National Institutes of Health, Ford Foundation, Council on Library Resources, Inc., and others. Later all the ordinances of the city of Pittsburgh were added by the Center under a contract with the City. The Center now has contracts from the two states and the U.S. Air Force for systems that will be operational, rather than experimental.

One of the first uses of the New York retrieval system by the Legislature there will be for a proposed simplification and recodification of the state's education laws. New Jersey plans to interest selected members of its state bar and judiciary in using automated retrieval of legal information. The Air Force system is to enable military administrators to find U.S. Code provisions and decisions of the U.S. Comptroller General relevant to fiscal law questions with the aim of saving time, money and personnel.

The system, Horty explained, is applicable primarily to statutes, rules and regulations, but his group is developing a similar system which might be used for the storage and retrieval of case law. On a national basis, Horty said, automated legal research could save millions of man-hours of work per year, free judges for more courtroom work and be of invaluable use to legislators in helping them streamline the laws of their states.

A COMPUTER BUILDS SHIPS

Norwegian Veritas Company of Norway is an enthusiastic user of the Univac 1107 installed at the State-owned Computing Centre just outside Oslo. The organization is responsible for research into shipbuilding methods and materials and for approving the design of most of Norway's ships. Whenever a new Norwegian ship glides down her builder's slipway into the waters of a fjord, one can be certain that calculations on the computer have contributed materially to the efficiency of her construction.

Norwegian Veritas, described as a "ship classification society", was among the first organization of its kind to set up a ship research department. Privately owned by shipbuilders, shipowners and marine insurance companies, it also maintains a complete register of shipping for all the Scandinavian countries.

The organization began investigating ways in which computers could be used to solve problems associated with the building and sailing of ships back in 1955. First was calculating the stresses undergone by the steel plates, frames and girders which make the hull of a ship. Before computers were available, these were done manually. It was impracticable to calculate stresses on every part of a construction, so figures were worked out for the strategic points and wide safety margin allowed throughout. The speed, accuracy and low cost with which these calculations could be handled by a computer meant that every plate, frame and girder could be taken into account and a precise safety margin worked out for each. As a result of this work, therefore, many of the steel plates on modern Norwegian ships are thinner than in the past but with no sacrifice of safety. The vessel is more efficient and its cost substantially reduced.

Success in this area led Veritas to look for further applications. It was found that the calculations for some of the structural members of ships could be handled in the same way. Computers were used for vibrational calculations, and in connection with the design of engines where they worked out the harmonic components of pressure within cylinders and the resulting static and dynamic stresses on crankshafts.

One of the most ambitious projects afoot at the moment is the writing on magnetic tape files of all the thousands of standard rules relating to the structure of ships. In progress for some 2½ years, the programs have been adapted for the 1107 at the Norwegian Computing Center (acquired in 1963). With this scheme in operation, the computer is able to produce complete construction specifications. And

the only data required by Veritas is a simple outline arrangement and a series of filled in forms. Once the computer program gets fully operational, the shipbuilder will work on his drawings while Veritas makes the calculations for him.

DESIGN OF XB-70 AIDED BY COMPUTER

A computing record of 18,000 hours was set in designing the XB-70 to meet the demands of trisonic flights. The staggering amount of computer time was logged on several IBM 7094's by North American Aviation's Los Angeles Division (Calif.) to help engineers create the revolutionary design. By comparison, 1235 computer hours were used to help translate engineering plans into the hypersonic X-15 research rocket plane.

Twenty miles of taped information flowed through the computer every day in support of the program. The resulting daily printout of computer-prepared material is a stack some 10 feet tall. More than 50 million punched cards were used at the rate of 1½ million a month to solve the varied problems. Paper tapes used to drive numerically controlled milling machines (which in turn cut giant parts for the XB-70) were prepared by the IBM 7094.

In building the XB-70, one objective was to develop a wing shape which would provide the maximum lifting force at a minimum cost in drag for the 2000 mph speeds to be flown. As the external configuration was established and aerodynamic and structural requirements were met, some 5000 simulated computer flights were run before the prototype took its final shape. Major elements such as the airfoil, fuselage, fuel system and engines made individual computer trips before the entire plane was "flown" to mathematically check the effects of forces, stress and the sudden extreme temperature build-ups.

Using the computer, engineers were able to eliminate time-consuming electrical schematics for the new bomber. Computer-prepared wire lists with assembly instructions were printed out to tell production line crews where each of the 30,000 wire segments belonged.

The "shirt-sleeve" environment of the XB-70, which enables the crew to operate without cumbersome space suits at high speeds and altitudes, also was simulated on the IBM computer.

The data processing team at North American will analyze the test information recorded aboard the plane, during the taxi-tests of the first XB-70 as it prepares for intense flight testing at Edwards Air Force Base.

NEW CONTRACTS

POTTER INSTRUMENT AWARDED $1 MILLION PLUS CONTRACT BY ICT

International Computers & Tabulators, Ltd., London, England, has recently awarded Potter Instrument Co., Inc., Plainview, N.Y., a contract in excess of $1 million. The award is for a production quantity of Potter MT-120 Digital Magnetic Tape Transports to be integrated in ICT's new real-time, multi-program computer, the 1900.

This is the third significant award to Potter Instrument by ICT within the past few months.

ITT DIVISION TO SUPPLY TRANS WORLD AIRLINES WITH ADX SYSTEM

International Telephone and Telegraph Corp.'s Data and Information Systems Div., Paramus, N.J., has been chosen to supply an ITT 7300 ADX Automatic Data Exchange System to Trans World Airlines for use as a message switching center and for preparation of certain administrative management reports. It will be located in TWA's downtown offices in Kansas City, Mo., where it will replace three existing electromechanical switching centers — two in Kansas City and one at New York's La Guardia Airport.

MEN'S FASHION FIRM ORDERS IBM SYSTEM/360 COMPUTER

Michaels Stern & Co., Inc., Rochester, N.Y., has ordered a new IBM SYSTEM/360 computer. The men's fashion firm will take first delivery of the new computer to increase its computer capabilities and have instant information and control on orders, production facilities and inventories. It will be able to monitor its 30,000 to 60,000 units of clothing in production at all times. Additionally, instead of following routine inventory and surveys, the computer also will be used for forecasting.

NORTHWEST ORIENT ORDERS $2,000,000 SYSTEM

Northwest Orient Airlines, St. Paul, Minn., has ordered a UNIVAC 490 Real-Time Computer System to handle increasing passenger traffic. The $2,000,000 system, scheduled to go into operation in the first quarter of 1965, will replace a UNIVAC computer which has served the airline since 1959.

— Northwest Orient Airlines stewardess Marion Patterson (r) and reservations sales agent Anne Francis preview the UNIVAC 490 Real-Time System being demonstrated by UNIVAC computer operator Patrick R. Smith.

In addition to handling passenger reservations, the new system will be used as a message switching center, automatically routing all company teletype communications. Message switching will take place simultaneously with the reservations function. The large capacity and flexibility of the 490 also will permit Northwest Orient to take advantage of other computer functions.

BUNKER-RAMO 340'S FOR GIANT COLONIAL PIPELINE

The Bunker-Ramo Corp., Canoga Park, Calif., has been awarded a contract by the North Electric Co., Galion, Ohio, to supply two Bunker-Ramo 340 computers that will be a

part of the supervisory control for the massive 2900-mile petroleum products pipeline system being built by the Colonial Pipeline Company between Houston and the New York Harbor area. North Electric Company is the prime contractor for installation of the supervisory system that will control operation of the entire network of 1600 miles of mainline and 1300 miles of spur lines.

The twin Bunker-Ramo 340 systems initially will be used to scan the remote stations for abnormal conditions and log out flow data through the entire pipeline; they will update all dispatcher information every ten seconds; and eventually will operate closed-loop, allowing for completely automated flow control.

Besides providing the computer hardware systems, the Corporation will be responsible for the programming and maintenance of the 340 systems. Delivery of the systems is scheduled for early 1965.

BANKERS DATA PROCESSING, INC. ORDERS $3,000,000 IN BURROUGHS EQUIPMENT

Burroughs Corp., Detroit, Mich., has reached an agreement with Bankers Data Processing, Inc., Boston, Mass., to install an "on-line" computer system which will supply the data processing requirements for a large group of savings banks in the Boston area. Bankers Data Processing, Inc., is a subsidiary of the oldest chartered savings bank in the United States — Provident Institutions for Savings in the Town of Boston, founded in 1816. The contract provides for nearly $3,000,000 in Burroughs equipment, scheduled for installation June 1, 1965.

The system's configuration includes four Burroughs B283 solid-state electronic data processing systems; 13 Burroughs Disk File modules; 150 "on-line" teller's window machines and 45 remote terminal units.

Banks included in the original group are located from within a few blocks to more than 50 miles from downtown Boston. A number of others also have the program under consideration. The data center will be set up in downtown Boston where it will be operated by Bankers Data Processing, Inc.

DEFENSE COMMUNICATIONS AGENCY AWARDS CONTRACT TO DATATROL

The Defense Communications Agency has awarded a contract for $75,576 to the DATATROL Corp., Silver Spring, Md., to provide research and design services and technical assistance to the National Military Command System Support Center. Additional work is to be performed on two programming systems perviously developed and implemented by DATATROL for the Center — a computer-oriented war gaming model and a full-color information display system.

CONTRACT AWARDED INFORMATICS INC. BY OFFICE OF NAVAL RESEARCH

The Office of Naval Research has awarded Informatics Inc., Sherman Oaks, Calif., a contract for studies of future Naval Tactical Data Systems. The contract is in excess of $300,000.

Informatics will survey and analyze all applicable information processing technology, making future projections as appropriate. System design methodology will be analyzed and developed. The effort is directed toward Naval Tactical Data Systems for the 1970-1980 era.

RUTGERS ORDERS PDP-5 FOR USE BY STUDENTS

The Electrical Engineering Dept. of Rutgers University has ordered a Programmed Data Processor-5 (PDP-5) computer from Digital Equipment Corporation, Maynard, Mass. The computer will be used to give undergraduate engineering students some familiarity with computers and computing techniques. The department plans to add an interface to an analog computer for demonstrating hybrid computer techniques and an automatic multiply and divide capability.

CONTROL DATA RECEIVES POLARIS SUBMARINE APPLICATION CONTRACT

Control Data Corp., Minneapolis, Minn., has been awarded a contract of approximately $3 million from the U.S. Navy's Special Projects Office for the Polaris Target Card Computing Systems (PTCCS). The new contract calls for the design, development, manufacture, and support of the PTCCS that will augment the existing Mark 80 Fire Control System installed aboard the earlier Polaris submarines.

Each PTCCS will consist of two general purpose, stored-program digital computers, associated input/output equipment, and an operator area. The purpose of the PTCCS is to perform initial calculations required for missile guidance to target and to make the results available for use in the Mark 80 Fire Control System. The new systems will provide greater flexibility in both target selection and operation to the Mark 80 Systems.

COMMERCIAL APPLICATION OF REMOTE, ON-LINE DATA PROCESSING

The Service Bureau Division of Computer Sciences Corp., El Segundo, Calif., has announced their first commercial application of remote, on-line data processing, as a part of a major contract received from the Signal Oil and Gas Company, Los Angeles, Calif. The system will provide Signal with the power and economy of one of the nation's largest computer systems. With direct access to CSC's large scale 1107 computer, solutions to many of Signal's operational and engineering problems will be made available within minutes after data is sent to CSC via telephone lines.

A UNIVAC 1004 card processor installed by Signal at its L.A. headquarters is used both for direct input to the service bureau in El Segundo, Calif., and to print the results of the large machine's computations. Problem solutions are provided as fast as if the same computer were installed at Signal's corporate headquarters. Transmission speeds of 40,000 binary digits per second will be possible. In effect, the CSC system provides Signal with a centralized computing facility.

MONSANTO ORDERS PRODAC 50

Monsanto Company's Inorganic Chemicals Division, St. Louis, Mo., has completed a contract with Westinghouse Electric Corp. for the purchase of a Westinghouse Prodac 50 digital computer. The computer will be used by Monsanto for testing direct digital control at the new biodegradable alkylbenzene plant now under construction at the company's Chocolate Bayou complex near Alvin, Tex.

NEW INSTALLATIONS

FIRST H-200 IN N.Y.C. TO BE INSTALLED BY DISCOUNT CHAIN

A softgoods discount chain will become the first user in metropolitan New York of a Honeywell 200 computer, when the Atlantic Thrift Centers, Inc., installs the H-200 in its home office in Manhattan next month. The computer will handle the data processing workload for more than 45 discount department stores and 24 apparel stores throughout the North, South, and Midwest.

The system has a 12,384 word memory. It can print checks at the rate of 900 lines a minute, and transfer sales and other information from its four magnetic tape units at 66,700 characters a minute.

AUTO CLUB OF MISSOURI TO INSTALL GE-415

The Auto Club of Missouri will install a new GE-415 computer at its headquarters in St. Louis. The system consists of the GE-415 central processor with a 32,768 character memory; four magnetic tape handlers; a 900-card-per-minute card reader; a 100-card-per-minute card punch; and a 1200-line-per-minute electronic printer.

The Club will process new applications, maintain current listing of all members, update the membership file as necessary, as well as handle all billing and bookkeeping with the new system. In addition the computer will analyze past road service records and current weather forecasts to determine when and where motorists are most likely to have emergencies.

The GE-415 is one of a new generation of advanced data processing systems recently introduced by General Electric's Computer Department, Phoenix, Ariz. (see Computers and Automation, May 1964, p. 56)

SOUTHERN AIRWAYS TO INSTALL RCA 301

The general offices of Southern Airways, Inc., Atlanta, Ga., will install an RCA 301 computer system. Applications of the system are planned in two phases — first, to process routine financial reports, flight performance and traffic data and, later, for scheduling aircraft maintenance, automating inventory control and preparing charts for aircraft loading requirements at Southern's 48 airports in eight Southeastern states.

LTV MILITARY ELECTRONIC DIVISION RECEIVES ASI COMPUTER

Advanced Scientific Instruments, Minneapolis, Minn., has delivered an ASI 210 Digital Computer to Ling-Temco-Vought, Military Electronic Division Engineering Dept., Garland, Texas. The computer will be used on an open-shop basis within the Engineering Department in the design of guidance and radar systems and other ground-support equipment.

The computer system consists of a 210 central processor with 8192 words of magnetic core memory, paper tape reader and punch and an input/output typewriter. It is the fifth ASI computer system to be installed within the LTV Dallas complex within the past twenty-four months.

ADVANCED MODEL COMPUTER TO BE INSTALLED BY ATLANTIC REFINING

The Atlantic Refining Co., Dallas, Texas, plans to install an advanced model computer — capable of adding or subtracting six digit numbers at a rate of 83,000 per second — in its data processing center. The new machine, a GE-235, has a basic memory cycle of six microseconds (6/1,000,000ths of a second) and will provide solutions to scientific problems about eight times faster than the earlier model GE computer which it will replace. It will also process business data and management information systems for the company.

SUPERIOR COACH WILL INSTALL H-200

The Superior Coach Corp., Lima, Ohio, will install an H-200 data processing system at its Lima headquarters. The company, a major manufacturer of ambulances, school buses and funeral coaches, will replace an existing tabulating machine installation.

The system configuration will include a central processing unit with 8194 characters of memory, four magnetic tape units that transfer information at the rate of 20,000 characters per second, a card-reader-punch and a 900 line-per-minute printer. It will handle payroll, production scheduling, and other general accounting work.

FOURTEEN RCA COMPUTERS TO BE INSTALLED AT SEVEN STRATEGIC CENTERS

The U.S. Air Force Logistics Command and the Radio Corporation of America, New York, N.Y., have announced that 14 EDP systems will be installed in pairs at seven strategic centers to handle, on a priority basis, the flow of about two million materiel items ranging from washers to warheads.

The new systems are in addition to the 30 RCA 301 systems already being installed at 10 key sites in the United States to provide AFLC with more comprehensive management reporting and faster response to the needs of command aircraft and missile units in all parts of the world.

The 14 additional RCA 301's will implement a Priority Distribution system geared to update inventory quickly as well as speed shipment of priority items.

COLUMBIA UNIVERSITY INSTALLS PDP-4 COMPUTER

A general-purpose Programmed Data Processor-4 (PDP-4) built by Digital Equipment Corp., Maynard, Mass., will be used by Columbia University physicists to perform multiparameter analysis of gamma ray particles produced by a Van de Graaff accelerator.

The Columbia system will include a PDP-4 with 8192-word memory, console teleprinter, perforated tape punch, data interrupt multiplexer and an automatic magnetic tape control. University personnel are constructing a special-purpose cathode ray tube display to be driven by the PDP-4. It will permit investigators to view various presentations while the data is being collected and processed.

The Columbia installation is the first in which a PDP-4 will be used for nuclear physics laboratory analysis.

Newsletter

COMPUTER CONTROL DELIVERS DDP-24 TO LTV

A DDP-24 general purpose digital computer has been delivered by Computer Control Company, Inc., Framingham, Mass., to the LTV Michigan Division of Ling Temco Vought, Inc., for use in the Army Lance Missile Project. It will be used in a hybrid capacity with an analog computer to simulate and analyze the flight behavior and control system of the Lance Missile. It will also be used alone as a general purpose computer for engineering problems. The DDP-24 is installed at the Michigan Army Missile Plant, Warren, Mich.

AUSTRALIAN UNIVERSITY INSTALLS NEW COMPUTER

The University of Melbourne, Sydney, Australia, is installing an IBM 7044 computer worth over $2 million. It is the largest university computer and the second-largest IBM system in Australia. This new system will replace CSIRAC, the first computer built in Australia. CSIRAC was among the earliest EDP machines developed and is still producing results for the university's Computation Department.

The new 7044 will operate at the IBM Scientific Computing Centre in the Melbourne suburb of St. Kilda until the university arranges suitable accommodation on its premises. The computer has a complete package of programs which it will use for commonly-encountered problems. A number of different computer languages will also be available for those who will write programs for the 7044. These include: FORTRAN, COBOL, IOCS, SORT, and BASIC MONITOR.

500th NCR 390 SERIES INSTALLED IN PHILADELPHIA BANK

The National Cash Register Company, Dayton, Ohio, has announced its 500th delivery of the 390 series. The NCR 390 computer system has been installed at The Philadelphia National Bank, Philadelphia, Pa.

The system will process commercial loan payments handled by PNB's main office and 34 branches, calculate borrowers' interest as a by-product of the transactions, prepare various management reports and aid in the settlement of accruals.

CONTROL DATA 3600 TO BE INSTALLED AT UNIV. OF WISCONSIN

A Control Data 3600 Computer System will be installed this summer at the Computing Center of the University of Wisconsin, (Madison, Wisc.). The new equipment in combination with the University's existing system (a Control Data 1604) will make this one of the most powerful university computer centers in the United States.

The 3600 system will include two smaller satellite computers connected directly to the large computer: a Control Data 160-A will be used to pre-process input/output data for the 3600; a 924 will be used for research in high energy physics and will be able to communicate directly with the 3600 for final computing and processing of data.

The new computer will be used in research on nuclear energy, numerical analysis, chemistry, engineering, the social sciences and other fields.

UNILEVER AUSTRALIA TO USE CRAM ORDER SYSTEM

Unilever Australia Pty. Ltd., (manufacturers and distributors of soap products and food lines) plans to install an NCR 315 computer system later this year. Program testing and trial runs for the system will be done at NCR's new computer center in Sydney which will provide supporting services for installations in the area as well as contract data processing services.

The random access CRAM system will be used for high-speed processing of customer orders and analysis of product sales and stock levels. Various technical and research programs will also be carried out.

The new NCR system will handle some 25,000 accounts with an average daily invoice load of 28,000 lines. It will replace a punched card system.

ORGANIZATION NEWS

DIGITAL FORMS SUBSIDIARY IN SYDNEY, AUSTRALIA

Digital Equipment Corp. Maynard, Mass., has announced the establishment of an Australian subsidiary, Digital Equipment Australia Pty., Ltd. at Colman House, North Sydney, New South Wales. The new affiliate will handle sales and service of Digital's line of computers, circuit modules, and special systems throughout the Australian continent.

This is the third international subsidiary formed by Digital in the past year and a half. The first, Digital Equipment of Canada, is located in Ottawa; the second, Digital Equipment GmbH, is in Munich, W. Germany.

ELECTRONICS FIRM PURCHASED BY RENWELL INDUSTRIES

Renwell Industries, Inc., South Hadley Falls, has announced the purchase of Nashville Electronics Corp. of Nashville, Tenn., and a 50% interest in Elcap Electronics Ltd., in Hong Kong. Both are manufacturers of subminiature electrolytics.

Renwell also has acquired the exclusive distribution rights in the United States for polystyrene, manufactured by Bolton Electronics, Ltd., of Hong Kong.

Renwell manufactures peripheral data processing equipment, numerical control machines, and a variety of components used in the electronics industry.

CONTROL DATA ACQUIRES COMPUTER LABORATORIES, INC.

Control Data Corp., and Scientific Computers, Inc., (SICOM) of Minneapolis, Minn., have announced the acquisition by Control Data, of Computer Laboratories, Inc., a subsidiary of SICOM. The agreement is subject to SICOM stockholder approval. It covers the acquisition by Control Data of all Computer Laboratories, Inc. stock in return for an undisclosed amount of Control Data stock.

Computer Laboratories, Inc., which will function as a subsidiary of Control Data Corporation, is a

computing center organization located in Houston, Texas. It serves the area's oil and oil exploration industries, business and scientific communities.

NCR OPENS NEW DATA CENTER FACILITIES—MORE DUE OVER NEXT 16 MONTHS

The National Cash Register Co., Dayton, Ohio has opened seven new data processing facilities, four of which are in the United States.

Four of the newly opened facilities use NCR 315 computers equipped with CRAM (Card Random Access Memory) units. These are located in San Francisco, Calif.; Toronto, Canada; San Juan, Puerto Rico,; and Dundee, Scotland. The other three are smaller facilities in Chicago, Detroit and Dayton. They use NCR 310 computers equipped with optical reading equipment.

Other 310 processing facilities will soon be opened in Brooklyn, Baltimore and Kansas City, with 12 additional cities to receive similar services by late 1965. New 315 CRAM centers are scheduled for openings this year in Buenos Aires and Montreal.

When the expansion program is completed, NCR will have data processing services in 50 major cities in the United States and abroad — approximately double the number presently in operation.

TELEREGISTER, BUNKER-RAMO TO COMBINE CORPORATIONS

The Teleregister Corp., Stamford, Conn., has announced that it has reached agreement in principle with The Bunker-Ramo Corp. under which the assets and business of the two corporations would be combined. Under the proposed program Teleregister will issue an additional 4,939,000 shares of stock, of which 1,400,000 shares will be sold to Martin Marietta Corp. and Thompson Ramo Wooldridge for cash at $15 per share. The balance will be issued to acquire all of the assets of The Bunker-Ramo Corporation.

Ownership of the enlarged enterprise will be vested approximately 35% with existing Teleregister shareholders and the balance with Martin Marietta Corp. and Thompson Ramo Wooldridge. Martin Marietta now owns 90% of Bunker-Ramo (see Computers & Automation, March 1964, p. 42) with the remaining shares owned by Thompson Ramo Wooldridge.

Consummation of the proposed program is subject to execution of detailed written agreements and to approval by the stockholders of both companies.

OVERSEAS EXPANSION ANNOUNCED BY DATAMEC

Major expansion moves into the computer equipment market overseas have been announced by Datamec Corp., Mountain View, Calif.

A newly-formed subsidiary, Datamec Ltd., will be responsible for the digital magnetic tape unit manufacturer's European operations. Special studies by the firm have shown a large potential for computer equipment sales in the European markets, company officials explained.

At the same time it was disclosed that Datamec is establishing a distribution arrangement for the Japanese market.

TELEREGISTER-NIPPON AGREEMENT

The Teleregister Corp., Stamford, Conn. and the Nippon Electric Company Ltd. of Tokyo have signed a technical assistance and licensing agreement which will give the Japanese firm exclusive rights to build, use, lease and sell certain of Teleregister's electronic data processing products in Japan, in exchange for royalty payments and other fees. Teleregister produces electronic "on-line" systems for stock exchanges, brokers, banks, hotels, airlines and other industries. Nippon Electric, Japan's largest producer of communications equipment, is establishing a permanent facility in Tokyo in which Teleregister products, connected to high speed NEAC real time computers built by the Japanese firm, are being demonstrated.

Teleregister is also providing the Tokyo firm with systems design engineering and marketing assistance.

EDUCATION NEWS

PREPARE

Project PREPARE (Plan for Retraining of Employable Persons As Related to EDP) is the first full-scale program, under the United States Manpower Development and Training Act (MDTA), for the training of unskilled workers in the electronic data processing field. It was conceived by Hugh P. Donaghue, President of DATATROL Corporation (Silver Spring, Md.), and will be supervised by the DATATROL staff.

PREPARE is a seven-to-nine month course in which 35 unemployed or partially employed workers of limited educational background and skills will be trained as operators and programmers in EDP. The group of students range in age from 18 to 46, a majority are Negroes, and four are women. The average educational level is approximately that of a high school graduate.

Students were selected from hundreds of applicants after being screened by the Department of Labor (which administers the MDTA). Nine separate aptitude, intelligence and educational tests were given to interested candidates. The top 60 candidates who passed these tests were further tested by DATATROL Corporation for aptitude in electronic data processing. The final 35 candidates were selected following personal interviews by Donald Finlayson, DATATROL Project Director.

The PREPARE course is divided into three phases. All students will participate in the first phase, which will last for ten weeks and will determine their ability and aptitude for specific areas of electronic data processing. After this ten-week course they will be placed in separate "tracks" leading to training as Electronic Accounting Machine operators, or computer operators, or computer programmers.

The students will all attend mathematics and English classes in one of the Washington D.C. public schools for two hours daily. The content will be oriented specifically towards appreciation of these skills in terms of data processing. They will then be transported by bus to the data processing headquarters where they will receive practical instruction from the staff of DATATROL Corporation for an additional two and one half hours.

— Victor R. Daly, Deputy Director of USES for the District of Columbia, greets the students of Project PREPARE at the start of their first class meeting at Armstrong Adult Education Center.

Before the Department of Labor approved project PREPARE, it received assurance from private industry that the students would be employable upon successful completion of the DATATROL course. Graduating PREPARE students can anticipate salaries as trainees ranging between $325 and $520 a month, according to United States Employment Service statistics — and following experience, national salary standards indicate salaries may range from $500 to over $1000 per month.

The District of Columbia office of the United States Employment Service has the responsibility of supervising the total PREPARE program for the Department of Labor. In the educational aspects of the program, the United States Department of Health, Education and Welfare (HEW) is responsible for the selection of the teachers employed in the teaching of the English and mathematics courses in the District public schools and for the monitoring of the general educational design of the total course of study.

The cost of necessary subsistance of some of the students during the training period will be paid for by the federal government. DATATROL is donating the entire teaching staff and absorbing other expenses involved in designing and implementing project PREPARE.

This is the first coordinated effort between the federal government and private business for training workers for a future world of computers and automation.

ANALOG SIMULATION AND ENGINEERING ANALYSIS COURSE OFFERED BY EAI

One week courses in analog simulation and engineering analysis are presented on a continuous basis by Electronic Associates, Inc., Princeton, N.J., at various prominent universities throughout the country, as well as at the Company's Research and Computation Centers. The intensive short course will be offered this month at the University of Tennessee, Knoxville, Tenn. on July 20 through 24.

This particular course is designed to give scientists and engineers a working knowledge of the analog computer and its applications. During the five day course a major emphasis will be placed on the solution of practical problems rather than on the design and construction details of computer hardware. In addition, methods, techniques and applications of analog computers will also be discussed.

The prerequisite is a bachelor's degree or higher in engineering, mathematics or a physical science, including one semester (or equivalent) in differential equations. Tuition is payable in advance.
(For more information, circle 26 on the Readers Service Card.)

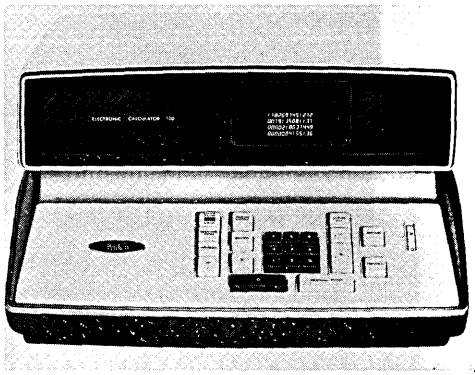
NEW PRODUCTS

Digital

FRIDEN 130 — AN ELECTRONIC CALCULATOR

Friden, Inc., the wholly-owned subsidiary of The Singer Co., New York, N.Y., has announced an all-purpose electronic desk-top calculator, the Friden 130. The device is described as being a very simple solid-state electronic computer, combining the speed and quietness of the electronic computer with the simple manual input and operational flexibility of the mechanical desk-top calculator. It is only slightly larger than a mechanical calculator in size.

The 130 operates at speeds measured in milliseconds with answers appearing almost instantaneously on the screen as control keys are released. The simple 10-key keyboard and clearly marked controls,



automatic decimal point-off, multiple registers, and other advanced features make the 130 easy to operate. Basic operation of the machine can be learned in less than five minutes.

A main feature is the automatic transfer of terms or intermediate answers which permits a logical flow of calculations. This feature of automatic storage of intermediate answers in such a way that they are always available for subsequent usage, according to the problem being solved, is expected to have particular appeal to calculator operators.

The new calculator is being manufactured at Friden's home plant in San Leandro, Calif., and is available for early delivery. (For more information, circle 29 on the Readers Service Card.)

NEW COMPUTER-CONTROLLED DATA SYSTEM FROM PB

Packard Bell Computer, Santa Ana, Calif., has introduced a computer-controlled system, designated the CDS250, for data acquisition and recording; automatic testing and checkout including integrated circuit testing; pilot plant, process and manufacturing control; and medical, biomedical and chemical laboratory studies.

The new system is centered around the Packard Bell PB250 digital computer, and includes a Flexowriter electric typewriter, an electronic multiplexer, a 64 KC, 12-bit analog-to-digital converter and a buffer and control unit to connect the system to data input channels and to supply control signals to other system elements.

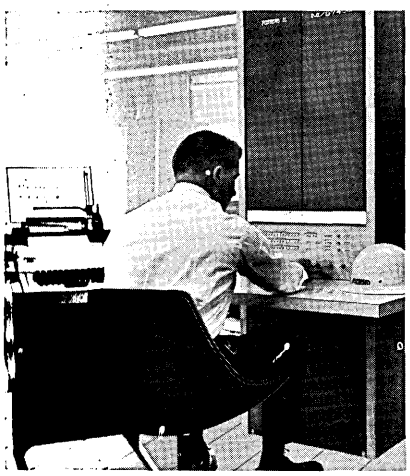
Because the CDS250 system uses a stored program digital computer, it can be easily expanded or repro-

grammed, is adaptable to changes in the number and type of inputs, basic process or control or to entirely new applications. It is contained in a single mobile rack, delivered ready for use with no further systems engineering required. A programming package for system operation is included. A two-week programming course and three-week maintenance course are offered at no additional charge. (For more information, circle 27 on the Readers Service Card.)

INDUSTRIAL COMPUTER SYSTEM

A low-cost industrial computer system, called the M/97400, has been announced by The Foxboro Company, Foxboro, Mass. It performs data logging, alarming, process supervision and control. The M/97400 samples inputs from a variety of plant instrumentation — temperatures, pressures, flows, and contact closures. The system provides contract outputs and analog signal outputs to operate valves and set-point stations. Its solid state digital computer has a library of executive routines that perform process engineering calculations and coordinate input-output. In addition it prepares typewritten logs, punched tape and can communicate with operator consoles and remote supervisory stations.

Internally, the computer includes magnetic core memory of 4096 words, optional expandable magnetic drums to 65,000 words, a complement of over 100 built-in instructions plus indirect addressing and auto-indexing. The input-



output system is composed of satellite modules, each equipped with individual buffering and priority interrupt generators. Add-on capacity both in the central processor and in all input-output sections is provided through its plug-in modular construction.

Engineering calculations and input-output may be performed simultaneously. Built-in automatic checking, over-load protection and data protection against power interruptions are also included. (For more information, circle 31 on the Readers Service Card.)

H-300, SIXTH SYSTEM IN LINE

A small, low-cost scientific computer, with fast processing speeds and a wide range of input and output devices, has become the sixth major data processing system in the Honeywell EDP (Wellesley, Mass.) product line in four years. The Honeywell 300 series is described as belonging to the same computer family as the Honeywell 200 (see Computers and Automation, January 1964, p. 32). Each has complete program and data compatibility as well as expandability in terms of size, processing speeds and storage capacity within its own series.

The H-300 has a "family interface" unit that permits it to be directly connected to its own or any of 30 different input and output devices of the H-200, or to the central processing unit of the H-200. The "family interface" permits either the H-200 or H-300 central processing unit, or both units, to share common peripheral terminals.

The new system is designed to perform the complex mathematical operations common to scientific and engineering data processing. A central processing unit with a minimum of 4096 words of storage is contained in the basic computer. (A word is 24 binary digits in size.) In addition, a control memory, used in the execution of scientific instructions, is also contained in the H-300. Internal processing takes place at a cycle speed of 1.75 microseconds in the main memory, and at 500 nanoseconds in the control memory.

A standard configuration will consist of a central processor with either paper tape reading and punching units, or a typewriter, or both, to handle input and output functions. A variety of scientific peripheral equipments will be available along with H-200 peripheral equipment.

Besides its scientific and engineering features, numerous design and program features have been implemented to give the H-300 additional capabilities in communications and business data processing.
(For more information, circle 28 on the Readers Service Card.)

PDP-7 ANNOUNCED BY DIGITAL

A fast, general purpose computer, the Programmed Data Processor-7, has been developed by Digital Equipment Corp., Maynard, Mass. The PDP-7 uses all-silicon, 10 megacycle processing circuits. It has a 1.75 microsecond core memory and an average high-speed multiply time of 4.4 microseconds. It adds two 18-bit numbers in 3.5 microseconds and performs a high-speed division in an average time of 9 microseconds.

The typical system includes processor, real-time control, high-speed multiply and divide element, up to 32,768 words of core memory, input/output typewriter, and high-speed paper tape reader and punch. Like Digital's other PDPs, the new computer is designed for scientific and engineering calculations, experiment control, on-line data collection and analysis, and general computing applications.

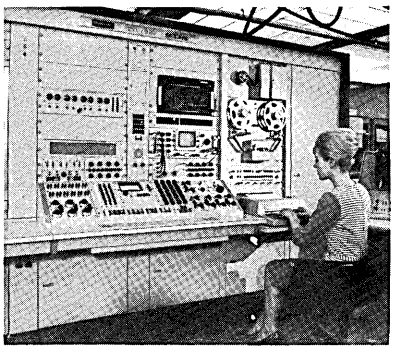
An extensive programming system is available for the new PDP-7 and includes a FORTRAN operating system, FORTRAN compiler and library, symbolic assembler and relocating linking loader, on-line symbolic debugging program, symbolic tape editor, and arithmetic utility, and maintenance routines. (For more information, circle 30 on the Readers Service Card.)

Digital-Analog

BECKMAN/SDS INTEGRATED COMPUTER SYSTEM

A solid-state computer system combining standard analog and digital techniques into a single computer has been introduced by Beckman Instruments, Inc. (Fullerton, Calif.), and Scientific Data Systems, Inc. (Santa Monica, Calif.). The new computer, called the Beckman/SDS Integrated Computer System, is said to be the first computer with capabilities for solving separately and in combination the advanced analog and digital problems formerly requiring the use of two computers.

The system will be offered in a series of eight standard models using one of two Beckman analog computers and any of four SDS digital computers. The computer shown in the picture below has a Beckman 2200 analog computer and an SDS 920 digital computer linked together in an integrated system with standard interface.



The new computer will enable scientists and engineers to solve a growing class of design and simulation problems beyond the scope of conventional separate analog and digital equipment. It is particularly suited to 'real time' problem solving and simulation in major aerospace and industrial process control applications.

In addition, a complete programming system has been developed for use with the computer. The programming system instructs the computer in how to analyze the problem, determines which part can best be solved with analog or digital techniques, and then controls the various functions involved in actually solving the problem.
(For more information, circle 32 on the Readers Service Card.)

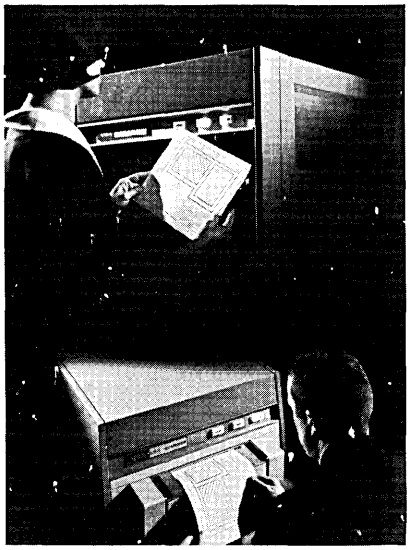
Data Transmitters and A/D Converters

LDX TRANSMISSION SYSTEM

Anything written, typed, sketched or printed may be transmitted electronically between two distant points in seconds using the LDX (long distance xerography) System introduced by Xerox Corp., New York, N.Y. Xerox researchers have tested LDX over distances upwards of 4000 miles and report excellent results at speeds up to eight feet of copy per minute.

The system consists basically of a scanner, a transmission link or network and a printer. When a document is fed into a scanner its image is converted into electrical signals for transmission over the broadband communication links which are now available. When the signals have been transmitted and received, they are converted back into light images and the document is reproduced in the printer through xerography.

The scanner document handling mechanism will accept documents as small as 4 x 5 inches and as large as 9½ inches in width, and unlimited length. The system can handle nearly all shades of paper since the scanner automatically adjusts to different paper backgrounds. Additionally, it has the capability for scanning both positive and negative copy and can handle tabulating cards.



— The LDX Printer above, reproduces in seconds even though thousands of miles away from the LDX Scanner, below. Broadband transmission links join the two units.

At the receiving end, reproduction is on ordinary bond paper or offset stock. An automatic cutter trims the documents to size as they emerge from the printer. Paper is supplied from a 2000 ft-long continuous web. A buzzer warns the operator when the supply is running low; the system automatically will shut down before the printer is out of paper.

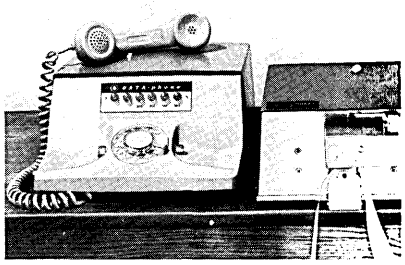
The scanner and printer are connected together by a supervisory control feedback loop so that a malfunction in either of the terminal facilities or in the communication link causes the scanner to shut the system off.

Applications for the LDX system are foreseen in any commercial or government situation where a volume of documents must move from one point to another.
(For more information, circle 34 on the Readers Service Card.)

DATA-PHONE DATA TRANSMITTER ANNOUNCED BY TALLY

Tally Corporation, Seattle, Wash., has announced the availability of a data transmission terminal which can be used to send all kinds of business and scientific data over the telephone at 600 words per minute.

The new unit, known as the Mark 10, can be used to solve data gathering problems whenever collection from multiple points for processing by central computer or other EDP equipment is required. The data transmission terminal transmits data on perforated paper tape at 60 characters per second using Bell System Model 402 Data-Phones. Any Tally receiving terminal will relieve incoming data. Size is only 8½" wide x 4" high x 11" deep.



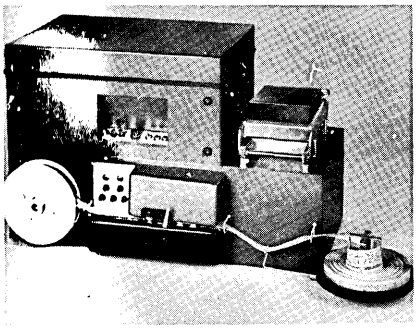
— Mark 10 with 402 Data-Phone

Typical applications include inventory control problems found in any kind of chain store operation, payroll and accounting prob-

lems of any manufacturing or service organizations with many locations, field to laboratory data acquisition situations encountered in missile and space engineering, petro-chemical computer processing control, etc. The terminal rents for $25 per month.
(For more information, circle 33 on the Readers Service Card.)

PAPER TAPE TO MAGNETIC TAPE CONVERTER

Digi-Data Corp., Hyattsville, Md., has introduced its Model 1810 Paper Tape to Magnetic Tape Converter. This is a small table top unit designed to perform off line conversion of all types of paper tapes to computer compatible magnetic tape. Primary advantages related for the Model 1810 are:



(1) modest cost; (2) simplicity of programming by means of IBM type plug board; (3) small space requirements; and (4) ease of service.
(For more information, circle 35 on the Readers Service Card.)

Software

SCERT PROGRAM NOW INCLUDES ALL MODELS OF IBM SYSTEM/360

COMRESS, Inc., Washington, D.C., has announced the inclusion of the necessary hardware and software factors of all models of IBM's new SYSTEM/360 in the computer program SCERT (Systems and Computers Evaluation and Review Technique), used for evaluating systems and computers. This brings the number of computer systems which can be simulated by the SCERT program to seventy basic systems.

In addition, as a result of recent European contracts for the use of the SCERT program, SCERT has been translated and now produces its management reports in seven different languages.
(For more information, circle 36 on the Readers Service Card.)

IBM COMPUTER PROGRAM GIVES SECURITY ANALYSTS WIDER MARKET VIEW

A new computer program, called the Financial Analysis Program, has been announced by IBM Corp., White Plains, N.Y. This will enable professional security analysts to examine a greater amount of useful information in appraising common stocks. The program makes it possible for an analyst to use an IBM 1401 data processing system to secure a variety of reports, which free him from much of the clerical work he must now perform in order to assemble information on which he bases decisions. It makes no judgement on market prospects or the prospects of individual stocks — but merely serves as a supplement to the analyst's personal judgement, experience and the various techniques he now uses in making stock evaluations.

For example, the program enables an analyst to secure — in minutes — a complete ten-year financial history of any company, group of companies or entire industry before coming to any conclusions about stocks.

The Financial Analysis Program is designed for use with a magnetic tape file containing information on the financial history of any number of companies. This would include balance sheet information, income statements and market data. This tape, called a financial data tape, may be prepared by the user or obtained from an organization which makes it commercially available. (IBM does not provide financial data tapes.)

A user may tailor the new program to his specific needs. For example, if industry or market data is available, a comparison may be made between such data and individual company results. Information on as many companies as are desired may be processed in a single computer run.
(For more information, circle 37 on the Readers Service Card.)

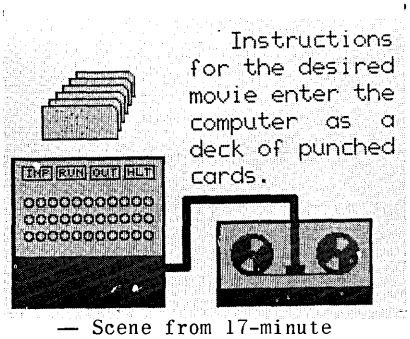
SDS ANNOUNCES ADVANCED PROGRAMMING SYSTEMS

Scientific Data Systems, Inc., Santa Monica, Calif., has announced four new advanced programming systems for use with the SDS 900 Series computers. The systems are: (1) MONARCH, a batch processing monitor system which permits the sequential processing of intermixed program assemblies, compilations, and executions under typewriter or card control with a minimum of operator intervention; (2) META-SYMBOL, a procedure-oriented symbolic assembly system consisting of a high-level symbolic language and processor; (3) Real-Time FORTRAN II, an expansion of the basic SDS FORTRAN II; and ALGOL, a comprehensive implementation of ALGOL 60, the international algorithmic language. All of the systems will be part of the standard SDS software package by the end of 1964.
(For more information, circle 40 on the Readers Service Card.)

"MOVIE LANGUAGE" DEVELOPED FOR MAKING ANIMATED FILMS BY COMPUTER

A general programming language has been developed at Bell Telephone Laboratories, New York, N.Y., for making simple animated films quickly and inexpensively with a computer.

The "movie language", called BEFLIX (Bell Flicks), was developed by Kenneth C. Knowlton within the framework of the MACRO FAP programming language.



— Scene from 17-minute animated film produced by a computer programmed in the new BEFLIX language. This self-explanatory film is entitled, "A Computer Technique for the Production of Animated Movies".

The language includes instructions for drawing pictures consisting of straight lines, arcs, complicated curves, letters, simple geometric shapes and shaded areas. BEFLIX also makes possible many special effects, such as "dissolving" by gradually "sprinkling" the new picture onto the previous one.

Newsletter

Computers can be programmed with this language to make educational films and to generate visual displays for psychological experiments or depict certain of their own operations.
(For more information, circle 39 on the Readers Service Card.)

Information Retrieval

MICROFILM READER-PRINTER

The Social Security Administration has revealed a new automated device that can turn out a copy of a microfilmed document in less than three seconds. The equipment, called a microfilm reader-printer, was developed by Old Town Corp., Brooklyn, N.Y. It is designed to speed the handling of thousands of microfilmed records annually processed by the government agency, and is expected to cut substantially the cost of copying the records.

The electrostatic machine can search through hundreds of microfilmed documents, extract the information needed in each document and produce a composite print containing only the desired material. The device can be instructed to arrange the information in any desired sequence. An 8" x 10" print can contain data from more than 20 different documents.

— New device can turn out copies of microfilmed documents in less than three seconds.

A new processing technique enables the machine to make prints without the aid of developing fluid, eliminating the need for "dark room" in copying microfilm records. The machine is reportedly easier to operate than existing equipment and requires only about 10 per cent of the space.

The Old Town machine can be used to copy microfilmed documents in banks, stores and other business firms as well as in libraries and educational institutions.
(For more information, circle 41 on the Readers Service Card.)

Memories

PIGGYBACK TWISTOR: NONDESTRUCTIVE READ-OUT MEMORY

A new type of electrically alterable, nondestructive readout memory has been developed at the Bell Telephone Laboratories, New York, N.Y. The memory, termed the Piggyback Twistor, operates in microseconds and has a storage capacity of more than 200,000 bits. It is being investigated for applications in a number of telephone switching systems.

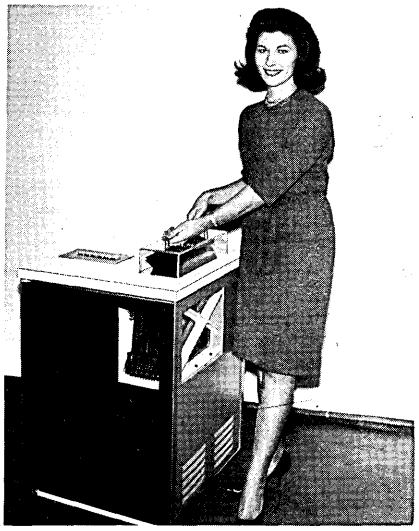
The Piggyback Twistor uses two magnetic materials: one to store information, the other to sense the stored information. Both mangetic materials are in the form of thin narrow tapes spirally wrapped around a fine copper conductor. The tapes are wrapped one on top of the other, piggyback fashion; hence the name.

The Piggyback Twistor was developed by W. A. Baker from an earlier invention of W. A. Barrett. This memory has 4096 words, each storing 54 bits of information. Each one of the words consists of a copper strap which is wrapped around a flat cable containing 54 twistor wire pairs. A binary digit (bit) is stored at the intersection of each word strap and twistor pair. There are more than 200,000 such intersections in the memory. This is called nondestructive read-out. The contents of the memory can be changed only when the proper combination of pulses is applied to the memory.

In previous nondestructive read-out twistor memories, information content was changed by removing a magnet card and replacing it with a modified card. The Piggyback Twistor memory can be changed automatically, by remote control, and thousands of times faster than card changeable memories.
(For more information, circle 42 on the Readers Service Card.)

NEW SMALL SCALE MEMORY SYSTEM

A new Random Access Disk File, named the Model 80, has been introduced by Anelex Corporation, Boston, Mass. The memory is a low cost, high performance system. It uses interchangeable disk kits, with a storage capacity of 3.9 million 7 bit characters per kit. The disk kit is a modular package containing six disks. Kits are light, easily interchanged, and provide protection for the disks at all times. This system provides a storage capacity limited only by the size of the user's disk kit library.



The Model 80 is compact, about the size of a bridge table. It has all the built-in reliability and ease of maintenance of the larger Anelex Model 800 and 4800 files. Designed primarily for use with medium to small scale data processing systems and sub-systems, the flexibility in data packing makes it suitable for application to large scale systems as well.
(For more information, circle 43 on the Readers Service Card.)

FRIDEN 6018 MAGNETIC DISC FILE

The new Friden 6018 Magnetic Disc File, introduced by Friden, Inc., a subsidiary of the Singer Co., San Leandro, Calif., operates on-line with the 6010 computer. Each side of a disc contains 960 individually addressable computer words of 64 characters each, or a total of 61,440 characters of on-line storage. The discs are interchangeable, thereby making off-line storage unlimited.

Automatic address verification assures that each record is properly located. The variable length data

capability permits use of records of any size. Data may be recorded on the disc through the 6011 Flexowriter® or directly from the Friden 6010 central processor. An entire system — 6010 Electronic Computer and 6018 Magnetic Disc File — takes up little more space than a secretary's desk.
(For more information, circle 44 on the Readers Service Card.)

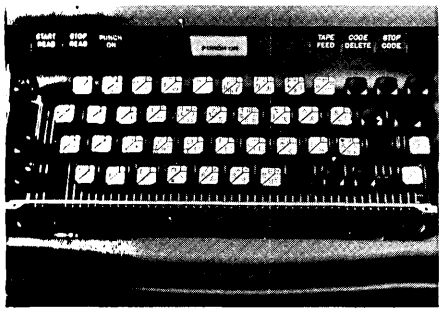
Input-Output

CHICODER MERGES LANGUAGE, SCIENCE

Itek Corp., Lexington, Mass., has developed a new machine that permits the rapid keypunching or typing of Chinese, Japanese and other Oriental languages. The machine, known as the Chicoder, was sponsored by the Research & Technology Division of the Air Force Systems Command at the Rome Air Development Center primarily for use in the Automatic Translation of Chinese. It also is expected to have applications in computer input/output, telecommunications and printing.

The machine is readily operated by typists unfamiliar with Oriental languages. In contrast to many devices invented over the years to solve the problem, the Chicoder is simple and inexpensive. It is equivalent in circuit complexity to a standard electric typewriter punch and only about twice as large.

The device contains over 10,500 ideographs as well as mathematical symbols and punctuation



— Keyboard close-up

marks. These are recorded photographically in sets (or families) having similar top and bottom features, according to a classification scheme first devised by the noted author Lin Yutang. Key locations for only 36 top and 32 bottom features need be learned.

Only three strokes are required for a Chicoder operator to encode an ideograph. After typing in a top and bottom feature, a typist has a family of ideographs displayed to her on a screen. She

— An Itek Chicoder operator is shown encoding an ideograph from a Chinese newspaper.

then selects the desired ideograph by typing in its order number in the family. Typists have achieved speeds over 40 ideographs per minute with relatively little training.

The same master matrix, which can accommodate 30,000 characters, is used for ideograph display and print-out. A punched paper tape record is also produced which can be entered into a computer or into a data set for transmission. In a reverse mode, the Chicoder can be driven by punched tape to serve as a computer output printer or message receiver.

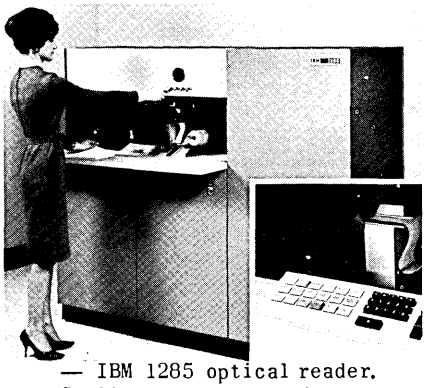
Japanese characters have already been entered into the machine, and other languages will be added in the future.
(For more information, circle 45 on the Readers Service Card.)

NEW IBM UNIT SCANS CASH REGISTER TAPES FOR FAST COMPUTER PROCESSING

A new high-speed optical reader has been developed by IBM Corp., White Plains, N.Y. The device can scan rolls of ordinary cash register tape and transfer the information to a computer at electronic speeds.

The new optical reader, IBM 1285, can read all entries on a 200-foot tape roll in three-and-a half minutes at speeds up to 3000 lines a minute. By using cash registers and adding machines (equipped with certain optical type fonts) as computer input units, the 1285 can speed the flow of vital sales information to manufacturers and retailers. The need to transfer the data from tapes to punched cards is eliminated.

Sales for all items can be rung up anywhere in a store. A sales clerk simply rings up on any register the price of the item along with coded information such as department and style number. Finished tapes then are placed on the scanner and threaded automatically. Pertinent information is read by the 1285 and passed on to the computer which then can update its records instantaneously for management review.



— IBM 1285 optical reader. Small round screen above control unit's buttons is used to display characters being read. Inset shows keyboard used to enter or change information.

The reader automatically skips blank spaces on the tape, increasing the speed at which information is read and transferred to the computer. If it locates a line containing a sub-standard character, the 1285 marks the tape with a dot at that point so a correction can be keyed in later. The reader also can be programmed to stop when it detects an error and display on its screen the erroneous character. The operator then can make a correction immediately by keying in on the console only the non-readable character.

The 1285 uses Solid Logic Technology circuitry introduced recently with IBM System/360, and an electronic beam of light, called a "flying spot", for high-speed type scanning. It is designed for use with IBM's 1401, 1440 or 1460 computers and with the new System/360.
(For more information, circle 50 on the Readers Service Card.)

SEFAC, ALPHA-NUMERIC DISPLAY SYSTEM

Contronics, Inc., Boston, Mass., has announced a new system for alpha-numeric display, called SEFAC (System for Electronic Flight Announcement and Control). It was

developed from and incorporates features of SAND. While the SEFAC system was specifically developed for airline customer arrival and departure applications, its versatility, flexibility, and ease of operation make it adaptable to many applications.

The system can be broken down into three main assemblies: (1) the operator's console which houses the alpha-numeric keyboard, the special function command-control panel, and the operator's monitor; (2) the main rack assembly which houses the magnetic core memory, the system power supplies, the digital logic, and analog circuitry for the system; and (3) the monitors which actually display the information to remote locations in the terminal.

When a key is pressed on the keyboard, six bits of digital data which define that character are fed into the input of the magnetic core memory in the main rack assembly where it is stored in ferrite cores. Data is transferred out of the memory through the digital logic, is decoded, and a character waveform representing that particular symbol is then fed to the monitor inputs, and the character is viewed on the screen. The special function command-control panel permits the operator to write characters in any of the memory channels, to display the written information on one of the four output channels, and provides automatic editing.

The standard storage medium is a 4096 x 6 coincident-current ferrite core memory system which may be addressed randomly in either a full cycle or half cycle mode of operation. The system uses a temperature stabilized memory unit to maintain a fixed operation temperature for the ferrite cores. A data saver circuit is also used to prevent the loss of information due to excessive a-c line variations or when power is turned off or accidentally removed from the system.

All alpha-numeric symbols are displayed in a continuous trace which enables variation in the size of characters. Characters are generated constantly in the character generator — input information merely selects the correct symbol to be sequentially displayed in position.
(For more information, circle 46 on the Readers Service Card.)

NEW LITERATURE

DIRECTORY LISTS AMERICAN INTERESTS IN UK

A directory "American electronics and instruments interests in the United Kingdom" by David Rayner, editor (David Rayner Associates, London, England) is claimed by its publishers to be the most comprehensive list of American interests in the UK electronics and instruments business available at this time.

It is divided into two parts: the first gives those American firms which are the principals, parents or licensors of firms in the UK; the second part gives the corresponding agents, subsidiaries and licensees in the UK. The address of each company is given and the entries are cross-referenced so that the interests of large companies are brought together.

The directory is available from Bob Denham, US office DRA, 510 Madison Ave., New York 22, N.Y., for $6.

USED EDP EQUIPMENT

Used electronic data processing equipment for sale is described in Information Processing Systems' latest Equipment Bulletin. Used equipment wanted by buyers is also listed. Copies may be obtained from: Information Processing Systems, Inc., 200 W. 57th St., New York, N.Y. 10019

STANDARDS NEWS

CHARACTER RECOGNITION, INFORMATION INTERCHANGE HEADED FOR WORLD STANDARDIZATION

Worldwide standards on optical and magnetic ink character recognition and information interchange between computers and business machines have been recommended for adoption by the International Organization for Standardization (ISO), Geneva, Switzerland. ISO's Technical Committee 97 on computers and information processing approved draft proposals of these standards at a series of meetings in New York — the first time that TC 97 has ever met in the United States.

ISO's proposal in the field of optical character recognition covers a numeric set, three abstract symbols and a control mark. It defines four standard sizes in standard shapes to allow optical reading of imprints from credit cards, typewriters, cash registers and EDP printers.

The new code for information interchange includes recommendations for both six bit and seven character sets. It identifies each of the 64 (6 bit) and 128 (7 bit) character codes in binary representation and assigns to each code an alphabetic, numerical or special symbol or equipment control function. Some of the code positions have been left unassigned to meet the national needs of individual countries. The code is generally compatible with the American Standard Code for Information Interchange (ASCII) approved by ASA (American Standards Association) under BEMA (Business Equipment Manufacturers' Association) sponsorship last year.

Another proposal, also approved for letter ballot, specifies the method of implementing this code in perforated paper tape.

The ISO draft proposal for magnetic ink character recognition deals with specifications for a standard size and shape for numbers and special symbols that have gained such wide usage in check processing. Two different type fonts identified as E13B and CMC 7 are being proposed. The resolution notes that the two are "of equal status and are not to be considered as alternatives".

The ISO meetings resulted in the passing of 24 draft resolutions. The American Standards Association, the U.S. member of ISO, was official host under sponsorship of the Business Equipment Manufacturers Association. BEMA is also the sponsor of a national standards program under ASA procedures.

BUSINESS NEWS

BOXSCORE OF SALES & INCOME FOR COMPUTER FIELD FIRMS

C&A presents below comparative operating results for firms of interest to computer people, as distilled from the latest group of news releases.

COMPANY	PERIOD	SALES Current period / Previous period	(%)	NET INCOME Current period / Previous period	(%)	NOTES
Addressograph-Multigraph	Nine months ended April 30, 1964	$181,699,329 / $171,618,346	(+5.8%)	$11,163,952 / $10,552,606	(+5.7%)	
Anelex	Six months ended March 31, 1964	$9,074,563 / $6,472,901	(+40.1%)	$529,986 / $287,661	(+84.1%)	President Anderson expects company's disk files should be in production late in 1964.
Audio Devices	Three months ended March 31, 1964	$2,461,818 / $1,899,050	(+30.2%)	$139,063 / $123,480	(+12.6%)	President Hack said company is developing special new tapes for two computer manufacturers.
Beckman Instruments	Three months ended March 31, 1964	$21,445,231 / $20,460,057	(+4.9%)	$668,405 / $996,389	(-32.9%)	
Burroughs	Three months ended March 31, 1964	$87,563,000 / $90,160,000	(-2.9%)	$1,910,000 / $1,722,000	(+11.0%)	President Eppert said the decline in revenues was due to decreased military billings.
Clary	Three months ended March 31, 1964	$2,748,000 / $2,336,000	(+17.6%)	$150,000 / $112,000	(+33.9%)	Chairman Clary announced an increase of 114% in order backlog.
Control Data	Nine months ended March 31, 1964	$82,794,100 / $40,411,190	(+105%)	$4,305,810 / $1,708,660	(+94.1%)	Company introduced 3200,8090, and 160G computer systems in last quarter.
Documentation, Inc.	Year ended March 31, 1964	$4,495,213 / $2,714,569	(+65.5%)	$106,996 / $53,440	(+100%)	President Miller said sales next year "might top $6 million".
Electronic Associates	Three months ended April 3, 1964	$6,984,000 / $6,392,000	(+9.2%)	$458,990 / $350,780	(+33.7%)	
General Dynamics	Three months ended March 31, 1964	$377,731,000 / $349,662,000	(+8.0%)	$7,290,000 / $4,904,000	(+48.8%)	
General Precision	Three months ended March 31, 1964	$48,051,293 / $48,224,241	(-0.04%)	$987,298 / $783,672	(+26.1%)	
General Telephone & Telegraph	Three months ended March 31, 1964	$170,737,000 / $151,301,000	(+12.6%)	$25,387,000 / $22,060,000	(+15.0%)	
Honeywell	Three months ended March 31, 1964	$157,607,388 / $147,582,300	(+6.3%)	$8,260,043 / $6,164,156	(+34.1%)	Increased income partly due to recent sales of computers to government, Chmn. Wishart noted.
IBM	Three months ended March 31, 1964	$831,734,938 / $666,400,337	(+24.8%)	$114,822,737 / $78,593,023	(+46.1%)	Chmn. Watson noted that recent computer purchases by federal government helped substantial gain in income.
ITEK	Six months ended March 27, 1964	$20,253,000 / $16,054,000	(+26.1%)	$442,000 / $314,000	(+40.7%)	
ITT	Three months ended March 31, 1964	$324,273,289 / $292,507,492	(+11.0%)	$12,321,799 / $10,662,682	(+16.0%)	
3M	Three months ended March 31, 1964	$192,079,000 / $174,495,000	(+10.3%)	$20,878,000 / $19,460,000	(+7.2%)	
NCR	Three months ended March 31, 1964	$140,757,000 / $125,021,703	(+12.0%)	$4,093,471 / $3,746,350	(+9.3%)	Chmn. Oelman said results from overseas countries were particularly noteworthy.
Packard-Bell	Six months ended March 31, 1964	$21,922,000 / $27,553,000	(-20.5%)	$348,000 / $752,000	(-53.7%)	Chmn. Bell noted that the tardily delivered PB440 exceeded specifications.
Singer	Three months ended March 31, 1964	$204,741,000 / $188,358,000	(+8.5%)	$12,551,000 / $10,805,000	(+15.7%)	Figures include operations of Friden, Inc., Singer's new subsidiary.
Standard Register	Three months ended March 31, 1964	$16,531,612 / $16,644,428	(-0.06%)	$585,479 / $933,999	(-37.3%)	
Whittaker	Six months ended May 3, 1964	$22,618,673 / $19,495,157	(+16.4%)	$804,732 / $1,130,838	(Loss)	Company recently changed its name from Telecomputing Corporation.

MONTHLY COMPUTER CENSUS

The number of electronic computers installed or in production at any one time has been increasing at a bewildering pace in the past several years. New vendors have come into the computer market, and familiar machines have gone out of production. Some new machines have been received with open arms by users — others have been given the cold shoulder.

To aid our readers in keeping up with this mushrooming activity, the editors of COMPUTERS AND AUTOMATION present this monthly report on the number of general purpose electronic computers of American-based companies which are installed or on order as of the preceding month. These figures included installations and orders outside the United States. We update this computer census monthly, so that it will serve as a "box-score" of progress for readers interested in following the growth of the American computer industry, and of the computing power it builds.

Most of the installation figures, and some of the unfilled order figures, are verified by the respective manufacturers. In cases where this is not so, estimates are based on information in the market research reference files of COMPUTERS AND AUTOMATION. The figures are then reviewed by a group of computer industry cognoscenti.

Any additions, or corrections, from informed readers will be welcomed.

AS OF JUNE 10, 1964

NAME OF MANUFACTURER	NAME OF COMPUTER	SOLID STATE?	AVERAGE MONTHLY RENTAL	DATE OF FIRST INSTALLATION	NUMBER OF INSTALLATIONS	NUMBER OF UNFILLED ORDERS**
Addressograph-Multigraph Corporation	EDP 900 system	Y	$7500	2/61	16	7
Advanced Scientific Instruments	ASI 210	Y	$2850	4/62	18	2
	ASI 2100	Y	$3000	12/63	4	2
Autonetics	RECOMP II	Y	$2495	11/58	68	X
	RECOMP III	Y	$1495	6/61	18	X
Bunker-Ramo Corp.	TRW-230	Y	$2680	8/63	11	2
	RW-300	Y	$5500	3/59	40	X
	TRW-330	Y	$5000	12/60	30	X
	TRW-340	Y	$7000	12/63	4	14
	TRW-530	Y	$6000	8/61	22	4
Burroughs	205	N	$4600	1/54	64	X
	220	N	$14,000	10/58	44	X
	E101-103	N	$875	1/56	130	X
	E2100	Y	$535	8/64	0	625
	B100	Y	$2800	5/64	2	33
	B250	Y	$4200	11/61	47	13
	B260	Y	$3750	11/62	74	56
	B270	Y	$7000	7/62	65	46
	B280	Y	$6500	7/62	88	51
	B5000	Y	$16,200	3/63	32	24
Clary	DE-60/DE-60M	Y	$525	2/60	216	5
Computer Control Co.	DDP-19	Y	$2800	6/61	3	X
	DDP-24	Y	$2500	5/63	23	16
	DDP-224	Y	$3300	12/64	0	5
Control Data Corporation	G-15	N	$1000	7/55	304	X
	G-20	Y	$15,500	4/61	27	X
	160/160A*	Y	$1750/$3000	5/60 & 7/61	362	14
	924/924A	Y	$11,000	8/61	28	6
	1604/1604A	Y	$35,000	1/60	57	2
	3600	Y	$52,000	6/63	16	25
	3400	Y	$32,000	11/64	0	17
	3200	Y	$9000	5/64	1	52
	6600	Y	$150,000	5/64	1	2
Digital Equipment Corp.	PDP-1	Y	Sold only about $120,000	11/60	52	4
	PDP-4	Y	Sold only about $60,000	8/62	28	10
	PDP-5	Y	Sold only about $25,000	9/63	34	28
	PDP-6	Y	Sold only about $300,000	7/64	0	4
	PDP-7	Y	Sold only about $72,000	10/64	0	2
El-tronics, Inc.	ALWAC IIIE	N	$1820	2/54	24	X
Friden	6010	Y	Sold only about $20,000	6/63	115	100
General Electric	210	Y	$16,000	7/59	73	1
	215	Y	$5500	11/63	19	4
	225	Y	$7000	1/61	166	6
	235	Y	$10,900	12/63	10	8
	415	Y	$5500	10/64	0	105
	425	Y	$7500	7/64	0	36
	435	Y	$12,000	10/64	0	19
	455	Y	$18,000	6/65	0	10
	465	Y	$24,000	6/65	0	5

NAME OF MANUFACTURER	NAME OF COMPUTER	STATE STATE?	AVERAGE MONTHLY RENTAL	DATE OF FIRST INSTALLATION	NUMBER OF INSTALLATIONS	NUMBER OF UNFILLED ORDERS**
General Precision	LGP-21	Y	$725	12/62	107	55
	LGP-30	semi	$1300	9/56	445	4
	RPC-4000	Y	$1875	1/61	101	2
Honeywell Electronic Data Processing	H-200	Y	$4200	3/64	7	490
	H-300	Y	$3900	7/65	0	8
	H-400	Y	$5000	12/61	95	18
	H-800	Y	$22,000	12/60	61	3
	H-1400	Y	$14,000	1/64	6	10
	H-1800	Y	$30,000	1/64	3	7
	DATAmatic 1000	N	---	12/57	5	X
H-W Electronics, Inc.	HW-15K	Y	$490	6/63	3	3
IBM	305	N	$3600	12/57	540	X
	360/30	Y	$4200	7/65	0	550
	360/40	Y	$9600	7/65	0	210
	360/50	Y	$18,000	9/65	0	170
	360/60	Y	$35,000	10/65	0	85
	360/62	Y	$50,000	11/65	0	18
	360/70	Y	$80,000	10/65	0	90
	650-card	N	$4000	11/54	410	X
	650-RAMAC	N	$9000	11/54	82	X
	1401	Y	$4500	9/60	6950	750
	1401-G	Y	$1900	5/64	20	900
	1410	Y	$12,000	11/61	310	170
	1440	Y	$1800	4/63	900	1600
	1460	Y	$9800	10/63	255	480
	1620	Y	$2000	9/60	1480	30
	701	N	$5000	4/53	1	X
	7010	Y	$19,175	10/63	35	31
	702	N	$6900	2/55	2	X
	7030	Y	$160,000	5/61	6	X
	704	N	$32,000	12/55	44	X
	7040	Y	$14,000	6/63	42	50
	7044	Y	$26,000	6/63	32	18
	705	N	$30,000	11/55	88	X
	7070, 2, 4	Y	$24,000	3/60	480	60
	7080	Y	$55,000	8/61	68	10
	709	N	$40,000	8/58	11	X
	7090	Y	$64,000	11/59	60	4
	7094	Y	$70,000	9/62	250	30
	7094 II	Y	$76,000	4/64	25	85
ITT	7300 ADX	Y	$18,000	7/62	8	6
Monroe Calculating Machine Co.	Monrobot IX	N	Sold only - $5800	3/59	160	X
	Monrobot XI	Y	$700	12/60	380	180
National Cash Register Co.	NCR - 304	Y	$14,000	1/60	26	0
	- 310	Y	$2000	5/61	46	1
	- 315	Y	$8500	5/62	174	100
	- 390	Y	$1850	5/61	580	175
Packard Bell	PB 250	Y	$1200	12/60	153	10
	PB 440	Y	$3500	3/64	2	8
Philco	1000	Y	$7010	6/63	16	7
	2000-212	Y	$52,000	1/63	6	5
	-210,211	Y	$40,000	10/58	19	4
Radio Corp. of America	Bizmac	N		-/56	4	X
	RCA 301	Y	$6000	2/61	414	155
	RCA 3301	Y	$20,000	4/64	1	16
	RCA 501	Y	$15,000	6/59	96	4
	RCA 601	Y	$35,000	11/62	4	1
Scientific Data Systems Inc.	SDS-910	Y	$2000	8/62	59	38
	SDS-920	Y	$2700	9/62	45	8
	SDS-930	Y	$4000	5/64	1	14
	SDS-9300	Y	$7000	8/64	0	2
UNIVAC	I & II	N	$25,000	3/51 & 11/57	33	X
	Solid-State II	Y	$8500	9/62	41	4
	III	Y	$20,000	8/62	68	65
	File Computers	N	$15,000	8/56	40	X
	Solid-State 80, 90, & Step	Y	$8000	8/58	344	1
	418	Y	$11,000	6/63	5	8
	490	Y	$26,000	12/61	32	24
	1004	Y	$1900	2/63	1250	1075
	1050	Y	$8000	9/63	47	260
	1100 Series (except 1107)	N	$35,000	12/50	15	X
	1107	Y	$45,000	10/62	18	14
	LARC	Y	$135,000	5/60	2	X
				TOTALS	19,349	9491

X = no longer in production.

* To avoid double counting, note that the Control Data 160 serves as the central processor of the NCR 310. Also many of the orders for 7044, 7074, and 7094 I and II's are not for new machines but for conversions from existing 7040, 7070, and 7090 computers respectively.

** Some of the unfilled order figures are verified by the respective manufacturers; others are estimated and then reviewed by a group of computer industry authorities.

NEW PATENTS

RAYMOND R. SKOLNICK
Reg. Patent Agent
Ford Inst. Co., Div. of Sperry Rand Corp., Long Island City 1, New York

The following is a compilation of patents pertaining to computer and associated equipment from the "Official Gazette of the U. S. Patent Office," dates of issue as indicated. Each entry consists of patent number / inventor(s) / assignee / invention. Printed copies of patents may be obtained from the U. S. Commissioner of Patents, Washington 25, D. C., at a cost of 25 cents each.

February 4, 1964

3,120,606 / John Presper Eckert, Jr. and John W. Mauchly, Philadelphia, Pa. / by Mesme assignments, to Sperry Rand Corp., a corp. of Delaware / Electronic Numerical Integrator and Computer.

3,120,618 / Charles Eugene Flickinger, Woodland Hills, Calif., and Robert L. McIntyre, Chappaqua, New York / General Precision, Inc., a corp. of Delaware / Error Signal Storage System.

3,120,653 / James Cobean Miller, Hamilton Square and Arthur W. Lo, Princeton, N. J. / Radio Corp. of America, a corp. of Delaware / Memory Systems.

February 11, 1964

3,121,173 / Arthur J. Radcliffe, Jr., La Grange, Ill. / International Telephone and Telegraph Corp., New York, N. Y., a corp. of Maryland / Logic Circuits.

3,121,176 / Joseph R. Burns, Trenton, N. J., and Juan J. Amodei, Levittown, Pa. / Radio Corp. of America, a corp. of Delaware / Shift Register Including Bistable Circuit for Static Storage and Tunnel Diode Monostable Circuit for Delay.

3,121,217 / Robert R. Seeber, Jr. and Frank R. Hartman, Poughkeepsie, N. Y. / International Business Machines Corp., New York, N. Y., a corp. of New York / Memory and Circuits Therefor.

February 18, 1964

3,121,787 / Sidney A. Bordelon, Jr., Anaheim, Calif. / Hughes Aircraft Company, Culver City, Calif., a corp. of Delaware / Digital Computer Apparatus.

3,121,806 / Carl I. Wasserman, Queens Village, N. Y. / Potter Instrument Co., Inc., Plainview, N. Y., a corp. of New York / Electronic Code Comparator.

3,121,860 / Robert F. Shaw, Locust Valley, N. Y. / Digitronics Corp., Albertson, N. Y., a corp. of Delaware / Data Translator.

3,121,861 / William G. Alexander, La Jolla, Calif. / General Dynamics Corp., Rochester, N. Y., a corp. of Delaware / Storage Apparatus.

3,121,862 / Louis N. Ridenour, Jr., Palo Alto, and Robert L. Koppel, Sunnyvale, Calif. / Lockheed Aircraft Corp., Burbank, Calif. / Magnetic Memory System.

3,121,863 / John E. Lovell, Greenwich, Conn. / International Business Machines Corp., New York, a corp. of New York / High Speed Data Tape Handling Mechanism.

February 25, 1964

3,122,231 / James T. Peace and Barney O. Rae, Milwaukee, Wis. / Cutler-Hammer, Inc., Milwaukee, Wis., a corp. of Delaware / Memory Type Storage Conveyor System.

3,122,313 / Hans H. Glattli, Kusnacht, Zurich, Switzerland / International Business Machines Corp., New York, a corp. of New York / Fluid Logical Device.

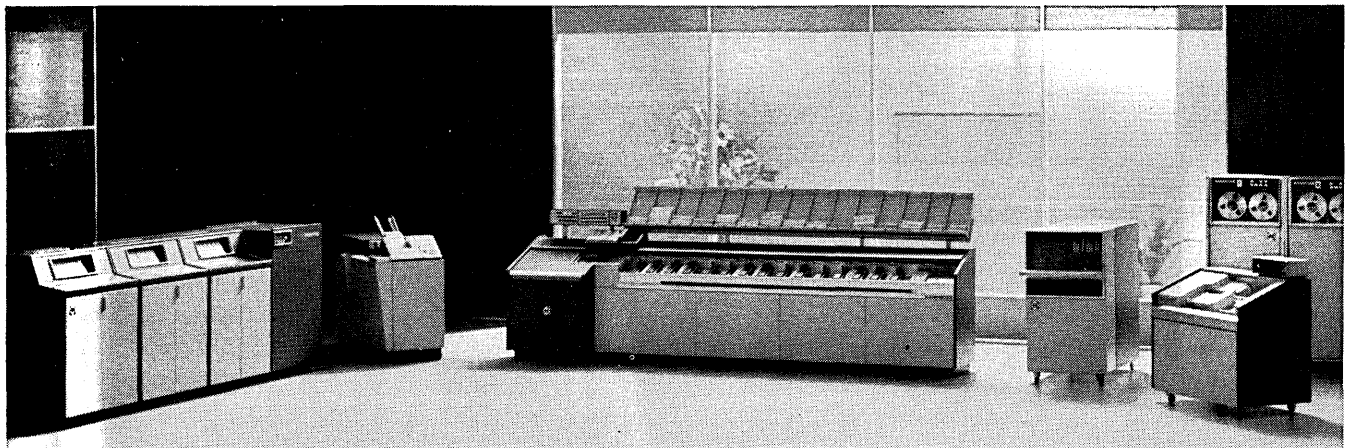
3,122,630 / Ancile E. Malden, Kingston, N. Y. / International Business Machines Corp., New York, a corp. of New York / Parity Circuit.

3,122,724 / Bruce C. Felton, Harry S. Hoffman, Jr. and Anthony S. Martello, Saugerties, N. Y. / International Business Machines Corp., New York, a corp. of New York / Magnetic Memory Sensing System.

ADVERTISING INDEX

Following is the index of advertisements. Each item contains: Name and address of the advertiser / page number where the advertisement appears / name of agency if any.

Proof-transit configuration of the new Burroughs B 370 electronic data processing system.



this new Burroughs B 370 is a generation ahead of its time

What you see here is the most advanced EDP system of its kind—the proof-transit configuration of the new Burroughs B 370, a general purpose bank data processing system. It is the only system with sixteen sorter pockets, eighteen tape listers (one per pocket plus two control tapes), speeds up to 1,500/1,600 checks per minute, a far more powerful central processor that permits multiprocessing. In other words, the new B 370 costs less per item and outproduces any other system, by as much as 30%. Call us for details.

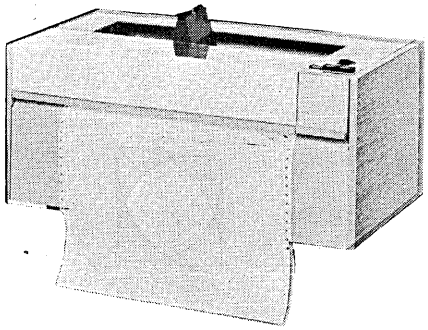
Burroughs Corporation

Burroughs—TM

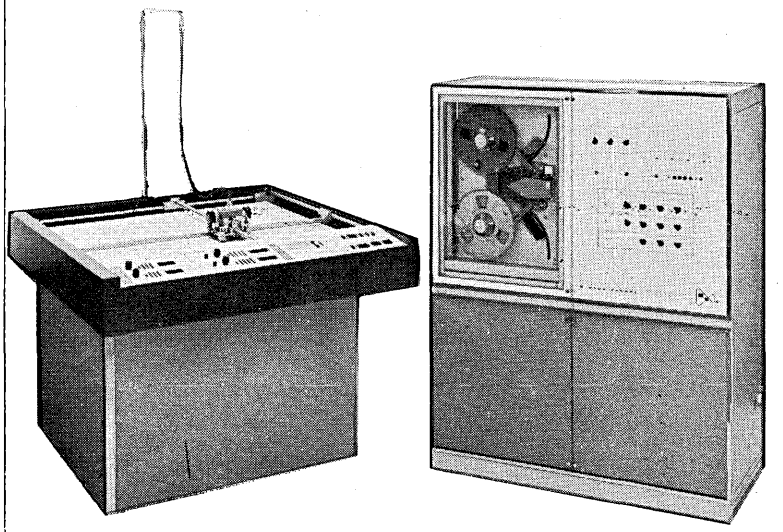
Detroit, Michigan 48232

Circle No. 16 on Readers Service Card

from COMPACT



When you pick a plotter, choose one that will do exactly the job you want. Don't pay for more, don't accept less. With Benson-Lehner's new and complete line of digital plotters and plotting systems, no job is too small or too large. The DRAFTOMATIC Incremental Plotter (shown above) is a compact, ruggedly built, precision instrument capable of drawing speeds up to 18,000 steps per minute and a high resolution of .005 inch. Designed for on-line or off-line operation with any medium scale general purpose digital computer, the DRAFTOMATIC Incremental Plotter can automatically produce fully annotated plots under computer control. Magnetic tape plotting system also available with this model plotter. ■ The new ELECTROPLOTTER II (shown below) furnishes a precise balance of speed and accuracy, permitting the broadest scope of application at the lowest cost in computer and programming time. Benson-Lehner's exclusive new double warranty policy gives you six months of factory service at no charge. It's backed by the nation's largest field service organization specializing in computer-graphic equipment. **Output:** Final, multi-color and/or multi-line width drawings of engineering quality and precision, including 48 character alpha-numeric printing. Size: 30 x 30 or 42 x 58.



to COMPLEX

benson-lehner corporation

14761 CALIFA STREET • VAN NUYS, CALIFORNIA

Circle No. 17 on Readers Service Card