DATAMATION 65

March

COMPUTING IN AUSTRALASIA

Everybody talks about tape transport reliability.

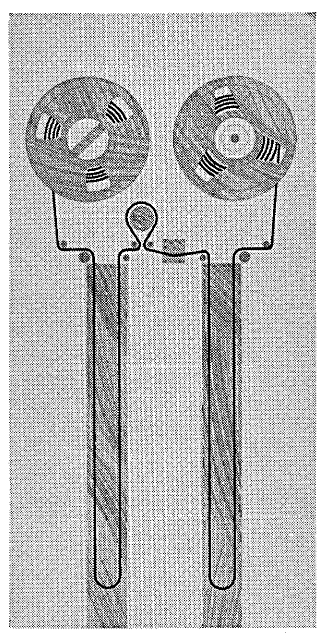
When we say reliability we mean one billion stop/start operations without replacing a single part.

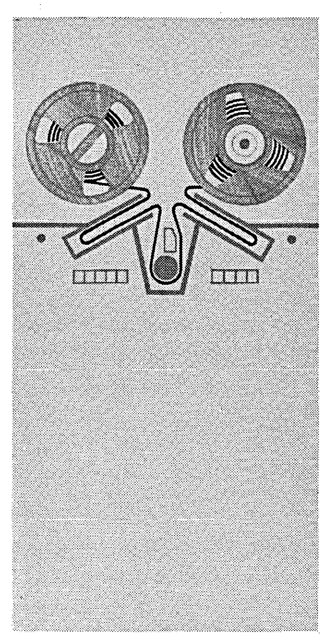
Reason? A simple (but revolutionary) single capstan drive concept that eliminates the rollers that pinch, the critical adjustments—all of the things that have previously made the transport the weak link in a computer system. Heart of the new concept is a single capstan drive and a low-friction tape path. The tape is held in contact with the capstan at all times by uniform tension derived from vacuum columns. Regardless of variations in the friction properties of the tape or mechanism, tape motion over the read/write head directly follows the servo-controlled motion of the capstan surface. The idea is simple. The results are extraordinary. The Ampex single-capstan-drive concept provides a previously-unheard-of MTBF of more than 2000 hours. It delivers 10^9 start/stop operations before minor replacement parts are needed in the drive mechanism.

In tests with data, 33 data blocks of 1024 bits (all "1's" in IBM format) were recorded at 800 bpi and re-read cyclically. *More than 160,000 passes of this one section of tape were made without a single bit error.* Everybody talks about "state-of-the-art" in tape transports. Ampex has delivered it. The new Ampex single-capstan transports are available in two configurations:

The high-speed TM-11 operates at electronically selectable speeds up to 120 ips, and densities of 200/556/800 bpi. The TM-11 meets all data formats. Plug-in 7 or 9 channel heads are available (ASCII compatible with IBM 360). Operator control panel and parity checking are optional. Militarized version available.

The medium-speed TM-7 is completely compatible with IBM tape formats and with other Ampex equipment. Packing density is 200, 556 and 800 bpi. Tape speed is electronically selectable up to 45 ips. Incremental and military versions currently under development. For complete specifications or demonstration, write Ampex Corp., Redwood City, California

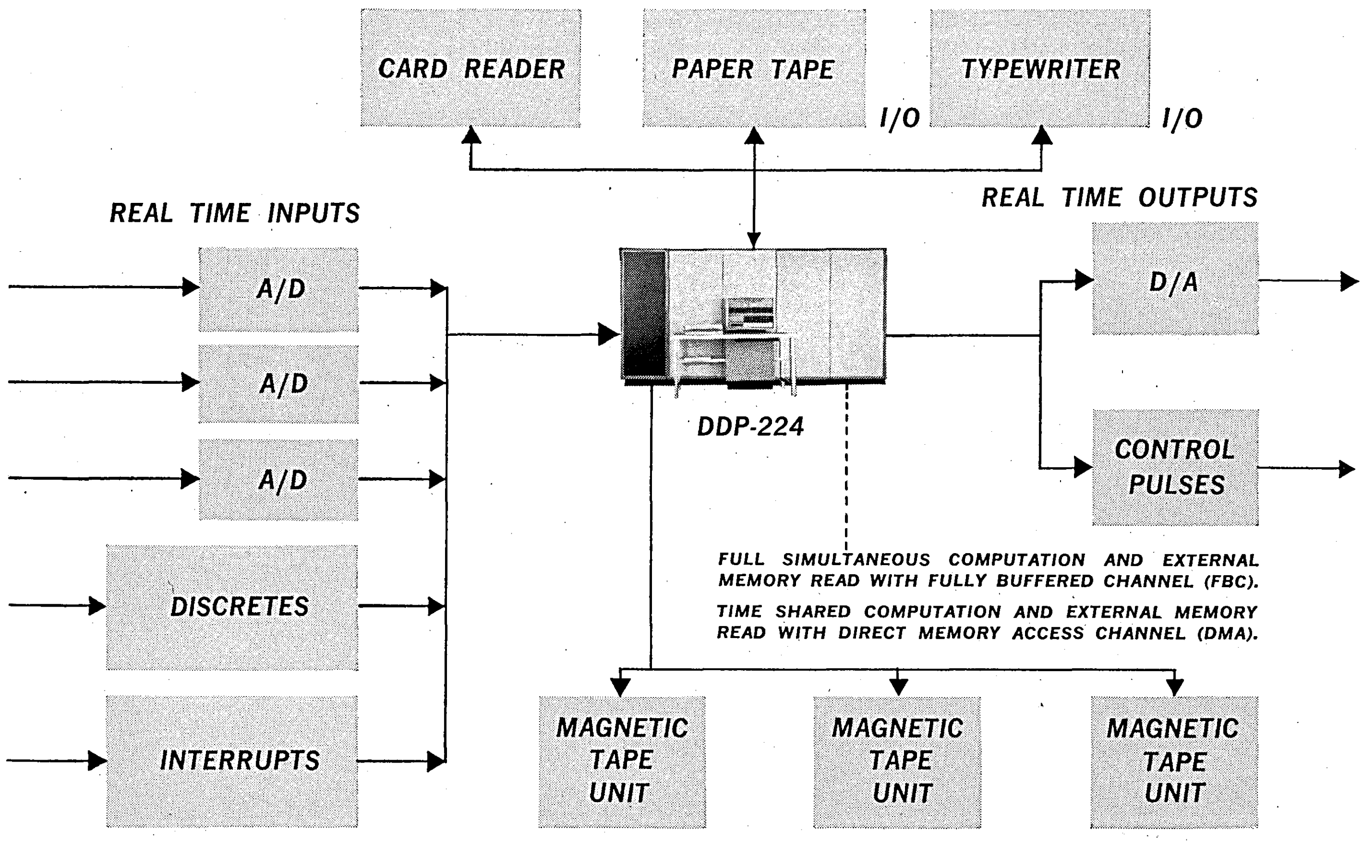




AMPEX

CIRCLE 1 ON READER CARD

DDP-224
REAL TIME MACROMODULE*



DDP-224 is built for real time system teamwork. Functions comfortably in hybrid company. Communicates effectively with analog and digital system components. Solves complex problems in sophisticated system configurations. Applications to date include high energy physics research, jet transport flight characteristics simulation, Apollo mission simulation, and rocket engine operational display for automatic checkout. Special options make it possible to combine several DDP-224's into large scale integrated multi-processor systems. Off-line, DDP-224 offers even the occasional user a versatile problem solver with comprehensive support service including FORTRAN IV scientific programming software.

DDP-224 features 24-bit word, 1.9 μsecs (0.8 access) memory cycle, powerful command structure, and 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 65,536. 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. Write for complete specifications.

*Mac' ro mod' ule — general purpose digital computer designed for special purpose systems implementation; a solution-oriented system "component" with off-line scientific capabilities.

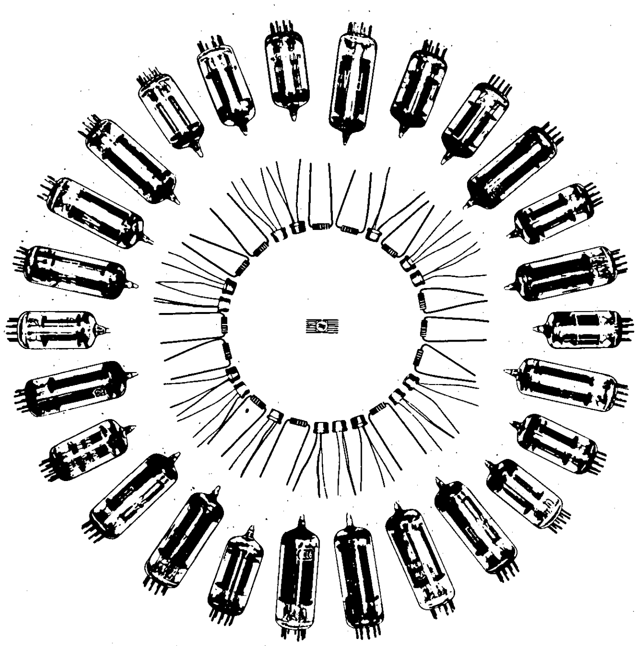
3C DISTRICT SALES OFFICES: NEEDHAM, MASS.; SYRACUSE, N.Y.; COMMACK, L.I., N.Y.; LEVITTOWN, PA.; CLEVELAND, OHIO; SILVER SPRING, MD.; DES PLAINES, ILL.; ORLANDO, FLA.; ALBUQUERQUE, N.M.; PALO ALTO, CALIF.; LOS ANGELES, CALIF.; HOUSTON, TEX.; HUNTSVILLE, ALA.

COMPUTER CONTROL COMPANY, INC.

OLD CONNECTICUT PATH, FRAMINGHAM, MASS. • 2217 PURDUE AVE., LOS ANGELES 64, CALIF.

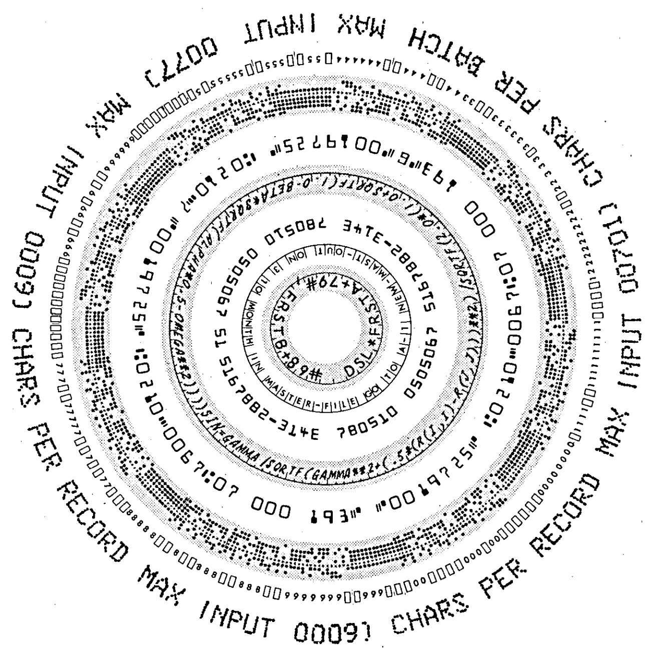
CIRCLE 4 ON READER CARD

The new RCA Spectra 70, first series, talks to other computers



First true third-generation computer series. Puts you in the 1970's now.

The reason is the RCA Spectra 70's tiny *monolithic integrated* circuit (above, center). RCA space skills gave it its high performance. One circuit replaces 15 transistors and 13 resistors. Or a shoeboxful of tubes! The two larger computers in the series may have up to 8,000 circuits. Each is many circuit elements that give the pulses a shorter distance to go. *That means higher computer speed.* And RCA takes fewer steps to tie them into one circuit. *That means lower computer cost.* You get the best management control for your computer dollar. 1970 performance now. Another 1970 standard is the solid backplane wiring. So simple it makes bulky hand wiring obsolete. So precise its design is computer-controlled. At RCA, we use a computer to make a computer.



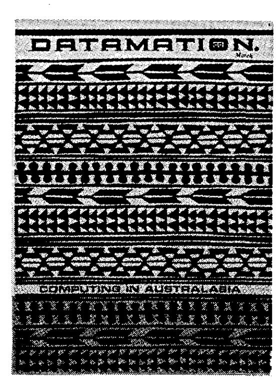
Talks to other computers without costly reprogramming.

That means savings. Because the RCA Spectra 70 speaks most computers' language, it protects your program investment. You save on "software." Extend computer flexibility. With its new eight-bit-plus-parity language configuration and its instruction set, it meets latest industry standards. It trades instructions with the latest series announced. RCA's own software makes the RCA Spectra 70's hardware work its *hardest.* Tailors performance to your needs. Extends range to its broadest limits. And no language barrier within the family. Its advanced communications, terminal devices and other units see to that. There's one language it doesn't speak. Words like *re*training, *re*investment, costly *re*programming. With the RCA Spectra 70, these are words you largely forget.

DATAMATION

march
1965
volume 11 number 3

automatic
information
processing
for business
industry & science



march
1965
volume 11 number 3

President	**FRANK D. THOMPSON**
Publisher	**GARDNER F. LANDON**

Editor	**ROBERT B. FOREST**
Managing Editor & Art Director	**CLEVE MARIE BOUTELL**
Associate Editor	**EDWARD K. YASAKI**
Assistant Editor	**HEIDE E. HESS**
Eastern Editor	**ANGELINE PANTAGES**
European Editor	**DON B. PRELL** F. D. Thompson Publications, Inc. 27 Baker St. London W.I., England
Washington Reporter	**JAMES McCROHAN**
Editorial Adviser	**ROBERT L. PATRICK**
Technical Consultants	**DANIEL D. McCRACKEN** **LOWELL AMDAHL** **E. H. HERRON, JR.**
Production Manager	**MARILEE PITMAN**
Circulation Mgr.	**ALGENE TRAINA**

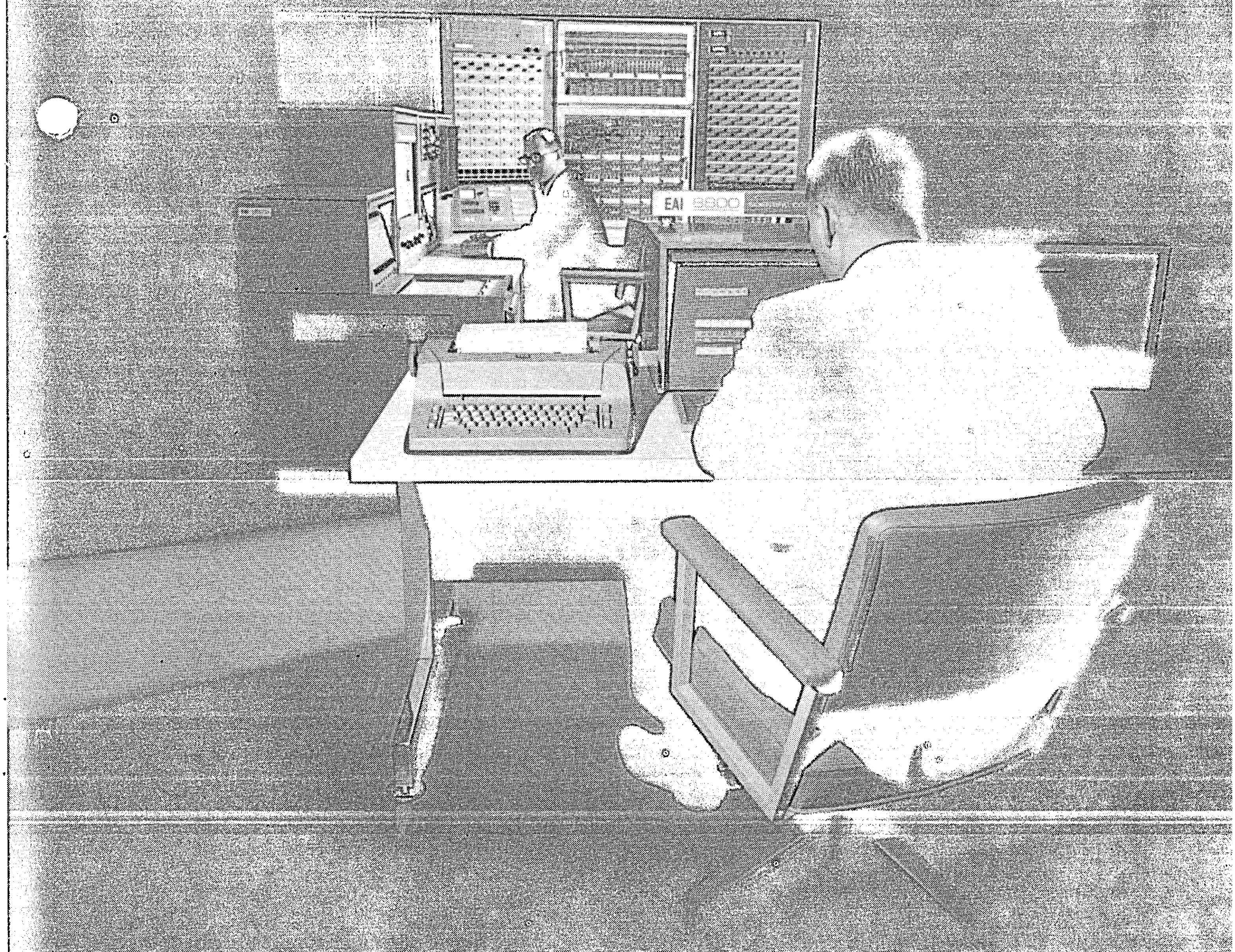
Eastern District Managers	**JAMES M. MORRIS** **WARREN A. TIBBETTS** **FELIX CHARNEY** 141 E. 44th St., New York N.Y. 10017 [212] MUrray Hill 7-5180
New England District Manager	**WARREN A. TIBBETTS** 112 West Haven Rd., Manchester, N.H., [603] NAtional 5-9498
Midwest District Manager	**JOHN BRENNAN** 205 West Wacker Drive, Chicago, Ill. 60606 [312] Financial 6-1026
Western District Manager & Vice President	**HAMILTON S. STYRON** 1830 W. Olympic Blvd., Los Angeles, Cal., 90006 [213] 385-0474

EDITORIAL OFFICES
1830 WEST OLYMPIC BLVD.
LOS ANGELES, CALIF. 90006

BPA Circulation audited by Business Publications Audit — Member, National Business Publications NBP

Microfilm copies of **DATAMATION** may be obtained from University Microfilms, Inc., 313 No. First St., Ann Arbor, Michigan. DATAMATION is published monthly on or about the tenth day of every month by F. D. Thompson Publications, Inc., Frank D. Thompson, President. Executive, Circulation and Advertising offices, 141 East 44th Street, New York, New York 10017 (MUrray Hill 7-5180). Editorial offices, 1830 W. Olympic Blvd., Los Angeles, California 90006. Published at Chicago, Ill. DATAMATION is circulated without charge by name and title to individuals who qualify by our standards and are employed by manufacturers or users of automatic information-handling equipment in all branches of business, industry, government and the military. Available to others by subscription at the rate of $15.00 annually; single issues (when available) $1.50. Foreign subscriptions are on a paid basis only at a rate of $25.00 annually. No subscription agency is authorized by us to solicit or take orders for subscriptions. Controlled circulation paid at Columbus, O. Form 3579 to be sent to F. D. Thompson Publications, Inc., 205 W. Wacker Dr., Chicago, Ill. 60606. Copyright 1965, F. D. Thompson Publications, Inc. Printed by Beslow Associates, Inc.

THIS ISSUE — 57,000 COPIES


EAI 8800

DATAMATION calendar

● Third national biomedical sciences instrumentation symposium will be held at the Statler Hilton Hotel, Dallas, Tex., April 13-15. Symposium is sponsored by the Instrument Society of America.

● The fifth annual one-day technical symposium of the Washington chapter, ACM, will be conducted at the Marriott Motor Hotel in Washington, D.C., on April 15, 1965.

● The University of Alabama, Birmingham, will host the 10th annual dp conference, April 20 and 21, 1965. The conference is sponsored annually by the certified public accountants, National Accountants Assn., DPMA, Univ. of Alabama, and Auburn Univ.

● Southern California business show will be held at the Ambassador Hotel, Los Angeles, April 20-23. Sponsored by LA Chapter of National Assn. of Accountants.

● The semi-annual meeting of the Philco 2000 Users Group (TUG) will be held at the El Tropicana Motor Hotel, San Antonio, Tex., April 21-23.

● Spring meeting of CUBE (Cooperating Users of Burroughs Equipment) will be in the Penn-Sheraton Hotel, Pittsburgh, Pa., April 28-30.

● International well logging symposium, sponsored by the International Society of Professional Well Log Analysts, will be held May 4-7 at the Sheraton Hotel, Dallas, Tex.

● The National Defense Education Institute will hold the following seminars: "Purchasing—EDP: Buying by Computer" March 30-April 1 in Pasadena, Calif.; April 6-8 in Detroit. Cost: $200. "Implementing PERT Cost" April 20-22 in Wash., D. C. and April 27-29 in Palo Alto, Calif. Cost: briefing $75, seminar $100. Additional $25 for non-NSIA members. NDEI and Harbridge House of Boston, Mass. are the sponsors.

CALENDAR . . .

● A conference on "Applications of EDP for State and Local Government" will be held March 29-31 at the Univ. of Georgia, Athens, Ga. Co-sponsoring the conference with the University will be SDC.

● The Univ. of Miami's School of Engineering has scheduled a workshop on Methods of Operations Research, April 12-16.

● CEIR's Institute of Advanced Technology will hold a course on PERT, PERT Cost & Critical Path Methods at the Princeton Club, N.Y. April 6-8; tuition and course materials $135.

● The Sixth Scandinavian DP Congress, AUTOMATION V65, will be held in Stockholm, Sweden, April 5-9. Included will be a computer exhibition.

● Lectures on microelectronics, sponsored by the Chicago section of the IEEE, will be held April 5, Sunnyvale, Calif.; April 12, Elkridge, Md.; April 19, Oswego, N.Y.; April 26, Phoenix, Ariz. Cost for series: $6.

● Symposium on information storage and retrieval, sponsored by Information Control Co., will be held at the Ambassador Hotel in Los Angeles, April 8 and 9.

● Conference on batch fabrication to probe the effects on future computers will be held April 6-8, Thunderbird International Hotel, Los Angeles. Conference is sponsored by the Institute of Electrical and Electronics Engineers.

● One-day DPMA COBOL symposium will be held in Los Angeles, April 8, and in San Francisco, April 9. Contact DPMA International Headquarters, Park Ridge, Ill.

● Numerical Control Society will hold its annual meeting April 21-23, Hotel La Salle, Chicago, Ill. Theme: "How to Succeed With NC."

● Detroit Research Co., Detroit, is offering three seminars: Practical aspects of dynamic programming, April 12, 13; Critical path method, April 21-23; Applied statistical reliability, April 26-30.

letters

technology & society

Sir:

Dr. Fein's article, "Dear Mr. President," (Jan. p. 39), while postulated in the "systems" vernacular and therefore not likely to attract wide attention, was outstanding. It *is* high time that someone extrapolate this amazingly accelerating curve representing technological competence levels to see where we will be in a few years and to determine its social impact. . .

Technological advance has always been assumed to be good by innovators because history has thus far shown that, except for temporary dislocations, new inventions have created more new jobs. . . Dr. Fein speculates, then, that it may be proper to examine whether we won't someday approach the end of the line here. It is possible that we will become so "automated" (that's getting to be a dirty word and it shouldn't be) that one-tenth of the people can make everything everybody can possibly need, and the other nine-tenths won't have anything to do. . . This concern should certainly be taken seriously. . .

Yet it doesn't seem that we are very close to the apex of the curve. We still have many things to create, many problems to solve, before having to concentrate on the puzzle of overabundance. We must, for example, see that all the world enjoys the same affluence in food, shelter, and health that we Americans have, even if we have to, in a manner of speaking, give it to them. Many Americans feel we give away too much to foreign countries already, but cause-and-effect reasoning makes me believe that they will eventually to try take it away from us, at great cost to both sides, if we don't.

M. R. Knisley
Pensacola, Fla.

Sir:

Dr. Fein's 'Dear Mr. President' (Jan., p. 39) is certainly thought-provoking, but quite pessimistic. I believe that even Dr. Fein would admit that we are not quite as ignorant concerning our condition as the article would lead one to believe. It seems obvious that we are in a period of transition. . . between one in which so-called conventional assumptions apply and one in which counter-assumptions will apply.

In the present dynamic transition, the actual situation could significantly differ from the one we try to sample for a survey to be completed in a finite time. Thus, large government-sponsored programs such as the war on poverty are to be welcomed insofar as they buy time to allow us to adjust to the new economic environment. Although such programs are only an aspirin for our economic headache, and will not cure it, nobody is even looking for a more permanent treatment.

The great question is how to overcome ever-increasing unemployment without generous infusions of federal deficit spending. Certainly, although I do not have the answer, it does not lie in conventional solutions. Probably the most fruitful soil for search is into the basic tenets of economics and the sources of wealth.

The choice, if we do not undertake such a study, is between ever-increasing government intervention into our personal lives . . . and a poverty-amidst-plenty which would make life in the underdeveloped countries look good by comparison.

Vincent F. Ryan, Jr.
Haddonfield, New Jersey

numerical control codes

Sir:

The January issue (p. 87) contains an item on the Electronic Industries Association (EIA) Standard RS-244, on Character Codes for Numerical Machine Tool Control Perforated Tape, which is currently being considered for American standardization by ASA.

It is difficult to see how the ASCII supporters can justify describing EIA's action as a "mad rush," as reported in this article, since:

1. RS-244 was issued in July 1961, two years before the issuance of ASCII, and was first submitted

to ASA X3 for American standardization in May 1962.

2. While EIA is the body which has formally submitted this standard, its adoption is endorsed by BEMA, NEMA, API, ASTME, NC/S, AIA, NMTBA.
3. The X3 committee, which formulated ASCII, has recorded the fact that there is no conflict between ASCII and RS-244 since they are intended for different purposes.
4. RS-244 is used almost 100% on machines numerically controlled by perforated tape in the U.S., and is widely used and fast gaining acceptance internationally.

You correctly identified the real source of difficulty as the "fear (of the ASCII proponents) of the precedence which might lead to a different standard for each process industry . . . ." But to deny the manufacturers of numerical controls, systems, and machines, and their users, the American standardization of the code they find most useful, on the specious argument that it might lead to requests for standardization of other "process industry" codes rather than further the use of ASCII, seems to us inconsistent with the spirit and intent of the ASA system.

Supporting documentation for facts stated herein are on file in the EIA Engineering Office.

J. A. Caffiaux
Electronic Industries Assn.

Nevertheless we have reason to believe that the DOD and four others are lined up against RS-244, which is evidently doomed.

deceptive math

Sir:

As a solution to your dilemma in Editor's Readout (Oct. '64, p. 23 and Jan. Letters, p. 12), may I offer the following to prove that

$$\frac{1984-1964}{20}=2:$$

Let:	$a=b$
Multiply by a:	$a^2=ab$
Subtract b^2	$a^2-b^2=ab-b^2$
Factor:	$(a-b)\ (a+b)=b(a-b)$
Divide by (a—b):	$a+b=b$
Substitute a=b:	$b+b=b$
or	$2b=b$
Divide by b:	$2=1$

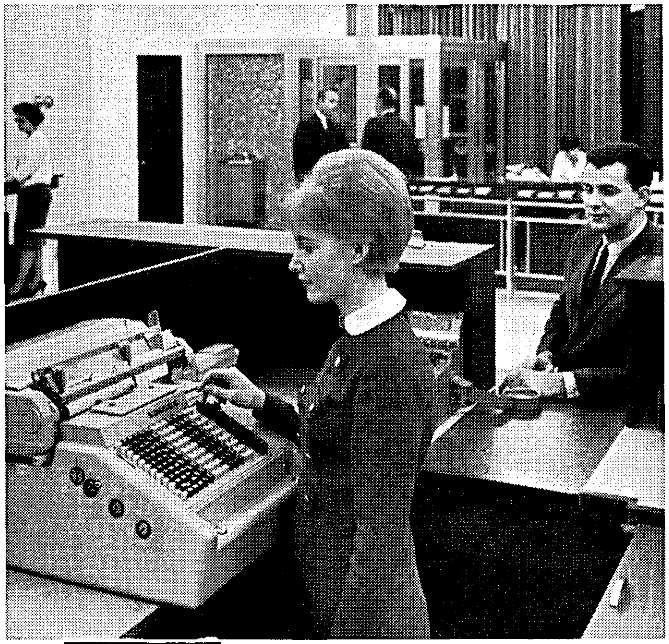
Therefore:

If $\frac{1984-1964}{20}=1$ and as proved above $1=2$

Then $\frac{1984-1964}{20}=2$

Who knows, perhaps in the "magic time of two score years from now," it will be proved that $a-b\neq0$.

David O. Nicholson
Life Insurance Management Assn.
Hartford, Connecticut



Burroughs Teller Console

Hot Line!

Burroughs On-Line!

RTISERS' INDEX

DATAMATION

BUSINESS & SCIENCE

SO LONG, LIBRASCOPE; HELLO, ITEK

While Librascope silently folded its commercial computer business, a new face appeared on the scene. It's Itek, which will unveil an MCP-1000 system at a service center in NYC later this year. A preview of the system appears elsewhere in this issue, but since that was written we have some late additional information on the MCP-1 processor.

The computer will feature nine groups of instructions, not all of which a customer has to order. Thus the user could start with a little machine and, presumably, upgrade it as needed. There are four eight-bit characters to a word.

Sixty-four general registers can be wired (at additional cost) to speed up instruction cycle times. If, for instance, all 64 registers were wired, a three-usec operation would take only one usec. In the simplest machine, all 64 registers would reside in thin film.

Whether Itek can muster the muscle to sell and support its new system is the big question. Until it's answered, replace LGP with MCP on your computer scorecard.

THE 360 & UNHARDENED SOFTWARE SPECS

The itch to learn more about 360 software gets worse, but information is still scarce. One big retailer is reported to have delayed confirmation of 35 360's until software is firmed up. But the date by which such info was to be available -- Jan. 4 -- is long gone. But IBM reputedly swears it would rather be late than wrong. RCA will probably have to wait until it gets its 360 before it knows how compatible it will be with that machine. And users may have to wait until a text on advanced 360 programming hits the street ... just before 360 deliveries begin.

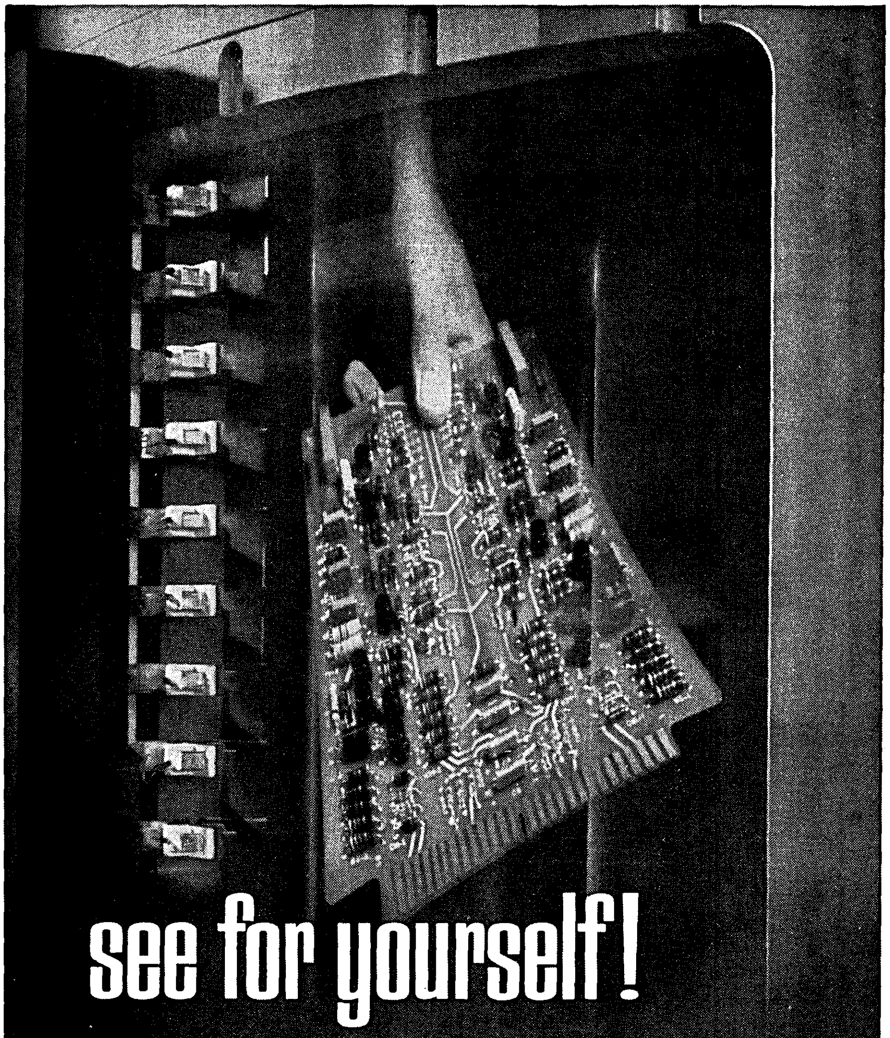
DECENTRALIZING EDP AT NORTHROP

It looks as if the recent change in information processing management at Northrop (see "People"), may have more than casual implications. For one thing, it probably marks a move away from centralized edp; already one computer center has been turned back to a division to run. The return to decentralized edp may well jeopardize the order for the GE 625, which will probably now be delayed as Northrop reevaluates its decision in the light of new (old) edp policies.

NEW IBM OFFENSIVE; NUMBERS GAME THICKENS

Shaken by the loss of several key time-sharing orders, IBM has set up a special T-S organization; its charter: Thou shalt not lose another key T-S sale.

Continued on page 19


see for yourself!

Continued from page 17

Initial success was recorded at Lincoln Labs, and IBM is now leveling guns at such spots as SDC, which is looking for something to replace a 94, a 1401 and a Philco 2000 at its corporate computer center, to be run by Guy Dobbs. The U. of Michigan, General Motors and a leading aerospace firm are other prime targets.

The computer numbers game will be getting even more crowded, if the rumors about new IBM machines are true. The leading contender for IBM's T-S machine is the 360/64 and 66, but we've also heard 44, 55, 77, and 88. Then there's the 42, a hopped-up 360/40. Another rumor has it that No. 1 is coming out with a new, small non-360 out of San Jose which will be the business equivalent of the recently announced 1130. Maybe they'll call it High Noon. Then there's the NCR 615. And Burroughs is toying with the D851 and B6000. Help!

UNDERGROUND PRICE WAR RAGES

Specs aside, the big competitive battle now is to see which manufacturer can come up with the best deal to ease users over the transition period. We've heard that IBM is offering a special policy to its users converting to 360's; the policy varies with the machine involved, and covers anywhere from two to four months.

One policy offers the old system at 10% of 1/176th of the monthly prime-shift rate. Thus, a $17,600/month system costs only $10/hour, $1760 per shift.

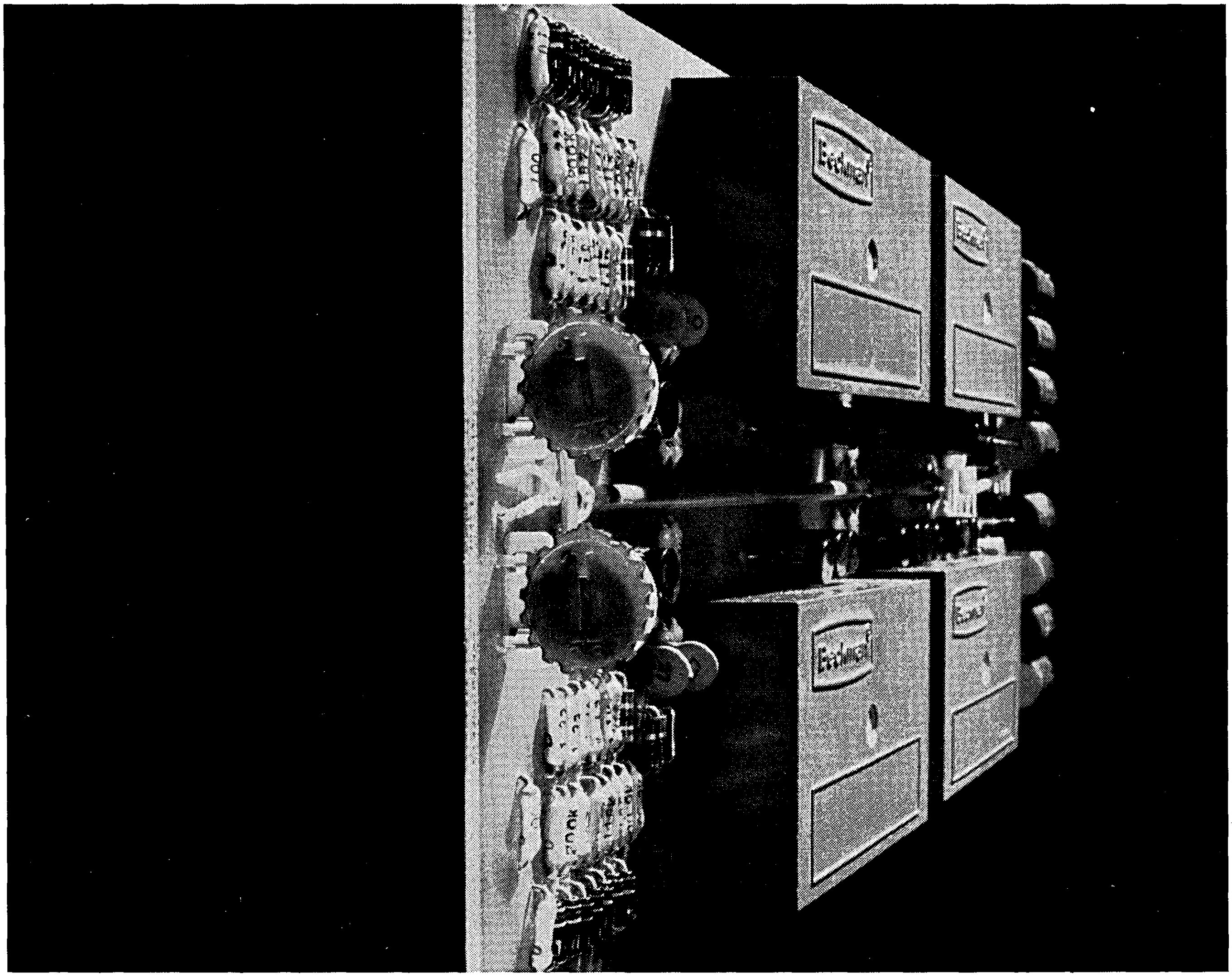
And IBM is speeding up the depreciation of the 7080/90/94/94-II; a machine in for two years now looks as if it's been paid up for 3-4 years. One user bought his 1.2-megabuck 90 for $800K, a 33% saving. Another user got the feeling that IBM might be willing to make a deal even if the user hadn't plunked down the 1% deposit for purchase option. IBM may offer similar accelerated amortization of the 7074.

RUMORS AND RAW RANDOM DATA

The main stronghold in the IBM aerospace fortress -- North American -- looks safe. The big, big user will go 360. ... Although Ed Fredkin of International Information, Inc. was the official winner of an on-line programming contest conducted at the FJCC by Stanford's John McCarthy, Rand's Chuck Baker beat Fredkin's time in a post-contest try. ... An omnibus mag tape standard is being published over the strenuous objections of IBM. Other manufacturers will probably raise a howl too. The proposed standard specifies ASCII. But no current computer can record ASCII, and it would require a special code or black box to allow even the 360 or Spectra 70 to do that. ... We hear that Univac will announce a new, advanced Fortran for the 1108 which can be used in current Fortran unit-record or in free-form syntax. Said to possess all the power of NPL, the new compiler is supposed to produce even more efficient code than its 1107 F-IV predecessor. And the 1108 will also offer a 7090/94 emulator which will run faster than either of those machines while it's processing 1108 programs. Rental is expected to be quite attractive. ... Bob Bemer has left Univac for a Paris post with GE/Bull. ...The long delayed BOB report is still not out, but we understand it little resembles the original Clewlow committee document, will recommend passage of the new Brooks Bill (HR 4845).

Honeywell
SERIES 200
...new dimensions of proven computer performance with exceptional ability to match the exact dimensions of your business.

The pace-setters are here!



EDITOR'S READOUT

THE PROGRAMMING LANGUAGE PROBLEM: FIRST SIGNS OF A SOLUTION?

There are signs that the information processing industry is growing up.

At a January meeting of a special Codasyl subcommittee, for instance, Greg Dillon of DuPont declared that the manufacturers are now savvy and wise enough to design programming languages and compilers . . . without the confusing influence of users who want every software system to include their pet esoteric options which tend to reduce compiler speed and efficiency.

The manufacturers applauded and so do we.

We also like the turn the meeting then took . . . a discussion of the idea that perhaps Codasyl should get out of the language development business, turning such work over to the manufacturers.

And our understanding is that the manufacturers in general are in favor of setting up a special organization for such work which would be manned by top technical software experts loaned full-time. The makers would also kick in dollars. Certainly such an arrangement would be far superior to the current one, where groups of revolving, part-time people meet from time to time. It might also help to minimize ax-grinding by individual company representatives.

Meanwhile, down at the ranch (Washington, D.C.), Rep. Jack Brooks was preparing to re-introduce his bill to centralize edp controls. He did so on February 11, noting that the bill recommends the establishment of federal standards for ADP equipment, techniques *and computer languages* (italics ours). And he said that the bill authorizes the research to accomplish such goals.

The notion of federal control is generally unpopular, and we're not sure we like it here, either. But it would be silly to deny the influence of the government. Even if the manufacturers established an independent language development group, they could be expected to listen attentively and sympathetically to the wishes of their biggest customer.

The solution may be a combination of the two ideas expressed at the Codasyl subcommittee meeting and in Representative Brooks' legislation. Perhaps the Government and the manufacturers can combine their moneys and talents to establish an Institute to develop a sound theoretical basis for the establishment of advanced programming languages which could lead to true source-language compatibility. Certainly the long-range rewards in dollars and anguish saved would be immense.

It would be naive to think that such a beautiful dream goal could be achieved overnight, even if the money and top talent for such a program could be made immediately, and all political and organizational problems resolved. If such an Institute comes into being, we must not expect of it miracles.

But such an Institute could be the first giant step toward a sensible, organized approach to the programming language problem which has already seriously crippled the industry's ability to live up to its true potential.

ORGANIZING FOR NATIONWIDE DP

australian census network

by H. D. PRIDMORE

The assistant Commonwealth statistician, Mr. Pridmore spent a year in the U.S. under a Commonwealth Fund Fellowship, studying dp at the Census Bureau and at George Washington and American Univs. He holds degrees from the Univs. of Melbourne and Tasmania, majoring in math, physics and economics.

The population of Australia estimated as at September 30, 1964, was 11.19 million. Of this total the capital cities of the six states accounted for 55.8%—distributed as Sydney, 2.3 million or 20.7%; Melbourne, 2.06 million or 18.5%; Brisbane, 0.66 million, or 5.9%; Adelaide, 0.61 million or 5.5%; Perth, 0.46 million or 4.1%, and Hobart, 0.12 million or 1.1%.

Constitutionally the Commonwealth of Australia is a federation of sovereign States that were once separate British colonies. The Constitution was passed by a referendum in 1899, given royal assent in 1900, and proclaimed in 1901. Prior to 1901, the Australian continent and adjacent islands contained six British colonies: New South Wales, Victoria, Queensland, South Australia, Western Australia and Tasmania. These colonies were governed by popularly elected parliaments which were sovereign within their powers as laid down by the British Acts of Parliament creating their constitutions.

Australia is sometimes called the "Island Continent" and the capital city of each State is situated on the coast or within a few miles of it. Brisbane, Sydney, Melbourne and Hobart are on the east coast the last being the capital of the small island State of Tasmania. Adelaide is situated on the south and Perth on the west coast of the continent. Brisbane is situated on the 27°S parallel of latitude and is the most northern capital. The latitude of the remaining capitals are approximately Perth 32°S, Sydney 34°S, Adelaide 35°S, Melbourne 38°S and Hobart 43°S. The distances between the centres of population by the shortest regular air-route are therefore roughly Brisbane-Sydney 480 miles, Sydney-Melbourne 460 miles, Melbourne-Hobart 390 miles Melbourne-Adelaide 400 miles, Adelaide-Perth 1350 miles.

The division of powers between the Commonwealth and state Parliaments, which is the essence of the federal system of government, was adopted from the American model. The powers to be exercised by the Commonwealth authorities are specified, leaving all other powers to the states. This makes for decentralised government and requires co-operation between the Commonwealth and state governments on many matters of national importance.

The American system of division of powers between the Executive and Parliament was not adopted. The Constitution does draw a clear distinction between Parliament, the Executive, and the Judiciary, but it also allows scope for the operation of the conventions of responsible cabinet government on the British model. The distinctive feature of cabinet government is the concentration of legislative and executive responsibility in the hands of a small group (or cabinet) of ministers appointed by the government of the day. This makes for centralized government within the separate spheres of action of the Australian parliaments.

This blending of the American federal system with British parliamentary traditions has produced a distinctive form of national government, which is now establishing its own set of institutions, conventions and traditions.

Administrative services for the Commonwealth government are provided by the Commonwealth Public Service which was established by statutory enactment of the parliament. The Public Service operates under the principle of control by an authority appointed by the cabinet but removable only by parliament. This authority is the Public Service Board and its main responsibilities relate to the establishments, personnel, organization and adminstration of the executive departments and agencies subject to its control.

Each department is controlled by a Minister who is a member of the Commonwealth Parliament. Ministers are appointed by the government and are responsible to Parliament for the administration of their departments. Ministers have been described as "political heads" and may be replaced each time there is a change in government. In the event of ministerial changes, continuity of control and administration is provided by the permanent departmental heads, who are career public servants, usually designated as secretary to the department, and who are responsible to their Ministers for administration of their departments and for advice on policy matters and proposals affecting their department.

The Commonwealth Public Service is at present organized into twenty-five departments. In 1901 there were seven departments—Attorney General's, External Affairs, Home Affairs, Treasury, Postmaster General's, Trade and Customs, and Defence.

The departments themselves are organised into major branches, offices and bureaux. Some of these, including the Commonwealth Bureau of Census and Statistics, and the Taxation Branch, which are formally branches of the Dept. of the Treasury, are actually semi-autonomous bodies with varying degrees of independence. Most departments and major branches have a central office, located in Canberra, Melbourne or Sydney, as well as state offices in each state and territory of the Commonwealth.

The Bureau of Census and Statistics provides technical services to both the Commonwealth and its states, relating to the collection, tabulation, analysis and publication of Australian statistics and associated investigations. Included are the publication of Year Books of the states and the Commonwealth, and of annual, quarterly and monthly statistical bulletins; tabulation of statistics for principal departments of the states and the Commonwealth, as well as the taking of periodic population censuses.

The history of mechanized data processing in the bureau dates from the Population Census of 1921 when punched card equipment was first used. The initially small plant grew steadily until by 1960, it was one of the largest installations of punched card machines in the southern hemisphere, using well over 100 machines of various kinds including several electronic externally programmed calculators in the Central office in Canberra. This plant was also used to undertake a considerable amount of processing of specific tasks requested by other departments or agencies and thus acted on a small scale as a service bureau.

At the same time the steady expansion of the statistical services, particularly during the fifties, brought about the establishment of smaller conventional unit record installations in all states except South Australia and Tasmania. By 1958 the volume and complexity of the processing had reached the point when it was clear that future expansion demanded the use of a digital computer. The development of computers had been constantly under consideration over the preceding four or five years, and during the third quarter of 1958 initial plans were instituted for the change over.

Concurrently with the investigations undertaken in the bureau, the Public Service Board was taking an active part in investigating the probable impact of computers on the public service as a whole. This was stimulated by the use of CSIRAC by the CSIRO and later at the University of Melbourne, the installation of SILLIAC at the University of Sydney, and of WREDAC at the Weapons Research Establishment of the Dept. of Supply. All these machines and particularly the former two, which were built in Australia, played an important role in establishing a small nucleus of people in the service with some knowledge of ADP.

By the late fifties the Public Service Board had gained considerable experience and knowledge concerning the effects of ADP. This was augmented by a number of extended overseas trips by officers of the board who studied, in both the U.S. and the U.K., the use of computers in governmental administrative functions.

This build up of knowledge within the board itself meant that it would be in a position to continue its role of promoting efficiency in departments following the introduction of computing equipment. The probable impact of this was seen to be so far-reaching that it was considered prudent in a public service of the size of the Australian to proceed carefully with the acquisition of computers. This course was influenced by the published reports of GSA and Bureau of the Budget studies.

Accordingly early in 1960 the Prime Minister approved the establishment of an Interdepartmental Committee on ADP to be comprised of representatives of the Dept. of the Treasury (represented by the Commonwealth Statistician), Dept. of Defence, and Postmaster-General's department under the chairmanship of a representative of the Public Service Board.

adp study & specification

The Bureau's approach to the acquisition of computing equipment followed the now virtually classical lines of Applications Feasibility Study, Preparation and Issue of Specifications, and Evaluation and Selection. The Applications Feasibility study was begun in June 1960 and occupied approximately two years. During this time the major statistical applications were studied in considerable detail and written reports prepared. The specifications were issued by the Commonwealth Stores Supply and Tender Board, one of the official tendering authorities of the Commonwealth government. The specification was promulgated simultaneously in the state capital cities of Australia, in London and in New York. In addition, some 80 manufacturers were mailed copies direct simultaneously with the official release, on September 19, 1962, and the tenders closed on December 13, 1962.

The requirements specified in the invitation to tender covered the central computer system, subsidiary computer systems, data preparation and verification equipment, data transmission equipment, and magnetic ink document handling equipment. Two aspects of the specification are worth mentioning—namely, a section giving details of the terms and conditions to be met by the successful supplier, and a set of eight benchmark problems to be coded and timed by tenderers for both the central and subsidiary computers proposed.

The sample problems were chosen as representative of the kinds of processing to be performed and included internal transfers, logical tests, limits tests, tally matrices, indirect addressing, and four- and two-way merges. Tenderers were warned that the problems would be used as part of the acceptance tests and that any times quoted would have to be realized.

Eight manufacturers tendered equipment for the central and subsidiary computer systems. Several alternative configurations were proposed by almost all tenderers. Each of these were costed in detail and costs projected over the expected life of the installations.

The objective comparison of computer performance was made principally using the benchmark problem solutions; measures of gross productivity and a cost-productivity index were computed. Evaluation, reviews, report preparation submission and approval extended over six months, and on June 19, 1963 the successful tenderer was announced as the Control Data Corp., the computers tendered being the 3600 and 3200 systems. The order comprised a 3600/3200 complex for Canberra and subsidiary installations of 3200's in Sydney, Melbourne, Brisbane, Adelaide and Perth.

As a result of the evaluation studies no data transmission equipment was acquired. The decision was reached from a consideration of cost and the problem of obtaining in 1962 the transmission facilities which would be required for the successful implementation of the system envisaged.

For the central installation at Canberra, the equipment ordered was a 32K 3600 with an 8K 3200, 12 magnetic tape transports, and other peripherals. At each subsidiary installation would be an 8K 3200, four tape transports, card reader and printer. In addition, a Burroughs B103 MICR sorter/reader is to be installed at the Sydney subsidiary. The delivery schedule envisaged the installation of the six computer and data preparation equipment by December '65, and the MICR equipment simultaneously with the installation of the Sydney subsidiary.

To handle the programming, operation, and administration at the installations, two operating groups were created—the Applications Programming section and the Systems Operations section, each under a director. The former is further divided into four groups, three specializing in programming for particular statistical areas (Industries, Demographic, and Financial applications) and a fourth called an Advanced Techniques group. The functions of the latter are to develop new techniques and assist with applying them to the solution of the day-to-day problems encountered by the applications programmers. The organizational structure has sufficient flexibility for the transfer of personnel to meet unforeseen changes in priority.

Among the functions of the Advanced Techniques group are research in socio-econometric models and simulation methods and the use of such mathematical techniques as O.R., PERT, and linear programming.

The Systems Operations section is subdivided into three groups: Training, Systems Programming, and Equipment Operations. These subsections each serve as a service group to the Applications Programming section and to other users with respect to staff training, specialized programming services, and the provision of physical data processing facilities.

The Equipment Operations subsection is itself further divided into a data preparation group, a production control group and a computer operations group.

The organization for the considerably smaller subsidiary installations has developed by combining some of the functions performed by separate groups at the central installation. The existence of a 3200 at Canberra has permitted a saving to be made on systems programming staff at subsidiary installations and has naturally assisted with the setting up of standard procedures and conventions.

approach to applications programming

The data processing environment into which the computer was to be introduced was essentially a multijob situation. The number of tasks had been estimated as being of the order of 100, ranging in nature from large-scale enumerative statistical applications, such as the population census, to mathematical and statistical operations, such as matrix inversion and smoothing of time series. In addition the interrelationship of one task to another was found often to be complex—e.g., the design and subsequent processing of intercensal sample survey collections in relation to the previous and following censuses.

To recount at this stage the story of an escape from previously well used modes of thought may seem a little naive to the sophisticated ADP audiences of 1965. Nevertheless the struggle was real enough and has proved persistent enough to warrant perhaps one further reiteration.

A great number of articles has been produced on the subject of the "total systems approach." Many of these were studied, and from this perusal there developed a healthy scepticism towards an adherence to the precepts of the doctrine. This scepticism was engendered partly from the results of an examination of the bureau as an information system and partly from the different characteristics of the multiplexity of jobs presenting themselves.

Detailed study of the latter had convinced those responsible that the logical structure of many superficially different tasks was in fact basically the same, and this led to what has been designated within the organization as the Abstract Information System approach. The emphasis in all systems analysis and design has thus been directed towards the identification and abstraction of the data sources, sinks and flows normally buried within the physical media and procedures concomitant with the operation of an organization.

The establishment of the logical structure of the application led naturally to an effort to devise means for describing this structure in a form amenable to subsequent program preparation. This aim has by no means been achieved but has, in turn, led to a long-term interest in the development and use of information algebras and in the applicability of logico-mathematical methods of documenting the relationships between data sets rather than in procedural descriptions.

The result of the kind of approach taken to applications programming has been a considerable modification of the total systems concept. This does not imply an unconditional rejection of the lessons to be learned from the use of this method but, rather, the concept is used to provide the framework within which the implementation of the individual applications is effected.

The number of tasks to which computer processing may be applied has presented a problem of determining in what order the work should be done.

This question of priorities is determined through the co-ordination of a Priorities Committee, comprising three senior executive officers. Allocation of priorities is made essentially on the basis of the statistical importance of the job and the resources available to undertake the analysis, design and programming. The volume of data is naturally considered but may not necessarily assume overriding importance. The responsibility of the bureau to provide current, timely and accurate economic, demographic and social statistics for the use of both the government and private sectors of the economy has an important influence on the approach to applications programming. The production of official statistics by whatever means is always subject to decisions with respect to publication.

This overriding requirement implied that should applications be converted there was almost certainly a deadline by which the job must be completed and the statistical information made available. This in turn demanded an efficient, easy-to-learn and adaptable programming language. The major language of all users has thus been determined as 3600 FORTRAN. The use of this language instead of COBOL for the financial accounting and other business type applications was considered, at the time, to be something of a departure from normal practice but one made possible by the availability in the more powerful versions of FORTRAN of extensive logical operations and the manipulation of character variables. The further necessary condition for efficient data processing with FORTRAN, namely, packing data on magnetic tape and unpacking for use in core, is provided by systems subroutines.

Experience has been similar to that of the Sandia Corporation.[1] The existence of both 3600 FORTRAN and 3200 FORTRAN represented a slight additional complication in that it was necessary to ensure upwards compatibility of the languages. The two methods, modification of the compiler or use of the subroutine features of the language, were considered and the latter used.

By this means compatibility was achieved and also a number of additional functions incorporated. The more important of these: SHIFT (I,J) UNLOAD (I), SKIP (I), DENS (J,K), STATUS (I,S), LABEL (I,J,K,L), TIME (I,J,K), DATE (K), TYPE BYTE 5(/6).

[1] Fimple, M.D., "FORTRAN vs COBOL," Datamation, August 1964)

system operations and standards

The installation and successful operation of the central computer complex together with the creation of an experienced group of ADP personnel has afforded the bureau the opportunity of establishing standards pertaining to the activities of the whole computer network.

Having entered the field of large-scale data processing relatively late, the major objective has been to take full cognizance of the experience of forerunners in the field and attempt to avoid the better known pitfalls. The success of this effort has been considerably enhanced by the generous assistance and advice given by a number of colleagues, particularly in the U.S. Bureau of the Census.

The primary decision made was that all installations would operate as "closed-shops." This was based on the need for efficiency in turnaround of programs, given the number and variety of applications, the speed and size of the equipment, and the existence of supervisory monitor systems, higher order programming languages and operating procedures.

The adoption of this principle in conjunction with the concept of the Systems Operations group as a service unit implied the logical consequence of organizing data preparation, program punching, and control of source document receivals and results distribution as separate functions.

The solution of the resultant problem of communication within the organization has been found in the establishment and proper use of standards. These have been carefully documented and distributed to all programmers. In addition, a system has been set up to expedite feedback of information concerning the value of proposed standards before their final issue. The standards used are in such areas as use of the installation, preparation of coding forms, documentation of applications, data preparation, etc.

In broad outline, each programmer retains control of his own program deck of source language statements during writing and check-out. When a program achieves production status it is handed over to operations together with operating instructions. The programmer's responsibility is then reduced to cooperating as necessary with the job's sponsor for data corrections, edits and discussion of results.

Scheduling is performed by Production Control from forecasts of time requirements by the programmers. Forecasts are revised weekly. Programs of short duration—i.e., of less than two minutes—are accommodated during an express run period twice per day.

It is characteristic of even the mathematical processing undertaken by the bureau that large volumes of information are used. To facilitate operations at the central installation, the standard approach has been adopted of using the CDC 3600 as a purely taped-oriented machine and the associated 3200 as an I/O converter. In addition, the 3200 is used for smaller tasks and proving out programs for use in the subsdiary installations. Special I/O conversion routines have been written, the package called SCRIBE. At present, a time-shared version is being designed, and when operational will considerably enhance the throughput on conversion operations by taking advantage of the full speed and power of the 3200 computer.

the manpower situation

One obstacle facing the Hera-like birth of ADP within the bureau and, for that matter, on a service-wide scale was an almost complete lack of skilled computer personnel. Many of the pioneer personnel had gained their experience at the Weapons Research Establishment and continued at that installation; others joined the growing staffs of various computer houses interested in the Australian market, while the staff engaged in the private enterprise installations were themselves pioneering the use of computing equipment in their own fields. In accordance with the general policy of the bureau it was decided that the programming staff should be university graduates, preferably in mathematics, statistics or economics. Graduates from any recognized discipline are recruited, however, and the ADP project has benefited greatly from the interdisciplinary nature of the backgrounds of the staff. This standard has been relaxed only in the case of personnel with some years' experience. The majority of these experienced people has been recruited in the United Kingdom.

The Public Service Board has assisted in the development of aptitude tests for applicants seeking positions as programmers. These tests are administered by psychologists from the board who have also developed selection tests for the data preparation staff and computer operators. Following the tests of prospective programmers, an interview with a psychologist present is given in addition to the usual selection interview. The selection procedures have been used for all staff recruited in either England or Australia, and on-the-job performance has validated the tests. Unfortunately it has not been possible to establish beyond doubt the unsuitability of all staff not given appointment.

After recruitment, any non-graduate staff are encouraged to undertake part-time tertiary education. As a result the bureau now has a reasonably large programming staff, about 90% of whom are graduates or undertaking university courses.

The standards of educational qualification for computer operators are less strict but operators with experience on large systems are probably scarcer than trained programmers. The bureau policy has been to recruit female staff; results to date have been particularly encouraging.

The need to staff six computer installations in a period of approximately 18 months has meant that a continuous recruitment and training effort has had to be sustained. At the time of this writing, almost all staff for the subsidiary installations have been obtained and most training has also been completed.

training schemes

The need to maintain a supply of skilled personnel both for the bureau and, indeed, the Public Service as a whole was appreciated early in the planning. It was established beyond doubt by projecting requirements over five years from 1963. This projection was undertaken by the Assessment Working Party of the Interdepartmental Committee as part of the forward planning associated with determining the best method of rationalizing the introduction of computers on a service-wide basis.

The Public Service Board encouraged the training of staff in those departments and authorities which were installing computers. A determination was made concerning the period of training, and the organizations proposed courses which were approved by the board.

The bureau developed a number of courses: (1) Programmer-in-Training (PIT) Course, (2) Computer Operators Course, and (3) Data Preparers Course. In addition to these, an "Executive" course for statisticians of about 65 lecture-hours' duration was developed, and a number of these presented. Their purpose is to acquaint the prefessional statisticians with the methods and techniques used by the ADP branch and the ways in which these are applied to processing their work.

Three PIT courses of approximately 12 months' duration have been conducted and some 60 officers have graduated. In addition a number of programming courses were given by Control Data which were attended by an additional 100 officers. The construction of the PIT course has aimed at developing not only programming skills but also giving the trainee some appreciation of the official statistician's job. The PIT course has recently been revised and divided into an elementary course and a second, more advanced, course. These will be followed by a sequence of seminars in advanced ADP subjects.

While the courses developed cannot be compared with those available in U.S. universities, in view of the considerable interest in curricula for courses in computer sciences,[2] it may be of interest to record the kind of topics covered.

PIT Course

(1) Introduction to official statistics.
(2) Introduction to Australian government and public administration.
(3) Computer equipment and techniques—Stage 1.
(4) Mathematics—Stage 1: including binary, octal, BCD arithmetic and notations; elementary theory of sets and introduction of Boolean Algebra; fixed and floating point numbers.
(5) Elementary statistical theory.
(6) Programming—Stage 1: including flow charting techniques and standards; programming languages, FORTRAN, operating procedures.
(7) Basic systems design: including stages of design, files in ADP systems, editing and control techniques.
(8) Operational practices: including documentation program testing and diagnostic procedures, and scheduling procedures, I/O conversions.
(9) Computer equipment and techniques—Stage 2: including gates, truth tables and elementary circuit design; I/O hardware, channels and interfaces, monitors, interrupt systems, buffering, file updatting techniques, file structure and manipulation, check point and restart procedures, principles of data preparation.
(10) Programming—Stage 2: including advanced FORTRAN topics, COMPASS coding, SCOPE system and COBOL.
(11) Systems analysis and design: including introduction to information systems, objectives of analysis and design, systems definition, information requirements, tools and documentation of analysis.

Assistant Programmers Course

(1) Computer equipment and techniques—Stage 3: including design of shift register, serial and parallel arithmetic units, data transmission equipment, random vs sequential processing.
(2) Mathematics—Stage 2: including manipulation of logical vectors and matrices, mathematical programming and some OR techniques, critical path methods, formal logic.
(3) Advanced systems analysis and design: including information set approach, use of algebraic—logical notations, decision tables and data structures, use of sort-merge packages, introduction to ALGOL.
(4) Selected topics in public administration.
(5) Selected topics in official statistics: including model building and statistical files processing.

Advanced Seminars

(1) General notation: including Lambda and Lukasiewicz notations.
(2) General syntax of language.
(3) Backus notation and description of ALGOL 60.
(4) The Iverson notation.
(5) Tree structures.
(6) File processing.
(7) Introduction to context-free languages.
(8) Structure and use of syntax directed compilers.
(9) Critical analysis of FORTRAN.
(10) List processing techniques.
(11) List processing languages and SLIP.
(12) Aspects of compiler construction for ALGOL 60.
(13) Coding, organization and accuracy of information.
(14) Machine organization.
(15) Tabular languages.
(16) Simulation languages.
(17) Information algebras.

Since the aim of the courses is to produce programmers well qualified in systems analysis, design and programming, relatively minor emphasis has been placed on logical design of computer hardware. Nevertheless it is considered essential to present enough of this subject for programmers to appreciate the relationship between hardware and software and the factors affecting the design of each.

The Operators Training Course has been designed to include some programming and a fairly detailed discussion of the monitor system, SCOPE. Consequently operators are expected to make an intelligent contribution to improve the day-to-day operations of the installation.

research in the bureau

The kinds of ADP development within the bureau have been indicated earlier in this paper. In addition to these there are three other related research projects scheduled for study. These are: (1) the continued development of notations for describing output and input requirements as a means for automating systems analysis and design, (2) the construction of a specialized statistical programming language to accelerate program preparation for enumerative statistical applications; (3) the application of syntax directed compiler methods to the editing by computer of statistical data. These projects are not independent but are rather all aspects of the study of automating as completely as possible the work of the bureau.

The installation of a 3600 computer by the CSIRO,[3] apart from providing slightly different peripherals—e.g., graph plotters and drums—has provided an invaluable opportunity for the bureau to take advantage of the basic research to be conducted by that organization. In particular the studies of on-line processing and time-shared facilities are of great importance.

The concurrent development of the two installations has been of assistance to the bureau's ADP effort, and combined classes and lectures have already been organized.

some wider implications

The successful introduction of ADP into the bureau on an Australia-wide scale has shown tangibly the value of using the electronic computer for non-scientific work. At the same time the production of considerable quantities of final output within a few months of installation has proved that, with a large-scale system, the transition from planning to production can be made with reasonable speed, and the advantages always claimed can, in fact, be realised.

The size of the operation has also enabled training on a wide front to be instituted and continued. Although the bureau is not constituted as a government data processing service centre for all departments and authorities not having their own computer, the facilities made available have enabled many of the benefits of such an arrangement to be realized. ■

[2] Comm. A.C.M., April 1964

[3] See the article by G. N. Lance, this issue.

AUSTRALIAN COMPUTING NETWORK

by G. N. LANCE

Scientists throughout the world have been quick to appreciate the value of automatic computers in scientific research. Australia is no exception, and the computer needs of its scientists have increased enormously over the past decade. Simultaneously, with the design of more complex and capable computing devices, scientists have extended the amount and variety of experimental data gathered, by using automated data recording equipment. Furthermore, the application of computers has been extended to an over-widening range of scientific and related disciplines.

By the end of the 1950's, it was clear that Australia could no longer rely on "home-made" machines; rather, it needed more adequate computing resources in order to maintain and develop its scientific resources. Additional computing equipment was necessary not only for application to research problems, but also in tertiary education to prepare the next generation of Australian students to help meet the computing needs of industry, commerce and research. As a preliminary step, the early 1960's were devoted to extensive surveys and careful planning.

As a result of detailed studies made by the Commonwealth Scientific and Industrial Research Organisation (C.S.I.R.O.), in cooperation with the Australian Universities Commission, the Australian Atomic Energy Commission, and various other Commonwealth departments, plans were made for the best means of supplying computing facilities for current and anticipated needs, and a proposal was presented to the Commonwealth government.

The proposal specifically recognised the special Australian conditions of a number of groups based in widely separated capital cities. It called for establishment of a number of computers in the form of a network. The network was to consist of at least one large and powerfully equipped central computing system and a number of smaller "subsidiary" systems. These were to be arranged to meet the needs of the main centres of scientific research, the universities and Commonwealth departments engaged in technical functions.

A high degree of compatibility throughout the network was required to give users situated close to one of the subsidiaries ready access to the major computing facili-

Dr. Lance is officer-in-charge of the Computing Research section of the Commonwealth Scientific and Industrial Research Organisation. Prior to his appointment to this position in February '63, he was head of the Computer Branch of the U.K. Atomic Energy Authority at Winfrith in Dorset. He graduated from King's College, London, with a BS (1st Class Hons.) in math, followed by an MS and PhD.

ties of the central system in Canberra. In this way, problems could be initiated and developed locally by the research workers, even if they finally required the high speed and capacity of the central computer for their completion. Such problems would be transferred, with all their data, to Canberra and, without further change or adaptation, run on the larger computer. The results could be returned to the user with the least possible delay.

Further, a group of specialists in computing techniques was to be established in Canberra to maintain and improve the facilities and to engage in research extending basic knowledge of computing methods and applications of computers.

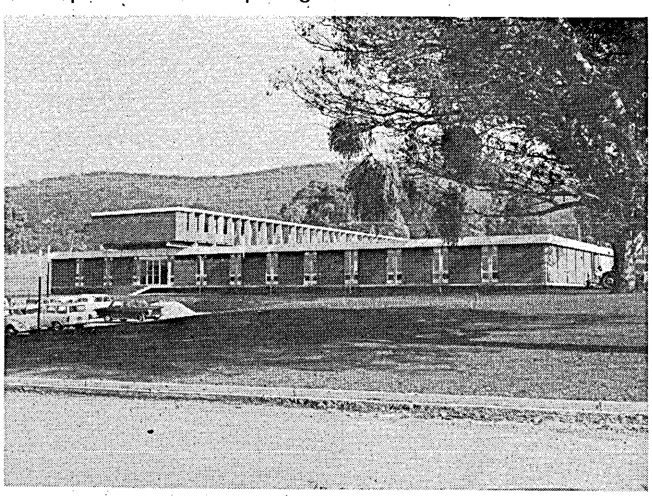
As a result of these proposals, C.S.I.R.O. was empowered in May 1962, by the Commonwealth government, to form a Computing Research Section and establish the basis of the network, at a capital cost of about £A1,500,000. Universities and other Commonwealth departments and agencies were to be provided with funds to acquire subsidiary facilities, or alternatively they were to be encouraged to use the C.S.I.R.O. network by allowing them to use it on an "at-cost" basis.

The C.S.I.R.O. has as its principal responsibility the undertaking of scientific research in connection with primary and secondary industry in Australia. To fulfill this responsibility, the organisation is divided into approximately 44 independent divisions or sections; a selection of their names will serve to indicate the diversity of the organisation's activities. For example, there are Divisions of Animal Genetics, Chemical Engineering, Wool Research, Applied Physics, Building Research, Entomology, Fisheries and Oceanography, Mathematical Statistics, Meteorological Physics, Plant Industry, Radiophysics and Soils, to name but a few. These groups are widely scattered throughout the country.

specifications and tenders

It is usual practice in Australia for organisations to invite tenders (bids or proposals) when procurement of any goods or services is envisaged. This method was followed in the present instance. The Universities Commission, the Atomic Energy Commission and C.S.I.R.O. cooperated in drawing up specifications. Two were issued, one to cover the large central machine and the other for the subsidiary computer systems. The order was split in this way so that manufacturers who could offer only subsidiary machines were not excluded from the competition, and vice-versa.

Headquarters of Computing Research section C.S.I.R.O.



By the 10th January 1963, the closing date, nine offers had been received for the large computer and 11 for the subsidiaries. Six manufacturers submitted proposals for both specifications. The specifications had been carefully prepared, and emphasized clearly the compatibility requirements. These were to be met by having available some common languages for all machines—e.g., FORTRAN, COBOL, and ALGOL. It was never planned to have compatibility at the machine-language level; neither was downward compatibility a goal.

Great care was taken with the assessment of the tenders, and after a short-list of four finalists had been prepared, two C.S.I.R.O. officers visited manufacturers in both the U.S. and England. In addition, visits were paid to typical users of equipment manufactured by the short-listed tenderers. These were extremely helpful and much useful background information was obtained.

On the 19th June 1963, the Minister for C.S.I.R.O. announced that both contracts had been awarded to Control Data Corp. of Minneapolis, Minn.

Meanwhile, a similar assessment of tenders was being undertaken by the Commonwealth Bureau of Census and Statistics, and the announcement that their order for computers was also being placed with CDC was made simultaneously. It is worthwhile recording that, contrary to certain rumors current at the time, the assessments by the two groups were made quite independently, and it was not until after the decisions had been made and the very last stages of the negotiations were in progress that the Commonwealth Treasury decided to coordinate the two contracts.

c.s.i.r.o. equipment

During the time between June 1963 and delivery of the equipment (and second half of 1964), some changes were made to the original specifications as a result of discussions held with Control Data. The CDC 3600 at present installed in Canberra is as follows:

One control console with monitor typewriter.
Computation module with 32K words of core (48 bits).
Eight model 607 magnetic tape units.
Card reader and punch.
Two paper tape readers and punches.
Two high-speed line printers (1000 lpm).
One low-speed line printer (150 lpm).
One large (30") and one small (12") graph plotters.
Four magnetic drums.
One large cathode ray display device with light pen.
Five remote console CRT's with keyboards are due for delivery during the first half of 1965.

In Adelaide, Melbourne and Sydney, CDC 3200's are installed and these each comprise the following:

One control console with monitor typewriter.
Computation module with 16K words of core store (24 bits).
Three model 603 magnetic tape units.
Card reader.
Paper tape reader and punch.
High-speed printer (1000 lpm).
Low-speed printer (150 lpm).
Small (12") graph plotter.

An adequate quantity of card and paper tape preparation units have been installed in all areas. The paper tape character set and code has been specially chosen to meet the needs of C.S.I.R.O. It is a code based on ASCII, and the characters available permit ALGOL to be punched on paper tape. There is also available in Canberra a chart converter manufactured by Gerber; the output of this instrument is recorded on paper tape.

The 3600 computer is housed in a building specially designed as the headquarters of the Computing Research Section. The photograph shows a general view; the computer room is on the right. On the ground floor is situated the computer room (3,000 sq. ft.), a small library which houses a specialised collection of books and periodicals, a room where out-of-town visitors may work, and rooms for data preparation and maintenance engineers. The computer and data preparation areas are fully air-conditioned. On the first floor, there is one large lecture room and 18 staff rooms, sufficient space for 25 people.

The building was opened and the equipment inaugurated by Sir John Cockcroft, chancellor of the Australian National University, on the 17th of September 1964.

staff and organisation

By June 1965, it is planned to have a staff of 56 people in the Computing Research Section. The organisation chart is shown in Fig. 1. It can be seen that in Canberra, the staff is divided into three groups comprising research scientists, service staff, and administrators. The duties of these groups are as follows:

Research scientists. These people conduct original research into any aspects of the efficient use of computers—e.g., numerical analysis, new special purpose languages, application of machines to simulation problems, etc. They are responsible for planning the way in which the drums and remote consoles will be fitted into the existing equipment and so provide an efficient multi-programmed operating system. The research scientists do not get involved in the day-to-day problems which arise in all computer laboratories. Such problems are first referred to the service staff.

Service staff. This group comprises eight professionals who help users with numerical problems and difficult programming questions. The network is run on an open-shop basis, as far as programming is concerned. The open-shop system is favoured for C.S.I.R.O. because it enables a limited staff to give reasonable assistance to the greatest number of people. Furthermore, the very wide variety of activities pursued by users makes it practically impossible to have an expert within the section in each and every discipline.

There is a total of eight card punch, paper tape punch and computer operators in the service group. The computers are all operated on a closed-shop basis, although later on programmers will have direct access via the remote consoles.

Administrators. Since the Computing Research Section is independent within C.S.I.R.O., certain administrative work must be undertaken by the section itself. A librarian is employed, an administrative officer and various other clerical staff. All purchasing of consumable computer supplies is done centrally from Canberra, although delivery normally takes place direct to the cities concerned. The computer accounting records are all kept in Canberra so the machine's log-book information is sent in monthly from the subsidiaries to be processed. Thus customers receive only one invoice, even though they might have used more than one computer of the network.

There are eight people stationed with each of the 3200's in Adelaide, Melbourne and Sydney; of each group, four are professionals and four are non-professionals (operators).

realization of the network concept

The geography of Australia plays an important part in determining the operation techniques which have been devised. The following are the air distances in miles from Canberra to:

Adelaide (via Melbourne)	733
Brisbane (via Sydney)	630
Melbourne	315
Perth	2,111
Sydney	148

C.S.I.R.O. divisions are situated in all these places. In Brisbane, the organisation is using the General Electric 225 installed at the University of Queensland for development of FORTRAN programs which are sent to Canberra when they reach the production stage. In Perth, a PDP-6 is to be delivered to the University of Western Australia in January 1965, and the organisation will use this machine for its local needs in the Perth area. As explained above, 3200's as subsidiaries of the C.S.I.R.O. network are available in the other three state capitals.

Thus the procedure is for scientists, in the five cities mentioned, to use their local machines for development of programs using FORTRAN, ALGOL, and COBOL according to their own preference. This enables them to obtain at least three or four test runs per day. Once a program is fully developed, the Computing Research Section reserves the right to run it on the 3600 in Canberra, if it is too large or too time consuming for the local 3200. Thus most jobs which would take more than 30 minutes on a 3200 are sent to Canberra.

The air-freight services in Australia are efficient, and it is found that people in Sydney and Melbourne whose jobs are sent to Canberra get them returned in less than 24 hours. The turn-around time from the other capitals is about twice as great. When it is borne in mind that the programmes transported in this way are fully tested and being used for production runs, it is clear that such turn-around times are quite acceptable.

Data transmission has been considered, but rejected for the time being. In Australia, the Postmaster General's communication network is not developed to quite such a high standard as in some other countries, and the use of ordinary telephone cables for phase-modulated transmission is not currently possible. Coaxial cables and/or microwave links are available, but it is too costly to use them over the distances involved. Investigations in this area are continuing. It should be emphasized that transmission at telegraph speeds is both efficient and economic in Australia, but because of the volume of information needed by scientific computers, such methods are far too slow.

At the time of writing, the 3600 in Canberra has been formally accepted only four months, so it is a little premature to discuss in detail the work carried out by it. (Testing of the 3200's in Adelaide and Sydney is about to begin). However, it can be said that from September to December over 900 hours of useful computing was obtained from the 3600. Approximately 100 scientists in C.S.I.R.O. used it, and they came from nearly all divisions previously mentioned.

Furthermore, 30 others used the 3600 from the Department of National Development, University of Sydney, University of Adelaide, Department of Works, Australian National University, Canberra, and the Bureau of Meteorology.

conclusion

From these facts it can be seen that the estimates of work load made for the purpose of obtaining government finance for the computer network have been fully confirmed by events. Many problems remain to be solved. However, plans have been made, particularly with regard to the use of the drums and the display consoles on the 3600, and it is confidently expected that all problems will eventually be overcome. The day may not be too far distant when the present equipment is saturated and our sights have to be set on computers not yet on the market. The fourth generation? ■

COMPUTERS IN AUSTRALIAN UNIVERSITIES

by DR. JOHN M. BENNETT

On the grounds that to most Americans Australia is a country inhabited only by Kangaroos and aboriginals, it seems desirable to begin an article of this type with a few vital statistics.

Australia, a country about the size of the United States, has about one-twentieth of the population, the income per head being about half that of the U.S.—a figure somewhere between that of West Germany and Switzerland. There is an installed computer population of about 230, about another 130 on order; and the latest information I have shows that "computer population" per head and the rate of increase is about the same as countries in Western Europe with similar per-capita incomes.

The country's economy can be summarized in the following table, in which a breakdown showing percentages of the national product for 1960-61 devoted to various activities is compared with corresponding United Nations figures for high income industrial countries averaged over the period 1950-60.

	Primary Prodn. (incl. mining)	Manufacturing	Basic Facilities*	Construction	Serv.
Australia	15.0	28.8	11.1	7.7	37.4
Typical high income industrial country	13.0	32.0	11.0	6.0	38.0

* Electricity, gas, water, transport and communication

Australia has 10 universities, six of which were in existtence before the war, and there are currently four more in the process of formation. The total enrollment in all universities is about 78,000 and, if allowance is made for part time students, the number of full time students is 60,000. This figure is about 7.5% of the 17-22 year population. The number of postgraduate students (candidates for masters' and Ph.D. degrees) is about 5,300, of whom about half are part-time students. Both the undergraduate and the postgraduate population are increasing at about 13% per year.

Australian university students usually enter the university at the age of 18. In most faculties (the word "faculty" refers to the body administering the by-laws leading to a given degree, such as Bachelor of Arts, Science, Economics, etc.), the course structures are somewhat more rigid than is the usual American credit system. Pass degrees in faculties such as Arts and Science are of three years' duration, an honours degree requiring an extra year. In some of the technical faculties, the pass and honours courses are longer—engineering degrees normally take four years, for example. No suitable comparison of American and Australian degrees exists, there being disagreement even among those who have had experience with both systems as to the relative merits of, say, an Australian pass degree and a degree from a good U.S. state university.

Of the total finance required to run the universities, about one-eighth comes from fees, about 40% comes from the various state governments, 40% from the Commonwealth government. Only in the older universities does income from private funds play a significant part. The total expenditure (of which one-third represents capital investment in building) is of the order of £A50 million per annum (£A1 is 2.28 U.S. dollars). Expenditure on research is listed at about 13% of this figure, this being somewhat arbitrary as it will not include any proportion of academic salaries. Recently, the Commonwealth government has begun the practice of making direct allocations to university research through the Australian Universities Commission, and contributions made in this way are currently running at £A1.7 million per annum.

The Commonwealth government set up the Australian Universities Commission (A.U.C.) in 1957, and financing is now carried out on the basis of triennial recommendations made by this commission. Although constitutionally education is a state affair, the commission's recommendations concerning expenditure on state universities are accepted by the various state treasuries.

The total number of full time academic staff is about 4,500, about four-fifths of whom have tenure in the American sense. Recent surveys show that an Australian academic will spend about two-thirds of his time teaching, one-third in research work. Full time appointments are for 12 months, and there is relatively little consulting work carried out by academic staff.

Comparatively little research is done by local industry, there being a general tendency to manufacture under license. This tendency is intensified by the large proportion of Australian firms which are subsidiaries of overseas concerns. (There are a few notable exceptions to this rule, however). The bulk of Australian research (apart from that carried out in universities) is carried out by various Commonwealth government agencies. Of the non-defence government research establishments, the C.S.I.R.O. (Commonwealth Scientific and Industrial Research Organization), with about 850 research scientists and an annual budget of about £A11 million, is by far the largest.

In addition to the universities, each state has a number of technical colleges. It is important to mention these colleges because of the role they are beginning to play in running less advanced EDP courses. Unlike the universities, they are controlled by the various state departments of education.

Finally, a word about population distribution. The two largest cities in Australia (Sydney and Melbourne) are

Professor of physics at the U. of Sydney, Dr. Bennett is also vp of the New South Wales Computer Society. He entered the computer field in '47 as one of the EDSAC team. He spent five years with the Computer Dept. of Ferranti Ltd., England, in the design and application of computers, his final assignment being the design study which led to the PERSEUS. He holds degrees in engineering and science from the U. of Queensland, PhD from Cambridge U.

about the size of Philadelphia. Most industrial and commercial organisations have their headquarters in these two cities, and so computer activity tends to be concentrated there, with data collected from elsewhere by post and, in a few cases, by landline. Canberra, the federal capital, has a population of only 70,000. It is only recently that there has been a major movement of various Commonwealth government departments to Canberra. As one might expect, there is a resulting shortage of junior clerical personnel, which, as CDC and Honeywell have already discovered, is the answer to a computer salesman's dream.

On the grounds that, from the U.S., New Zealand and Australia are in the same part of "down under," some information is given about machines at New Zealand universities. As "kiwis" will be quick to point out, New Zealand, with about a fifth of Australia's population and a slightly higher income per head, is very much a separate country.

training needs for computer scientists and e.d.p. specialists

Such a background must be given in order to discuss the training needs of the country. As might be expected, the bulk of commercial users are equipped with 1401-type installations, and state their requirements for programmers as being merely for individuals who can mechanise present processes. However, a number of larger firms and various state and Commonwealth departments, conscious of the contribution computers can make to managerial efficiency when coupled with operations research techniques, are realising the need for somewhat wider training. Accordingly, there is now a clamour for graduates in various fields—economics, engineering, physics, mathematics—with proper training in at least some aspects of computer science. The shortage of trained personnel brings with it the usual symptoms: spiralling salaries, short job tenures, costly mistakes because of inadequate training, and so on. Programming needs are invariably underestimated in the early stages of the introduction of computers into an organisation, a tendency often encouraged both by manufacturers and by individuals putting cases to management—and the Australian experience is no exception to this rule. So the shortage becomes evident only when delivery is imminent. And then doing something about it becomes a matter of great urgency.

Selections from the present salaried position for programmers and O. and M. systems analysts in the Commonwealth public service may give some indication of minimum salary trends. The computer "programmer-in-training" would apply to a fresh graduate with no EDP experience, and the training period would last a year. Salaries are given as multiples of the statutory wage for an adult unskilled male worker (the "basic wage"—currently £15.15.0 per week).

Programmer-in-training	(1.8 - 2.2) x basic wage
Assistant programmer	(2.2 - 2.5) "
Director (highest grade)	(4.6 - 5.6) "

These salaries are considered good by public service standards. Nevertheless, there have been a number of cases in which individuals have gone to other jobs with a 70-80% higher salary, and similar situations have occurred in industry. The pace is being set to some extent by a number of U.S.-based firms whose representatives, in making decisions about salary rates, are influenced by salaries paid for similar work in the U.S.

Projections made several years ago indicated that there will be openings for about 350 graduates working full time in the field by 1966, and perhaps four times that number of non-graduates, mainly for applications work. These figures now seem to be of the right order. In 1956, three universities, conscious that there would be such a need for training programs, and that computers would be required as research tools for their staffs, installed machines. One of these was purchased for the University of New South Wales with the help of state government funds (a DEUCE); one, a machine (called CSIRAC) designed and built in Australia in 1953 (by Pearcey of C.S.I.R.O.), was presented by C.S.I.R.O. to Melbourne University; and one was built with private funds at Sydney University (SILLIAC) to the design of (ILLIAC). As a result of the general appreciation of the need for further funds for new machines at these universities and for machines at other universities, the A.U.C. in 1961-62 made available £100,000 for three machines of about the 1620 capability and contributions to the purchase of two other machines (an Elliott 503 and a GE 225) by universities who by preempting time to various local groups could raise funds for larger installations.

At the same time, a Commonwealth government policy committee was set up to coordinate the needs of universities and various Commonwealth government agencies. This committee announced in May 1962 that a "network" to be managed by C.S.I.R.O. would cater for the civil research needs of the Commonwealth government. This "network"—actually a large computer in Canberra and four small computers in various capital cities, not interconnected in any way—would, it was said, be extended to the universities, which would purchase small machines to act as "satellites." The initial allocation for the scheme was £A1.5 million, and, later in 1963, a sum of just under £A1 million was allocated to various universities to acquire their own machines to be operated as part of the system.

"Ned Kelly's" article in the September issue of DATAMATION tells the story of the large order. Because of progress in the field since funds were originally asked for, C.S.I.R.O. was able to place an order for much more powerful machines than originally envisaged—i.e., a 3600 and four 3200's, most of which are now installed. The universities, once the funds were made available, individually went for the best bargains they could get, and as the table given below shows, did quite well. The overall picture appears to be that, if no allowance is made for educational discounts, there will be about £A3 million worth of equipment installed in Australian universities by early 1966. Its variety is a reasonable guarantee that, regarded from a national point of view, the influence of any one manufacturer on training will not predominate.

For convenience, New Zealand University and Australian technical college machines installed and on order, are also shown.

	Present Equipment and Actual or Expected Delivery Date*	
Australian Universities		
Adelaide	CIRRUS**	(1964)
	IBM 1620	(1963)
Australian National University	1620	(1961)
	IBM 360/50	(late 1965)
Melbourne	CSIRAC (installed 1956—decommissioned 1964)	
	IBM 7044	(1964)
Monash (Victoria)	SIRIUS	(1962)
	Burroughs B200	(1964)
	CDC 3200	(1964)
Newcastle University College	IBM 1620	(1964)
New England (N.S.W.)	IBM 1620	(1964)
N.S.W.	DEUCE	(1956)
	2 IBM 1620	(1963)
	IBM 360/50	(late 1965)
Queensland	GE 225	(1962)
Sydney	SILLIAC	(1956)

	English Electric KDF 9	(1964)
	IBM 1620	(1962)
Tasmania	Elliott 503	(1964)
Western Australia	IBM 1620	(1962)
	PDP-6	(early 1965)
New Zealand Universities		
Otago	360/30	(early 1966)
Auckland	1620	(1963)
Canterbury	1620	(1962)
Wellington	Elliott 503	(early 1965)
Technical Colleges		
Caulfield (Victoria)	SIRIUS	(1963)
Hobart (Tasmania)	ICT 1201	(1964)
Melbourne (Victoria)	Elliott 803	(1962)

* Digital computers only

** A machine designed and built at Adelaide University.

courses and staffing

Innumerable coding courses, introductory computer courses, and courses which form part of other courses for which credit is given, have been the main training contribution of the universities to date. It would be difficult to put a figure on the proportion of students graduating currently who have had some exposure to computers. One can say with confidence, however, that this proportion is too low.

As a first step towards recognition of computer science as a proper discipline, two universities—Sydney (since 1959) and Queensland (since 1964)—now offer postgraduate diplomas, and two more (Adelaide and W.A.) will do so in 1965. These diplomas take one year full time, but can be (and mostly are) taken on a part time basis, and include lectures and practical work in the three computer science fields—programming techniques, numerical methods and logical design. The total number of students at present is small—about 30 in all—and less than a dozen have completed the requirements.

The rationale behind including any logical design lectures as part of a computer science course when there are no domestic producers of computers perhaps requires some explanation. For anyone specialising in logical design, employment opportunities may be gauged from the fact that, in the last decade, apart from university work, one computer and several quite complicated digital devices have been designed for defence needs, and digital recording instruments have been designed for a number of special purposes. Some (but not all) electrical engineering courses now include some logical design lectures, so that electrical engineering graduates can contribute to work of this type. However, apart from work of this sort, some appreciation of the logic and organisation of a computer is regarded as necessary background for the university training. There is, of course, little or no emphasis on logical design in the more vocational courses offered for commercial systems analysts and programmers, and in introductory courses offered to students who will be specialists in other fields.

The next step towards university acceptance has been the introduction of full undergraduate credit courses in computer science (or with some similar title). Such courses (of about 360 hours in all) are being offered for 1965 at Adelaide, Sydney, Melbourne, and in 1966 at Monash, and a further (honours) year will be available at Adelaide and Sydney. With the introduction of computer science courses as credit courses in the undergraduate curricula, the output of graduates with a reasonable background in the computer field can be expected to grow. These courses can be combined with others, so that full degree sequences with either a scientific or a commercial bias, including the computer science course, are available.

As an additional sign that computer science is achieving a measure of respectability in Australian universities, there are now three full chairs in the field (Sydney, Adelaide and N.S.W.) and arrangements are now complete for establishing a fourth (Monash).

The total number proceeding to research degrees in the field is steadily growing. Thus, to date, perhaps four Ph.D.'s have been awarded by Australian universities for research on topics in the computer science field, and there is currently about the same number of Ph.D. candidates. This trickle will no doubt grow when the full undergraduate courses mentioned above get under way.

The pattern of use of university computers as a research tool may be gauged from the position at Sydney University. Here, about 60% of the computing time is used by the School of Physics—half for theoretical calculation, half for the reduction of automatically recorded experimental data. The next biggest group of users are the biologists—for the design and analysis of experiments. Computations arising in engineering and applied mathematics are next, followed by the social sciences. Medicos are beginning to take an interest; users from the humanities are quite rare.

University administrations are, on the whole, making little use of available computers on the campus. An exception is Monash University: in this case, the administration have acquired a Burroughs B200 for their own work.

The pattern of administration of the various computer groups varies considerably. When one individual has gone out to get funds for a computing facility, that facility usually remains under his wing. Where funds have become available through university channels, the computing facility is controlled by an interfaculty committee. Even the administrative arrangments for teaching courses vary considerably. In this regard, it seems that the Australian scene is not exceptional.

technical colleges

Diploma courses placing emphasis on programming techniques and systems work in the O. and M. sense are offered by three Victorian technical colleges. Less extensive courses are now being introduced in N.S.W. and possibly in other states. For the longer courses, the response has been poor, and it still remains true that, for instruction at this level, the machine houses and individual users are providing the bulk of the training themselves.

the future

Now that all universities have some computing facilities, graduates with specialist knowledge in the computer field, and those with sufficient acquaintance with computers to be able to spot applications in other specialist fields, will become available in increasing numbers. Nevertheless, it will be some time before the supply is equal to the demand. Training of a more vocational character (i.e., suitable for individuals who, for example will be concerned primarily with coding routine commercial systems) is lagging somewhat. It is here, unfortunately, that the major demand for personnel exists.

As far as the use of computers for university research is concerned, it will be interesting to see how the plan of concentrating funds in the purchase of a large central installation will work out in practice. The expectation is that universities, provided with minimal installations, will refer any serious computing to this central installation. Certainly one effect which this policy is having is to make it more difficult for universities to attract and retain the staff so essential for running an adequate training program. ■

there was a machine

CSIRAC DOWN UNDER

by T. PEARCEY

Activities in computer design and construction in the sparsely populated southern hemisphere started early and produced a machine which is now probably the oldest still in use at the time of writing. It is to be decommissioned in November after 13 years of sterling service to what was, throughout the last decade, a somewhat isolated and computer-starved community. It all started from a page or so of scrappy notes made hurriedly bv Douglas R. Hartree when he attended a lecture by John von Neumann late in 1945.

After 1945, the Radiophysics Division of the Council for Scientific Industrial Research was looking for a place to apply the electronic pulse techniques that it had acquired from its wartime radar activities, and some of the division's projects were, even then, leading toward massive computation. So in 1948 a study of digital electronics was initiated, the author being responsible for logical design with Mr. M. Beard B.Sc., M. Eng., responsible for electronic engineering and development. We knew that a storage medium, the acoustic delay line, was available from radar, and by 1950 we found, as a result of assembling various pulse generators, static and dynamic registers for control and arithmetical functions, that we very nearly had a computer. The decision to complete the job was taken, a design was fixed, and by 1951 a working computer was publicly exhibited. Since then it has been improved in many respects but has been kept in regular operation.

In 1956, it was transferred from Sydney to the University of Melbourne where it has since been a teaching and reasearch tool. We were all doubtful whether it would survive the ordeal of travelling over 500 miles of not the best of roads. Many graduates of Melbourne University look upon their workhorse with some affection even if it was constructed and ran like a Clydesdale. The university is replacing it with a 7044, and its C.S.I.R.O. users now have a much more powerful network of computers to call upon.* It will be fittingly retired to the technological museum in Melbourne. The name CSIRAC (for Commonwealth Scientific & Industrial Research Automatic Computer) was given only upon its transfer to Melbourne.

The designers were more concerned with the ease of handling and programming. Speed and precision were sacrificed in those interests. Thus, beyond the fact that the main store, never greater than 768 words, consisted of mercury delay lines (as did ACE, EDSAC, EDVAC), it differed from its contemporaries. The choice of 20-bit words was a compromise between datum and instruction length. Making them the same simplified the logical structure and placed the onus of precision of more than six decimal digits on the programmer, and made it even more necessary to design for simple and economical programming. Its closest relative turned out to be the pilot ACE at Teddington U.K., but possessed neither its complexities nor its difficulty of use.

Operation was serial at a digit rate of 1/3rd of a megacycle, and the delay lines were double packed to 32-word capacity by interlacing two digit trains. Instructions were serially addressed, and one cycle consisted of four datum transfers along the same cable: sequence counter to store address register, store to instruction register, instruction address to store address register and inter-register or store transfer. Each instruction was thought of as a 20-bit transfer from one register to another up to two simple transformations taking place during transfer—e.g., "Read out sign bit in register A, add to register C." Bits 1-5 and 6-10 were allocated to 32 register output and input gates, respectively; bits 11-20 represented a "sub-address"—e.g., the storage address or a local parameter, depending upon the other partition codes.

Although 18 separate registers were provided with the same arithmetical and discriminative capabilities, at least 15 of these were for free, being in the same delay line. Only a few mnemonics had to be remembered to refer to the individual functions, and there was no attempt at optimisation. Since the largest instruction partition could be used for routine parameters, a facility for shuffling 10 bits was included. Further, the control area was only

Mr. Pearcey has been a research scientist of the Commonwealth Scientific and Industrial Research Organization since 1945, and is now a member of the Computing Research section, Canberra, Australia. He graduated from the Imperial College of Science and Technology, London (physics and math), and had been engaged in math problems of radar development until 1945.

* See the article by Dr. G. N. Lance in this issue.

vaguely distinguishable from the airthmetical area, the control registers being provided with facilities similar to those of the arithmetical registers. Thus, not only could relative addressing be performed at execution time, but any register, including store, could be used to index the following instruction. Further, the multiplicity of accumulators with bit testers was invaluable for the control of nested loops and subroutine links without loading and unloading parameters to and from store. The result was an easily remembered but flexible programming scheme which still left plenty of room for the programmer to exercise his skill at the game of chopping one more instruction from his routine. The economy in use of instructions was found to be considerably better than that of any if its contemporaries. Although soon after 1951, a 10-millisecond magnetic drum store of 1,000 words—later extended to 2,000 words—was added, it was intended only for word by word data picking. It did not materially increase the area available for the program, which remained at a high premium.

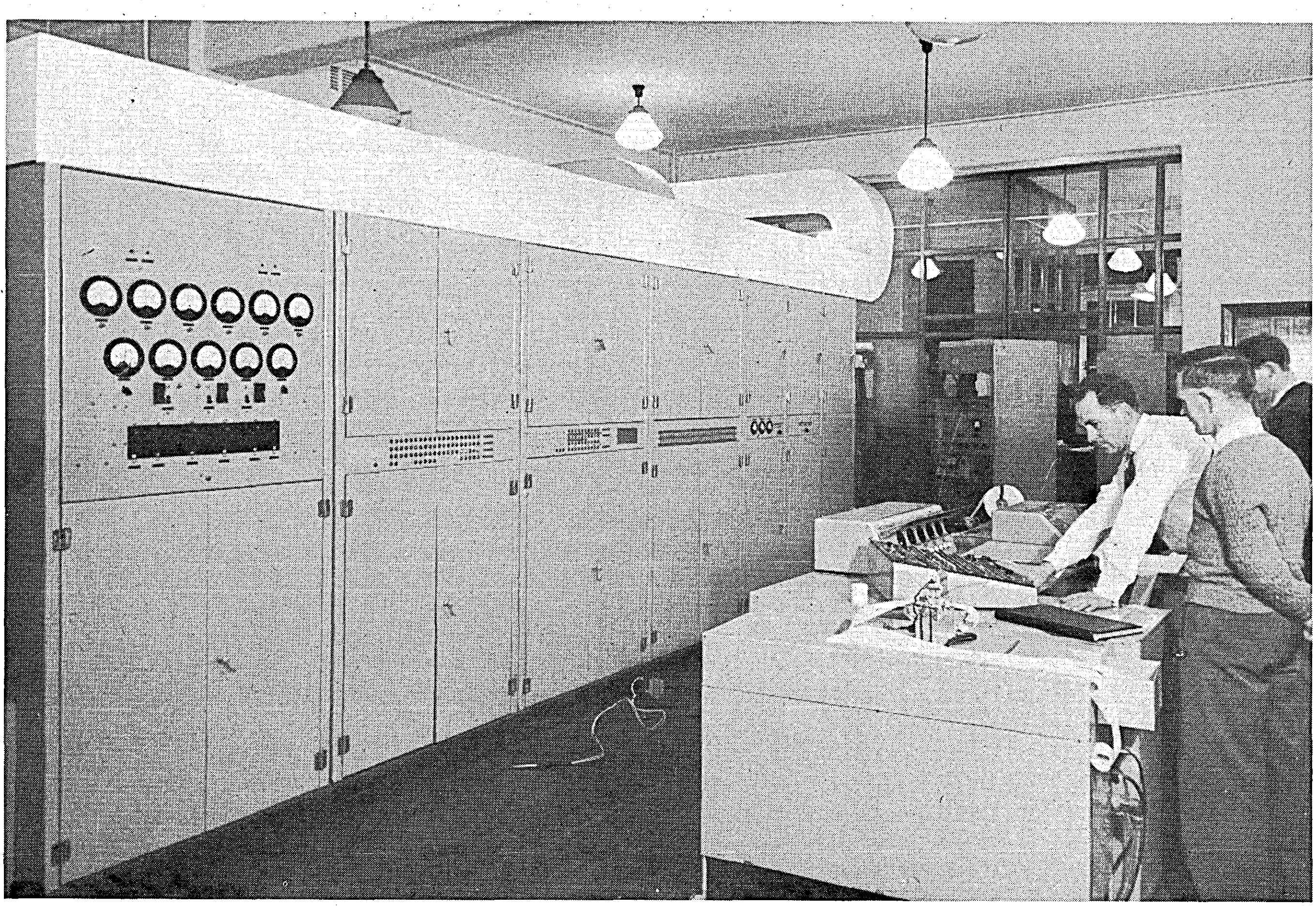
In the late '40's, card, tape and printing equipment was difficult to get in this part of the world, and frequently we had to make do with already wornout equipment. Teleprint gear was on two years delivery! The old "Morkrum" printer scrounged from the Post Office was originally used as main output. It must have already seen 30 years of work on the telegraph system, was built like a tank and is still working as the monitor printer, the main output later being on 5-channel paper tape with off-line printing.

So much trouble was received from a modified column-by-column card reader that we moved, without code change, to 12-channel paper tape—an indefinitely extended card. Photo-electric readers and mechanical punches were designed and made on the spot, and were invaluable at 900-bits-per-second input until 5-channel paper tape readers and punches were added. Even now the wide tape is frequently used for programs, using a keyboard of 32 keys engraved with their appropriate mnemonic pairs.

Practically everything was displayed, working registers and store on CRT's and controls on neon rows. Three rows of 20 switches allowed for good manual control of program and easy adjustment of parameters during exploratory work. Although a library of useful subroutines grew, very little was done in the way of diagnostic routines other than listing programs for proof reading. It was so slow at 1,000 instructions a second that the user could scan the displays during execution, take off his tape, patch it at the end or change a few holes and have another go at it. It didn't seem to be too uneconomical, and debugging was certainly made interesting.

It has always been run on an open shop basis and even overnight this was extended to open shop maintenance. Like all machines of its vintage, it has collected a group of stories like the evening when the console switches were set to a four-letter program identifier. Three times listing was attempted, produced a better attempt at spelling a different but unprintable word, succeeded at the third try, and closed down for the night.

The pioneering atmosphere of the decade following 1945 is now well over, and one feels a little like the school boy who finds the steam locomotive being replaced by the far less colorful diesel. Our new swift monsters will become swifter and ever more silent while stealthily remodelling our mode of life more profoundly even than atomic energy and spaceflight. What proportion of the major advances of the last decade have not owed their success substantially to the automatic computer, one thing we can be sure of: a count would show it to be surprisingly small, and the future will see a steady decrease in that proportion. ■



THE AUSTRALIAN MARKET

by E. M. U.*

Today there are about 210 computers operating in Australia and about 130 are on order. It has been estimated that the level of computerisation (ugh!) is about one-fifth that in the United States, but the presence of some 17 manufacturers is ample testimony to the potential of the market. IBM undoubtedly has the lion's share of existing installations and orders, with CDC, Honeywell and ICT in the front row. GE, English Electric-LEO (now amalgamated with a local company and named Australian Computers), NCR, Burroughs, Elliott Automation, Monroe, and Bunker-Ramo all have installations or orders. DEC is installing a PDP-6 and is well set up for further business. Other companies such as Philco, SDS and ASI are represented by local agents.

Not unexpectedly, the Commonwealth government is the largest customer. Almost all major installations have been purchased outright and include two 3600's, nine 3200's, a 7090, and a 7040 (to be replaced by a 360/50), six Honeywell 800's and an 1800, as well as a variety of smaller machines. The universities, operating with government funds with one notable exception, have acquired a battery of 22 machines, which include 1620's, two 360/50's, a 7044, an English Electric KDF 9, GE-225, 3200 and a PDP-6.

Government orders are based on a tendering system. Tenders are invited publicly and any supplier is then given the opportunity to supply the equipment specified. Tenderers must complete a form setting out the total price, including delivery and installation, together with the date on which the work is expected to be complete. In addition, the supplier must provide his estimate of customs duty on the equipment proposed. Although the government does not levy such charges (which would, of course, merely go out of one pocket into another), the cost aspects of a tender are intended to be assessed on a "duty-paid" basis to preserve the long-standing preference for Commonwealth goods. Effectively, this means that British suppliers of computers add nothing for duty, but U. S. suppliers add 7½% (the "most favoured nation" rate) to their invoiced figures.

Doubts have been raised in some quarters on the suitability of the tender system for purchasing computers; it has been pointed out that the system is admirable for acquiring army boots or aviation fuel where there is relative uniformity in the quality and function of the item, and therefore a price tends to be the deciding factor. But it has been criticised as a poor procedure for selecting a fighter aircraft or a computer where the low bidder is not assured of the order because there are so many other considerations. Nevertheless, the tender system seems to work well enough and protects both the supplier and the taxpaying public from irregular practices. The government's procurement services are ably staffed by men of high ethical standards and graft is unknown.

Most government organizations carry out a feasibility study as a first step toward acquiring the computer. This is frequently a monumental effort as instanced by that for

*** A computer salesman, the author has selected acronymic initials which spell out a native Australian bird similar to *the ostrich; unlike the latter, however, the emu lacks a tendency to put his head in the sand.***

the Dept. of Defence installation which occupied 30 people full-time and 50 others on a part-time basis for almost 18 months; the report is said to contain over 6,000 tables, diagrams and figures with about 3,000 pages of text contained in eight volumes. The system specification issued to prospective bidders is usually a highly definitive document calling for the most detailed answers—one recent specification required the type numbers of transistors, and several have called for lists of spare parts for test equipment.

The preparation of proposals is time-consuming and expensive—Australia is no different from the United States in this respect—and likewise, there are the usual problems in getting benchmarks run, hounding programmers through the dull business of coding up hypothetical and frequently ambiguous problems, as well as the analysis of the mountains of data thrown up by the feasibility study. Proposal writing and its concomitant tasks are among the least satisfying of all activities, and it is small wonder that the same pathetic theme harping on 99% uptime, support running out the ears, faith in the company, and so on, continues to run through generations of immaculately typed and colorfully bound tomes of hope.

State government departments operate in much the same way as the Commonwealth government. Australia has six states, and governmental data processing in each represents a valuable potential market: New South Wales (the largest state) chose Honeywell, Queensland has ordered two of ICT's 1900 series, while South Australia will install CDC equipment. The larger local government authorities are beginning to look to electronic data processing to reduce the human clerical content in billing rates and taxes, water and electricity supplies, etc.

Private companies in Australia (the word "corporation" is not in general use) are very strange animals indeed; many of the larger companies are dominated by overseas interests although the largest, oddly enough, is completely Australian. Overseas direction is largely British, with an increasing proportion of U.S. interest. The result, from the narrow view of the computer salesman, is that it is frequently not worth the trouble of trying to sell a business data processing system on its merits to "private enterprise": an explicit direction that a particular model is to be purchased is frequently issued by the parent company (to preserve compatibility!), and also, with greater justification, on the grounds that the devil that is known is preferable to the cherub that is unknown.

IBM and ICT have an initial advantage in the small machine market because of their punched card activities: ICT, evolving through the old Hollerith Company and later as British Tabulating Machines, was virtually sole supplier to this part of the Australian market until IBM entered after World War II. However, Honeywell has made some inroads into this area, while NCR, Burroughs, Monroe and English Electric-LEO (Australian Computers), have nibbled enough to stay healthy. Many of the individuals charged with carrying data processing responsibilities for their companies have an accounting background with little or no computer experience (apart from a brief "fact-finding" visit to Britain and the U.S.) and are therefore unlikely to oppose their lords and masters on the board who will normally plump for their present punched card supplier.

In the last few years there has been a great increase in the availability of data processing consultant services from management consulting companies. Generally speaking, these have been of an indifferent quality but a rapid improvement has been evident in the last two years. However, Australians, for all the boasting of individualism, tend to be great respecters of their neighbours' judgment (50% buy the same make of car), and the advent of computer consultants is unlikely to change the established pattern of purchases in the 1401/200/1004 market.

In the relatively small Australian computer community, most manufacturers can detect a sales prospect in the early stages. From that moment, until he makes his choice and sometimes for long periods thereafter, the head of the EDP group and his assistants will be lionised, interviewed, questioned, wined and dined, called incessantly on the telephone and probably ambushed at home. They will, of course, be inundated with brochures and manuals, invited to courses (for executives, naturally!) and may even be invited overseas to inspect manufacturing facilities, meet the top brass and get to know the software geniuses who, according to the salesman, are standing by just waiting to write the special executive routines which are all that is needed to make the ABC 5050 the perfect system for the application.

But from the salesman's point of view, Australians are reasonable people to work with. Relations between prospect and salesman are usually characterised by candidness, honesty of purpose, and a desire on the part of both to get down to business as soon as possible. At the working level there is always a genuine attempt to assess the relative technical merits of machines but, as elsewhere, the technical recommendation is frequently upset at the political level. It should, however, be pointed out that this has not been a characteristic of government orders, a state of affairs for which Honeywell and Control Data are no doubt duly grateful.

Toward each other the manufacturers affect a polite but guarded air of goodwill which, for the most part, reflects the attitudes of their parent organizations in the U.S. or the U.K. The smear technique is applied with the same devastating stupidity as elsewhere—most prospects have been advised in great confidence that A is being sued for late delivery, B is so far in the red they are pulling out of the market, while C is being taken over (usually by the informant's company). It says something for the common sense of Australians that such tactics are usually ignored, and most salesmen are beginning to realize that unfair criticism of the opposition earns only black marks. The relations between individuals in the competitive marketing organizations are comparatively civilized; it is by no means unusual to see rival salesmen sitting together over a drink at the Rex in Canberra or the Southern Cross in Melbourne, and one can only conjecture at the efficacy of the carefully misleading information so charmingly exchanged.

Taken all round, selling computers in Australia is exciting and sometimes rewarding. Neither the conservatism of private companies nor the inertia of government procurement agencies will prevent a rapid increase in data processing facilities; it is even possible that a little viscous drag of this sort will induce the salemen to think harder and put forward something better than the unimaginative recommendations air-mailed so frequently from their home offices. Australians are, by nature, rather cynical and are quick to point out obvious deficiencies—for instance, that cards and paper tape are surely far from ideal as input media. They want to know when optical character recognition equipment will cope with the input problem, why disc files seem to be a failure, why printers have not been largely displaced by visual displays *on demand,* and why one has to buy "a bloody great computer you can never get on to; what about some remote consoles—or is that all talk?" ■

COMPUTING IN NEW ZEALAND

by HONE HEKE

New Zealand is a small country with a population of some 2.6-million, the largest part being located in the four main centres, Auckland, Wellington, Christchurch and Dunedin. While Auckland is by far the largest city with a population in excess of 500,000, Wellington, situated at the southern end of the North Island, is the capital city and the location of the various government departments and head offices of many business organisations.

The country relies almost entirely on primary produce to maintain its overseas trade balance. Historically, there are strong ties with Great Britain and surprisingly few with Australia, the next-door neighbour. New Zealand still relies very much on Britain for its trade, although the recent furor about Britain's interest in joining the European Common Market has made the country think seriously about expanding its overseas markets. At the present the visitor gains the impression that the country is very prosperous. It has one of the highest ratios of motor cars to people of any country in the world; there are a large number of new buildings and construction projects in the main centres; and new homes are being built at a high rate. The level of unemployment is very low and most businesses complain about the difficulty of recruiting staff.

Nationalized essential industries and the idea of the "Welfare State" prevail. The government directly controls electric power generation, railways, postal services, telephone services, off-course betting, radio and television and, indirectly—through local bodies—power distribution, and medical services. Not only does the government exercise control, but also, in most cases, it carries out any work that elsewhere would be done by contractors. For example the Ministry of Works has constructed the hydro-electric dams on the Waikato river. Except for a few private schools the government provides and controls the education system which is of a high standard. It is often said that one of the country's biggest exports is university graduates. The high standard of education could be a factor weighing in favour of the use of computers as it leads to a situation where, with full employment, people are not satisfied by run-of-the-mill clerical jobs. With the Government performing so many functions, it is to be expected that its policies on the use of computers are likely to be a highly significant factor in the computer market.

Public and private companies in New Zealand are relatively small. Of those companies listed on the Stock Exchanges of New Zealand, there are approximately 50 with a capital in excess of \$2.5-million. To these could be added perhaps 10 subsidiaries of large overseas companies whose activities lie in such areas as oil marketing, motor vehicle assembly and the chemical industry. Because many companies are relatively small and dispersed, the development of effective low-cost data transmission equipment will be a significant step for the development of computer applications in New Zealand.

Whereas in the United States and Great Britain the universities and research laboratories were the first to use computers, in New Zealand the government was the first—a data processing application. In November 1960, an IBM 650 magnetic tape system, the first tape system in Australia was installed in the government Treasury. It was not until about two years later the Canterbury and Auckland Universities had IBM 1620 punched card systems installed for scientific work. The universities have therefore not been in the position to help significantly with the problem of training people in computer techniques, and users have had to rely very much on the computer suppliers and their own resources. In some cases staff have had to be trained, applications developed and equipment installed under adverse circumstances. An interesting situation exists in Auckland, where there are about six computers installed; yet, until April 1965 (when IBM will install 1401 tape system) there will not be a service bureau in Auckland with a computer. This indicates the interest in using computers that exists throughout the country. Companies appear to be prepared to install equipment using staff that have had a short computer course and little or no other computer experience.

When the government recently announced the budget for the universities for the next quintenium, there was considerable disappointment among academics. Certainly there were no specific funds allocated for computing facilities for the universities, which leaves them to struggle on with inadequate equipment. Victoria University, in Wellington, appears to be in a better position than the rest, as it will have access to an Elliot 503 system operated on its campus by the government department of Scientific and Industrial Research. The 503 system has no magnetic tapes and will on the whole be suitable only for scientific work. It is likely that the Accounting School at the university, which is tackling seriously the teaching of data processing and systems analysis, will have access to government-owned machines for students' practical work. This development, together with the recent appointment of a member of the Manchester Atlas team to the Mathematics Department, leads one to predict that Victoria University will assume the responsibility for specialized education in Computer Science just as the other universities have at times been given the exclusive responsibility of teaching Engineering and Medicine.

With about six universities for 2.6 million people, the government obviously feels that it cannot afford decentralization of all disciplines, particularly those involving large capital expenditures on equipment. Canterbury University, with an IBM 1620 system, teaches computer techniques for technical computation and is reported to be making this a specialty for engineering courses. On this scale, at least, there must be decentralization.

By the end of this year there will be some 45 computers operating in New Zealand, about 25 percent of these being in government departments. The largest installation will be the IBM 360/40 tape and disc system ordered by the Treasury in December, 1964; on this system much of the government's work will be centralized. The list price of these 45 machines will be in the range of \$250,000 to \$400,000, with the majority of them being at the lower end of the range. It is really only a case of small machines for small businesses. IBM and ICT, the usual leaders in a new market in a British Commonwealth Country, have captured most of the market with their usual sales techniques, with IBM taking the lion's share. Burroughs has sold some B200 series machines, Elliot Automation one machine, and English-Electric-Leo has a service bureau.

With very few exceptions the organizations interested in hiring computers are working in the unsophisticated way characteristic of a relatively new market. They are relying heavily on the manufacturer for advice on their systems and selecting equipment in an atmosphere where emotional rather than rational decisions are apt to prevail. The vital missing factor is experienced computer people. Because salaries for professional computer personnel are low, ranging from about $2800 to $7000, very few experienced staff have been imported from the United Kingdom or Australia, where the cost of living is comparable. In Australia, the official government salary scale is in the vicinity of $3500 to $7500, with top salaries in industry close to $10,000. It is likely that some of the overseas companies are not having quite the same problem, as they have access to their specialist groups in other countries.

The market is now entering the next stage, where data processing systems consultants spring up. One firm of public accountants and management consultants is reported to be doing good work and others are interested. However, it would seem that New Zealand is about two years away from the situation where the purchaser has the expertise to make the supplier toe the line. ■

INTRODUCTION TO STRAINE

Because this issue may generate, among its readers, dreams of glory, adventure, travel to distant lands, and the opportunity to be a bigger fish in a smaller pond, a few comments may be in order from a "Yank in the outback." Australia is in the southern hemisphere. This has many implications. For instance, light switches go down for on, doors open in, not out, cars are driven on the other side of the street, Father Christmas rides a surfboard, and the Easter bunny (besides being very unpopular) is a snowshoe rabbit whom everyone hopes will catch myxomatosis.

On declaring that you do not have any transistor wirelesses, dirty books, "knuckledusters, coshes, swordsticks, switchblade knives, pistols including spring guns or other dangerous weapons," you will be permitted to enter the country. Go immediately to the Sydney zoo and see a kangaroo; otherwise, unless you go to the outback, you may not see one. The first few hours are the most dangerous; when crossing the street, look to the *right*. The mortality rate is very high for new Australians.

Sooner or later, you will have to converse with local citizens. American is not spoken in Australia; nor is English, for that matter. Thus, the following list of the more useful phrases and definitions might be useful.

(One of the outstanding features of "Straine" is that most vowels are slurred, neglected, or otherwise mangled. The letter H is never used; A is often replaced with I, and the entire language is spoken without moving either the lips or mouth. Visitors are encouraged to practice that before departing for this island continent).

Abo	Aborigine, the first Australian; by law, can't vote, isn't counted in the census; very rare. However, a few have retired rich from selling boomerangs (made in Hong Kong) to tourists.
'Arfamo	Any period of time between five minutes and a fortnight.
Bob	Half florin, or 11 cents.
Billy	Large black tin can for boiling a cuppa (see Cuppa).
Bloke	I'm a bloke, you're a bloke, he's a bloke; roughly equivalent to the U.S.'s guy.
Bloody	Only known adjective in Straine.
Boomerang	Large, expensive piece of curved wood which, when thrown, goes through a car's windshield.
Bumf	Short for bum fodder; most computer output is bumf.
Cobber	Good friend or mate (pronounced mite).
Chook	Often found in the garden, does not grow out of ground but lays eggs; very expensive in restaurants.
Crook	Broken, bad, no good, doesn't work. Most software is crook.
Cuppa	Cup of tea; not to be confused with potable obtained with U.S.-type tea bags.
Dollar	Five bob.
Eight-hour day	Holiday, something like Labor Day. Name and celebration come from fact that one has never been worked in Australia.
Eye dee pee	Australian mnemonic code for either EDP or ADP.
Fare dinkum	The real stuff, no kidding, honest Injun.
Fargo	First part of the phrase, "Fair go, mate."
Foolscap	Standard size of Australian paper, 8½ x 15 inches, which won't fit anything.
Footie	Seasonal mania confined mostly to Melbourne. It ain't football, but something like it.
Gaol	As in Monopoly: Go straight to, do not pass GO, etc.
Lubra	Female abo.
Loolies	Candy.
Me	Only known first-person singular pronoun; as in "Who got me flamming beer?" or "Me and Jack."
'Owyer goin, mite, orright?	How are you, O.K.? To which the proper reply is, 'Orright, mite, 'owyer goin'?
Piper type	Preferred by some of the misguided natives as computer input medium.
Publican	Has nothing to do with politics; the bloke who is the licensed victualer; bar tender; his company is widely sought.
Quid	One pound; 2.23 U.S. dollars.
Shell be rite	Don't worry.
Straine	Native language of Australia, characterized by constant substitution of I for A.
Ta ta	Same as hooroo, which is the proper way to end a phone conversation.
Tucker	Food.
Tea	Evening meal; not to be confused with a cuppa, morning tea, or afternoon tea.
Woolloomooloo	Small suburb of Sydney.
Zack	Sixpence, half bob or two traybits.

DP IN SOUTHEAST ASIA

needs, resources and prospects

by DR. GEORGE K. CHACKO

A year-old census shows 13,709 computer systems installed in the U.S., and 3,702 U.S. computer systems installed outside the U.S.[1]—or one outside the country for every four installed within. Looking at computer usage from a per-capita basis, the total hardware and computer services stood at $647 million in 1955, when the U.S. population was about 168 million, and is estimated at $5,402 million in 1964,[2] when the U.S. population is about 192 million. Thus, in 10 years, the per-capita usage rose from $3.85 in '55 to $28.13 in '64.

It would be too fanciful to apply the $28 *per-capita* usage to the 840-million population of the 15 Southeast Asian countries. (These nations have a total income of about $50 billion. India accounts for 55% of the population and 52% of the income). The consequence would be computer usage of $23.5 billion, which would take up half the total income of these countries, compared with the one-hundredth of the Gross National Product spent in the U.S. However, the *rate of growth* of the per-capita usage of the more than seven-fold increase in 10 years may not be too unreasonable a guideline, particularly in light of the industry experience in Europe, where customers once exposed to the advantages of EDP seem generally to come back for more at a rapid pace, diligently discovering new and extended applications.

TABLE I

COUNTRY	POPULATION* (in '000)	INCOME** (U.S. $ Million)
1. Burma	22,351	300
2. Cambodia	5,900	400
3. Ceylon	10,625	1,325
4. Formosa	11,612	1,497
5. India	461,300	26,946
6. Indonesia	104,366	4,509
7. Korea, South	26,833	805
8. Laos	2,000	
9. Malaysia	10,310	1,857
10. Nepal	9,700	
11. Pakistan	98,612	4,734
12. Philippines	31,261	4,312
13. Sikkhim	165	
14. Thailand	29,700	2,277
15. Vietnam, South	15,500	1,962
TOTAL	840,235	51,954

* The population figures refer to the latest census available.

** The income figures (national income, gross national product) reported in the respective national currencies are converted into U.S. dollar equivalents by applying the current International Monetary Fund exchange rates.

The Indian Statistical Institute, the best-known user of data processing equipment in India, refers to its "starting with a single part-time computer and a total current expenditure of Rs. 238 in the first year."[3] Even at 1931 prices, a total current expenditure of $48 could not provide a computer, part-time or otherwise! The reference is to a person performing computations on a part-time basis.

introduction: defense and development dimension

"The Institute has an Electronic Computation Laboratory, which maintains an HEC-2M electronic digital computer and renders computation service to different departments of the Institute and to other scientific institutions in India. The Institute has a Machine Tabulation Unit with both Hollerith and Powers-Samas type punched card equipment consisting of about 20 sorters, 18 tabulators, and necessary complements of multipliers, collators, reproducers, and gang-punching equipment in Calcutta and a smaller unit at Giridih and Delhi."[4]

Of the three installations at the institute (British, Russian, and American), the British installation is the oldest. The British Tabulating Machine Company Ltd., which produces punched cards, introduced mechanical data processing in India more than 20 years ago. The company merged with Powers-Samas Accounting Machine Ltd. in 1959 to form Britain's largest computer manufacturer, International Computers and Tabulators (ICT), which acquired in 1963 the computer business of Electrical and Musical Industries Ltd. and the computer department of Ferranti Ltd.

The HEC-2M general purpose digital electronic computer is a product of ICT and is comparable to the IBM 650. The HEC-2M has a magnetic drum with a capacity of 1,024 words of 32 bits each. The instructions to the machine as well as data input are by Hollerith punched cards, and the results are punched in cards. Hollerith is the brand name of punched cards produced by British Tabulating Company, now part of ICT.

The use of data processing equipment by the Indian Statistical Institute corresponds to the growth in the need for handling data experienced by the institute. The first major data handling arose in connection with the land utilization survey conducted since 1936 for the Indian

Dr. Chacko is an operations researcher working in problems of national strategy in Washington, D.C. Born in India, he received his MA from Madras Univ. at the age of 19, received advanced statistical training at the Indian Statistical Institute, then came to the U.S. He received his PhD from the Graduate Faculty of Political Institute, then came to the School for Social Research, NYC.

[1] *Business Automation*, Feb. '64.
[2] *Business Automation*, Jan. '64.
[3] *Sankhya: The Indian Journal of Statistics*, September 1958
[4] ibid.

Central Jute Committee. Since 1950, the National Sample Survey, conducted for the government of India, has resulted in an increasing measure of data handling. A third major development in data handling has resulted from operational research studies inaugurated at the institute and related to national planning by Prime Mininster Jawaharlal Nehru in 1954.

In addition to the HEC-2M, the Institute has "two tabulators (type T.5), four sorters, 20 automatic electronic key punch duplicators, and six electrical verifiers, received from the USSR through UNTAA."[5]

Mr. Konoplev is the USSR senior engineer training the Indian Statistical Institute personnel in the use and maintenance of the equipment. In addition to Konoplev, leading experts in edp from the USSR including Academician Dorodnitzin of the USSR Academy of Sciences have led seminars at the institute. Nor has the wooing been limited to the USSR. Premier Chou-En-Lai accompanied by Ho Lung, Vice Premier, visited the institute on 9 December 1956, and a technical delegation led by Wang Szu Hua, Vice Director of the Chinese Central Bureau of Statistics, stayed from 11 December 1956 through 15 January 1957, studying sampling and other statistical methods in use in India. The hope has been expressed that there will be technical cooperation between India and China on statistical matters.

The Indian Statistical Institute is an unusual institution; it is an academic institution which provided until a few years ago "advanced training" in mathematical statistics, which had a master's degree in mathematics as a prerequisite for admission. During the last five years, its educational scope as been enlarged, and the institute now grants degrees as a university. It is basically a government-supported institution, insofar as the bulk of its funds come from the central and state governments in India. It is an influential research organization, capable of affecting public planning; the director has long been Honorary Statistical Advisor to the cabinet of the government of India. In 1955, he published in the well-recognized *Sankhya: The Indian Journal of Statistics* the "Draft Plan Frame," which was accepted as the basis for the formulation of the second Five-Year Plan. The institute hosts many foreign scholars in statistics, including Russian academicians and Polish planners. The director has for long been the secretary of the United Nations Subcommittee on Sampling. It is small wonder then that the data processing practices, policies, and preferences of the institute influence, directly or indirectly governmental, academic, research, developmental, and international institutions in India.

other governmental users

Telco The Army Statistical Organization, Delhi; Central Water and Power Commission Research Organization, Poona; Reserve Bank of India, Bombay; Director-general of Commercial Intelligence and Statistics, Calcutta; and the nationalized Life Insurance Corporation in Bombay and Calcutta are other prominent government users of data processing equipment in India. The last-named has two ICT 1501's, which are approximately equivalent to RCA's 301 on order from Britain.

Delhi University, Delhi, has an IBM 1620; so does the Indian Institute of Technology, Kanpur, and the National Physical Research Laboratory, Ahmedabad. Indian Institute of Science, Banglore, and Tata Institute of Fundamental Research, Bombay, are among academic institutions using data processing equipment.

industrial users

The Engineering and Locomotive Manufacturing Company, Jamshedpur; and Union Carbide (India), Calcutta, have data processing installations at present. According to Britain's ICT, four ICT 1300's, which are approximately equivalent to IBM 1401's, are on order by Bangalore Cotton and Silk Mills, Bangalore; Delhi Cloth and General Mills, Delhi; Buckingham and Carnatic Mills, Madras; and Saxby and Farmer (India) Ltd. ICT 1301's are transistorized and have magnetic drums, and core storage capacity of 2,000 words of 48 bits (12 decimal digits) each.

Hindusthani Aircraft of Bangalore has installed a National Elliott 803. Hindusthani Machine Tools Company has an ICT 1202. ICT has 250 punched card installations, with calculators, in different parts of India.

other southeast asian installations

Burma: The Union of Burma Railways have ICT punched card installations.

Thailand: The National Board of Economic Development attached to the Office of the Prime Minister of Thailand, has an IBM 1401 installation. In addition, there is an IBM 101 punch and an IBM 401.

Malaysia: Singapore City Council has an ICT 1301.

needs, resources, and immediate prospects

Perhaps the most basic need for data processing in India is data. While reliable data are gathered, analytical frameworks can be simultaneously developed. However, the question must be raised whether the cart is not being put way out in front of the horse.

Professor Max Millikan of MIT made the following observation about economic thought and its application and methodology in India:

> They (Indian economists) are beginning now to examine the applicability of some more recently fashionable tools, such as input-output analysis and linear programming, but there is still something of a lag. On the level of pure theory, India has still not made the frontier contributions to the analysis of economic growth which one might hope for from a country as fully embarked as she is on the experiment of consciously promoting such growth.[6]

Data collection, without an appropriate analytical framework, is like constructing a building without a blueprint, or even an artist's sketch, not to speak of detailed drawings. The largest effort at data collection in the largest unit in Southeast Asia is The National Sample Survey (NSS) of India. It is designed and planned by Indian Statistical Institute; the data are collected by the directorate of NSS and Indian Statistical Institute. The extent of analysis of the successive rounds of NSS data collection has been confined to "punching and machine tabulation."[7]

The most pressing need is the answer to the question: data for what? It is stated that "The National Sample Survey was started in 1950 with the objective primarily of filling gaps in statistical data."[8] Admittedly, there can be aesthetic gaps, funcional gaps, and a host of other types of gaps; but the question is: gaps for what purpose?

This is not a rhetoric question; it is a vital question with reference to data processing in India and other Southeast Asian countries. Without a proper answer, or the

[5]ibid.

[6]Max Millikan, "Economic Thought and Its Application and Methodology in India," *American Economic Review*, May 1956.

[7]*Sankhya: The Indian Journal of Statistics*, February 1962.

[8]ibid.

effort and inclination progressively to delineate such a question, data processing in Southeast Asia is bound to languish.

While the ground to build the edifice of data processing is amorphous, detailed blueprints for extensions of the 50-story penthouse are developed with vigour. Given the initial capital stock of 1960-61, and the Third Five-Year Plan target for 1965-66, what is the maximum consumption that can be permitted? The aggregate capital coefficients entering into this 350-restraints linear optimization problem are put together from a number of possible sources, and rather liberal use is made of *U.S.* data to arrive at a scaled-down structure of *Indian* industry, relating the output to input. This exercise currently uses an IBM 7090.

The paradox of the situation is that there is no dearth of real data in India. It is quite conceivable that data collection can be oriented to information utilization, rather than the other way around. Massive problems of economic and social emancipation for 450 to 840 million people certainly demand, not only the ingenuity of professionals, but also the capability of EDP. Water, water, everywhere; not a drop to drink: data, data, everywhere; not a datum for development.

resources: monetary and manpower

Money is likely to be the least of the resources problems. Computer facilities for developmental needs will be made available if necessary by long-distance Trans-Pacific communication links, as is already done by the MIT Center for International Studies. There, a center operated by MIT in New Delhi provides the input for the flow-matrix used in the input-output study, using an IBM 7090 which is at Cambridge, Massachusetts, to discover the optimal frontier of technology appropriate to India's Third Five-Year Plan. The Delhi Center works in cooperation with the Planning Commission, which is as it should be.

New Delhi is not the only instance of technological cooperation. Bangkok, for instance, has several installations of a technical nature, generally operated jointly by indigenous and foreign elements, which sets the stage for possible extension to the data processing fields when called for. It is also possible that owing to cold war pressures, the basis for such cooperation may be denied altogether as in the case of Ford Foundation aid in Burma.

The same cold war pressures underscore the defense needs of the United States and the free world, and they are likely to further the investment of EDP installations in the Southeast Asian theatre. There is an extremely crucial need for putting whatever little data that are available to the best use in developing tactical responses to the very unusual war that is currently waged with little precedence, overtly in Vietnam, and more covertly in Laos and other areas. Considerable attention will justifiably be given to the question of careful collection of casualty data, time and space of guerrilla attacks, weapons lost and gained, etc., to discover any possible structure that may emerge for use in development of tactics and strategy. An operations research study of the problem can be immensely aided by data reduction and manipulation not possible without EDP. Should this line of reasoning of the use of EDP as an adjunct to the conduct of the "warm" war prove meaningful, that would bring about considerably larger use of data processing in Southeast Asia. Money is unlikely to be a problem here; with the consent of the cooperating governments, Western EDP installations can whir away at the problems of common defense.

Turning to the *manpower resources* that are needed for effective use of EDP, a base for recruiting EDP trainees exists in Southeast Asia. Union Carbide (India) sends Indian employees from their Calcutta office to the electronic data processing department in New York for training. While this training relates generally to the *internal* reduction of *data*, some headway has been made in a neighbouring country, Thailand, thanks to Yankee ingenuity, in the persuasion to pay for information about *external data* affecting the market for one's products. This is a considerable achievement when it is recognized that any suggestion that one's products should be bought requires any justification and persuasion is almost a novel idea in Thailand. Dr. Frederic L. Ayer of Columbia University has successfully prevailed upon the initial inertia of Bangkok businessmen, and has induced them to *pay* for information in the fields of marketing, public opinion, communications media, television and radio listening habits in Bangkok, and purchasing preferences among branded products purchased for home consumption in Bangkok during recent years.

This is a healthy prospect for EDP in Southeast Asia. It is healthy, not because data are collected, or any data are collected. It is healthy because data are collected *for a reason.* Not only are they collected for a reason, but also are they analyzed, and cause is shown every time *why* the data contributed to the profit-making efforts of the business. Free enterprise may yet succeed in bringing to data processing in Southeast Asia the idea of getting a rupee's worth for a rupee of EDP, a baht's worth for a baht of EDP, etc. That is almost bound to accelerate the usage of EDP in that part of the world.

prospects: immediate and interim

Prof. Oskar Morgenstern of Princeton Univ. once said that mathematics is the only science which, once introduced into a field, has never been supplanted. To some degree that holds true for EDP.

In the *immediate future,* it is likely that the data processing equipment usage, ranging from punch card equipment to small, medium, and even large-scale computers pressed into the service of defense and development needs of Southeast Asia, is likely to increase, and perhaps increase substantially. If the current trend of increasing usage among the industrial components continues, that would not only enhance the *physical* usage, but also initiate rather forcefully in the language of rupees and nayapisas, or bahts and satangs, the *meaningful* usage of EDP.

In the *interim future,* indigenous efforts to evolve short-cuts and develop substitutes for the foreign equipment will continue. The Indian Calculating Machine and Scientific Instrument Research Society, established in 1943, is currently working with the Development Workshop of Indian Statistical Institute, which, "in addition to the maintenance and servicing of calculating machines and instruments and equipment of the Institute, assists the Electronic Computer Laboratory in the maintenance and development work of electronic computers. The workshop is carrying out developmental work for the manufacture of desk calculating machines and scientific instruments. It has recently received many items of precision tools and equipment from the USSR through the UN."[9]

It is unlikely that India will manufacture an electronic computer tomorrow. But, as an advertisement in the *New York Times* indicates, Indian enterprise is reaching out to manufacture semiconductors like diodes and transistors in India. "A small computer has 1,000 or more transistors and several times as many diodes within its anatomy; a really big one may contain several hundred thousand such devices".[10] India may not manufacture electronic computers in the immediate or even the interim future; but as India's neighbour to the north would say: A journey of a thousand years must begin with the first step. And that step is taken. The die is cast. ■

[9] *Sankhya,* September 1958.

[10] *Business Week,* March 26, 1960.

KANPUR REPORT

india conference highlights

by NED KELLY

Travelling by jet, one gets only superficial impressions of the world; and the novelty of being in India didn't strike until the morning after the day-and-night-long trip from London via Frankfurt, Munich, Istanbul, Beirut and Karachi. At the New Delhi airport, where I made connections with the Kanpur flight, the weather was cold; and the airport was filled with colorfully *wrapped* people. My curiosity was roused. Was he from Nepal? Were the bearded soldiers Sikhs? India is multi-lingual with English the nearest to a *lingua franca*, but I had frustrated moments getting through customs. The British left a heritage of bureaucracy symbolized by the legendary form with half an inch of space for name and address followed by a line for *sex*. I had made a number of errors, all of which were zealously detected and called to my attention. "Surely," the Inspector said, "you were not born in 1964!"

At Kanpur, I was met at the airport by a car from the Indo-American Program. This was fortunate since Kanpur, for its two million population, is hardly a Western-style city. Cars are rare and seemingly propelled by blasts of the horn rather than conventional engines; transportation is typically by foot, bullock carts, bicycles and rickshaws.

The driver honked his way across the city past an incredible variety of human and animal activities which, on a similar trip, led van Wijngaarden to ask an Indian companion if he did not find the West monotonous by comparison.

The Indian Institute of Technology campus is in striking contrast to the city itself. The successful completion of buildings under construction seemed improbable, if one judged by the rickety scaffolding; but finished structures, which had started out in the same way, are excellent examples of functional architecture. I learned something about the Institute: the government had requested the U.S. for advice and assistance in establishing an American style engineering college. The result was a cooperative effort by: Caltech, Carnegie, Case, MIT, Ohio State, Princeton, the University of California and the University of Michigan. The help has largely been in the form of people. In the field of computers, Harry Huskey of California, Forman Acton and Irving Rabinowitz of Princeton did the pioneering and are now followed by Robert Archer of Case and Gio Wiederhold of California.

Professor Huskey, a quiet unassuming man who has accomplished much in many facets of the computer field, had arranged the Kanpur program to provide the Indians with an opportunity to hear about and evaluate the experience of people abroad in establishing and using computer centers. He had invited specialists from academic, research and industrial organizations to give presentations and participate in discussions: Bennett of Australia, Wilkes of England, van Wijngaarden of Holland, Moriguti of Japan, Beltran of Mexico, and Acton, Barton, Carter, Evans, Gilchrist and Perry from the U.S. Professor Keshevan of the Institute handled the arrangements for the guest's comfort. Some 50 persons attended as representatives of institutions in other parts of India.

youthful programmers

In many respects Sergio Beltran of the University of Mexico made the most interesting contribution for he, perhaps alone of the participants, had come from a country which is not yet affluent in computers. His anecdotes, accompanied by expressive Latin gestures, on his unorthodox methods for obtaining computers and popularizing their use at the 90,000-student university were much appreciated. Professor Moriguti of Tokyo University was also most effective with his idiomatic English, occasional American slang, and dry wit, in his discussions of ALGOL versus FORTRAN and the role of computers in the curriculum. He put forward the interesting contention that only high school graduates should be employed as system programmers and then only during the years of youth. Such a remark might have stopped the show at a U.S. meeting but evoked only mild chuckles in Kanpur.

Some of the speakers seemed troubled by the thought: "Does India really need computers now?" Most of the favorite subjects were discussed, including the now popular notions of time-sharing and multi-console computers, with an occasional injunction to the Indians not to repeat all the mistakes and, *leapfrog* over the practice of recent years. Van Wijngaarden discussed whether computers should be built in India. This was not encouraged because of the probable conflict between engineering development and production computing; though a microprogrammed machine, of the type conceived by Morris Wilkes, is planned as a training project for electrical engineering students.

Since all the foreign visitors had had experience in running computer centers, there was much talk on the practical aspects of their management including open versus closed shop, system programmer training, and libraries. The business of job priority was examined at length and the still "surprising" fact brought out that the step to a larger machine often yields only modest improvements in service. The right of the computer center manager to play critic in respect to the "value" of work submitted was debated with the weight of opinion against any formal recognition of the critical function. It seemed to be appreciated that the ability to deal courteously and fairly with a variety of persons, some difficult personalities, was a prime qualification for success in operating a center, more than proficiency in numerical analysis or applied mathematics.

The computer manufacturer came in for the usual round of criticism when user groups were discussed. One sometimes wonders why any intelligent person would work in field support organizations caught in the wringer, so to speak, between less than perfect software implementers and sometimes unreasonably demanding customers. There were, however, some healthy signs in that several speakers, among them Clay Perry, reminded the audience that computers are not 100% certifiable as reliable, that logical errors sometimes persist for months; that software is also subject to logical flaws which may appear only after months of use; and that, finally, one can only attempt to produce correct results—no guarantee being strictly possible. Of course, we should know these things but often talk as if we believe that perfection were attainable.

Some sessions were devoted to survey or tutorial papers. Carter of System Development Corporation gave stimulating presentations on the use of computers in information retrieval and application in the behavioral sciences. Wilkes discussed practical aspects of list processing techniques. Barton, Evans and Wilkes speculated on possible future developments in equipment.

Tours had been arranged as breaks in the proceedings, to a Hindu temple, a rayon mill (whose owner had financed the temple construction), and a shoe factory. As architecture, the temple was impressive and the meticulously carved representations of Hindu mythology were fascinating but, one wonders, would it not have been better if the millions of rupees spent on the temple had been used for schools instead? The factories brought to mind the subterranean world of the Morlocks in H. G. Wells' "Time Machine." Though the caste system was officially condemned by the government in 1949, remnants remain, and the manufacture of shoes, since it necessitates the handling of leather, was once considered an occupation of very low caste. I do not know whether or not this affects working conditions at present, but these seemed so primitive and unpleasant that I wondered about the dilemma of automation: the work men do on mass production assembly lines is a less than ideal use of human beings; yet, to provide a basis for the distribution of goods and services we insist that all men work, which makes

Some computer configurations in India as reported to AICG till Oct. 23

Place	Make	Installed	Memory	Backing Store	I/O	Free Use
Tata Institute for Fundamental Research	TIFRAC	1960	2K Wd 40Bt	Mg Tp	P. Tp Printer	Yes
" " " "	CDC 3600	May '64	32KWd 48Bt	8 mg Tp	Card	Yes
" " " "	CDC 160A	May '64	8K Wd 12Bt	2Mg Tp 606	Card Printer	Yes
Physical Research Lab., Ahmedabad	IBM 1620	Dec '62	20K Dt		Card P Tape	Rent
Indian Institute of Technology, Kanpur.	IBM 1620	Aug '63	40K Dt	4 Mg Tp 7330	Card	Yes
Delhi University	IBM 1620	Nov '63	20K Dt		P. Tape	Yes
M.I.C., Bombay	IBM 1620	Jan '64	60K Dt		Card	
Director-General of Food, Calcutta	IBM 1401	April '64	4K Ch		Card Printer	Rent
Central Building Res. Institute, Roorkee.	IBM 1620	July '64	60K Dt		Card	
I.A.R.S., Delhi	IBM 1620	Nov '64	40K Dt	3 Dsk 1311	Card	
Programme Evaluation Organization, Delhi	IBM 1620	Nov '64	40K Dt	3 Dsk 1311	Card	
Central Mechanical Research Institute, Durgapur.	IBM 1620	Jan '65	40K Dt	3 Dsk 1311	Card Printer	
Carbide, Calcutta	IBM 1401	Jan '65	8K Ch	4 Mg Tp 7330	Card Printer	Rent
S.B. Mills, Delhi	ICT 1300	Jan '65	12 Dt	6K Wd 12Dt	Printer	
Life Insurance Corporation, Bombay	IBM 1610 E 3	Sept '65	40K ch	(7 Mg Tp 729 11)		
Life Insurance Corporation, Bombay	IBM 1401 E3	Sept '65	4K ch	7330 Mg Tp	Card Printer	
Life Insurance Corporation, Calcutta	ICT 1900	Sept '65	16KWd 4 ch	8 Mg Tp	Card	
A.T.I.R.A., Ahmedabad.	IBM 1620 1		60K Dt		Card	
Punjab University	IBM 1620		40K Dt		Card	
Indian Institute of Technology, Madras.	IBM 1620	Oct '64				

the ultimate replacement of men by improved machines seem more threat than promise.

indian computer society

The Institution at Kanpur was in the process of deciding upon a new computer. This would be the second large-scale machine in India (the other is at the Tata Institute of Fundamental Research). The Americans who have worked in Kanpur believe that equipping one school with a large computer should be sufficient for the next few years, while other institutions continue using smaller machines. The decision had been made in favor of an IBM 7044 with the understanding that no payment in India's precious foreign exchange would be required. IBM, at the time of the meeting, was reputed to have changed the terms of the offer by insisting upon payment of one-half million U.S. dollars with the balance in rupees. As a result, other manufacturers may be invited to submit proposals.

Steps have been taken towards forming an Indian Computer Society. A partial census of machines now in India was distributed and is reproduced here with some additions, to give an idea of the extent of current computer usage. U.S. manufacturers should not expect a rapid development of the Indian market, where the emphasis will probably be on scientific and engineering applications for some years to come.

Political pressures to develop nuclear weapons, now intensified after China's bomb test, may force the government into further use of computers. India now has an effective atomic power program, an excellent supply of physicists, and its single large computer, a CDC 3600 at Tata, is being used for problems of nuclear physics and engineering.

To one interested in the social impact of automation, the Indian trip prompted speculation as to whether there are better ways for India to spend its resources in foreign exchange. Would the same money spent, for instance, on factories for producing steel plow blades yield greater dividends, or is there for a developing economy an appropriate minimum level of effort with computers? In any case, the present level of expenditure, much paid for out of U.S. aid funds, is not high for a nation of 350 million people. It is unlikely that effort will be devoted to developing an indigenous computer technology, though one Indian speaker at the meeting argued that such was within the country's short range capability. It is sometimes claimed that the Indian educational system is more successful in producing theoreticians than engineers and technicians. Would Ramanujan, for instance, have been inclined to use a computer? This suggests that small computers may be adequate for the present with relatively slow initial acceptance into industry. Considering, too, such factors as the large supply of clerical labor and the inadequacy of communications, one thinks that the use of computers in modern data processing will have to wait.

It was a thought-provoking week, too short for any but hasty impressions. I left with appreciation of the many courtesies of our Indian hosts, respect for the Americans who are making worthwhile contributions to higher technological education in India, and renewed interest in the role of computers in technological societies. ■

AUSTRALIA AND JAPAN

random impressions

by ROBERT B. FOREST, Editor

The first peek out of my hotel room window in Sydney was both reassuring and disappointing: I might have been looking at any large, bustling American city. The astonishingly beautiful, haphazardly winding bay could have been Seattle; the new tall buildings were just as glassful and imagination-less as those going up all over the U.S. Here a quaint old clock tower, there a small row of Victorian shops were the only hints that I was not really home.

My first attempt to cross the street woke me up in a hurry. I paused, looked to my left, stepped out, and was nearly creamed from the blind side by a taxicab intent on impressing me in a hurry that things were done differently here.

Beyond these surface impressions, it is apparent that Australia is indeed different. For one thing, Australians are keenly aware of their role in Southeast Asia . . . and especially aware of their country's small population (about 10% greater than that of Tokyo) compared with the masses which strain the seams of India, Japan and Indonesia. This last country, unfriendly and dangerously close, especially concerns Australians. While Australia actively recruits immigrants, they have to be the "right sort"—spell that "white sort"—and naughty Americans who suggest that all the country needs to get it cracking is a couple of million bright, hard-working Japanese are scornfully ignored.

There is a chronic labor shortage in Australia, a strong impetus to automate which conflicts a little with a native conservatism revealed in a love of paper tape and similar standard ways of doing things. One American astonished one installation by suggesting the need for some keypunch machines. Still, there are many bright and brave computing pioneers in Australia, most of them in government or university circles. But it appears that there will be no more attempts to develop indigenous computers such as CSIRAC and SILLIAC. Asked to define the key difference between computing in his country and the U.S., Sydney University's John Bennett thought, smiled, and pronounced, "Less money."

It is perhaps this fact—plus the lack of a well-developed electronics technology—which has prevented Australia from developing its own computer industry. There simply are no huge government funds for the kind of research which has permitted American firms to produce their impressive armadas of machines. Nevertheless, the talent is there. People like Trevor Pearcey (key man behind the development of the CSIRAC), and Charles Hamblin (who did some early independent theoretical study on Polish notation machines which influenced the design of the KDF-9), are still around, as are such experienced and intelligent souls as John Bennett, Digby Pridmore, Cliff Bellamy and John Ovenstone, to name only a few.

But outside of the rather limited number of key university and government computing installations, there is little opportunity for truly bright and creative computer people. Thus, Australia may face the same kind of "brain drain" which has plagued Mother England. There has been some vague talk about American computing firms farming out programming or software research work to Australia, but nobody here has as yet done much to take advantage of Australian talent.

There has been some talk of the possibility that Australia, coming somewhat tardily to computing, might be able to vault over some of the idiocies, inanities and inefficiencies through which American users have stumbled on their way to such elusive goals as "total information systems." It is possible that Australia may be able to avoid some of the problems which faced early users of tapes and discs—now somewhat more reliable—but real breakthroughs are not overwhelmingly in evidence. The Department of Defence has an interesting "overlap" approach to development and installation of its three Honeywell systems for each of the services—there will be four compatible computers in all—which attempted to complete the preliminary design of one service system and start programming it before moving on to the next service. But some slipped completion dates have thrown the program slightly out of sync.

Dennis Moore, at the University of Western Australia, has received his PDP-6, which includes the first display device in Australia, a fact which Moore finds "incredible." (Interestingly, the system has eight microtapes, no standard tapes). Moore has some advanced ideas about the online use of a computer in a university and it will be fun to watch his progress on a machine which is about as far from the site of its construction as it is possible to get . . some 12,500 miles. Moore is credited by one observer—a man who lost the order—as having done the most rigorous selection job of any university man in Australia. Cliff Bellamy, at Monash University, a strikingly handsome new school outside Melbourne, also has interesting plans for his CDC 3200. The network concept of CSIRO is worth commenting upon, as is the work of the Bureau of Census & Statistics, but both are covered in detail in other articles in this issue.

Whether or not the Australian computer scene ever becomes large by U.S. or even European standards, the people there are avid students of the American Way. They admire Americans—much more than they do the British—and companies contemplating EDP regularly send study teams to the U.S. Said one man I met, "We're ready to learn. We want to do for Asia what you have done for us."

conflicting desires

Such desires may conflict with those of Japan, which has its own ideas about becoming a computer power.

Editor Forest (l.), John Bennett, Silliac in background.

Furthermore, Japan has the manpower and the technology to translate its desires into reality.

Japan is perhaps the complete antithesis of Australia in certain important respects (it is interesting to note that Australia, because of its agricultural exports, maintains a favorable trade balance with Japan). Japan is highly populated and exteremely well industrialized. The country's ability to throw large numbers of people into the development of an industry when it decides that such an effort will pay off—take the optics and steel industries, for instance—indicate that Japan can certainly significantly expand its own computer industry. After Japan itself, market targets include communist China and Southeast Asia. It wouldn't be surprising if the Japanese also had an eye cocked toward South America.

As of this writing, there are six major manufacturers. But nearly all of the key people I talked to mentioned three as the magic number which are likely to survive with the blessing of the Ministry of Trade. It may be relevant that three manufacturers—Fujitsu, Oki, and Nippon Electric—cooperated to produce the large-scale FONTAC, developed with the encouragement of the Japanese Electronic Industries Development Association.

But the FONTAC effort is in some quarters described as poorly coordinated, and besides, the impression I got is that Japan does not believe that large computers are its meat.

Most observers feel that Japan will concentrate on smaller machines, but continue to import those above the upper end of medium-scale systems. The reasons: smaller technical and capital requirements, larger demands in Japan . . . and the rather pertinent fact that the Ministry of Trade discourages the importation of small machines.

It's difficult during a 10-day stay in a country to accurately assess much of anything, let alone the market for large-scale machines, but one distributor of American gear feels it can sell maybe three giant systems. Nevertheless, about the only official government hardware research organization—the Electro-Technology Laboratories, roughly the equivalent of America's National Bureau of Standards—concentrates exclusively on big, big systems.

The ETL offers some insight into the differences between the status of the computer industries of the two countries. Housed in a dismal concrete structure, ETL's primitive quarters would make the typical U.S. Ph.D. shudder. There are about 30 people specializing in computer research, and my understanding, through an interpreter, was that one of them has a Ph.D. Salaries are poor even by Japanese standards. The pay for top-level government research workers is about $500 a month, plus bonuses which average perhaps 10%. Private industry pays on an average of 50% higher. Still, ETL has served as the focal point for much important research in magnetic cores and drums, tunnel diode and thin film memories . . . and has built six computers which have served as the starting point of the commercial machines now available in Japan. The latest machine, the ETL Mark VI, features a wire memory with a .250 usec access. It was designed by a team of five, assembled by 15, and ETL personnel told me it's about as fast as STRETCH, although the peripherals are "not so good."

The private computer manufacturers emphasize research quite heavily. One company I visited said that 10% of its computer sales are plowed back into research. That such research does not seem to strongly emphasize peripherals is perhaps indicated by the fact that one distributor recently sold a Japanese manufacturer 84 American mag tape transports for use with its computers.

Some government research is funneled through the Japanese Electronic Industry Development Association, which represents 86 manufacturers, and maintains groups which either conduct or coordinate (the combined English-Japanese abilities of my source and I did not permit me to make this clear) research on such topics as software and information retrieval, as well as more basic hardware activities.

Some interesting and important research is going on at the Labs of the KDD, the Japanese overseas radio and cable system. About 40 people do research there, about 10 of them Ph.D.'s. Since 10 are involved in computer research, it is safe to assume that 2.5 of these are Ph.D.'s. Much of the work in the past has involved the parametron, and the lab has its own home-made parametron KR-1 (used for satellite orbit calculations, voice simulation and pattern recognition work), which is being supplanted this spring by a solid-state 8K KR-2, which will be used for overseas message switching. Another hot project is the wire memory, which a KDD official said would be about ⅓ the expense of magnetic core memories, and is as fast as thin film. A 200-word prototype has been completed, and work is now underway on a 4K version. The process, which involves the weaving of permalloy-coated copper wire, has been licensed to General Precision (Librascope) in this country.

Perhaps the key problem at the present is the ability of Japan to translate its research activities into efficient mass production. At one plant I saw a man measuring off and cutting by hand wire for back panel connections—a process which is highly automated at U.S. production facilities. Another U.S. observer watched in astonishment as one worker hand-dipped circuit boards being soldered. In the two plants I visited, it seemed to me that two or three people were often performing work which would be performed by one or less (you know what I mean) person in the U.S. I wondered if this were not a deliberate attempt to develop new talent.

As far as I could tell, there was little or no work in integrated circuits going on in Japan, and I gathered that the country is trying to decide whether or not to set up licensing agreements with American firms to permit such work to progress.

sandals and cleanliness

From what I saw of Japanese computer installations, there is not much to set them off as special or different from their U.S. counterparts, save the row of sandal/slippers neatly arranged outside many of them. Rather than indicating any undue reverence, these sandals are, I was told, a precaution against the introduction of dust and dirt into the computer room.

Most of the installation managers and edp department heads I talked to seem to have come into the profession through some non-computer door. This is partly due to the fact that job-hopping is almost entirely unknown in Japan: edp managers are moved in from some other slot in the company, not raided from another company. The same restrictions apply to programmers, who are generally hired out of college (or, in some cases, high school), where they may have had an introductory brush with data processing.

Many of the larger companies recruit at the colleges rather intensively; candidates may be brought in for a summer of training and orientation, and the best offered jobs after their graduation.

Programmers in general are not considered a special breed requiring special treatment or high pay. They often make not more than their counterparts in other departments, or than they made before they became programmers. At the most, they may make 10% more than an equivalent clerical position, and this is sometimes more the result of longevity than of status. One man noted impassively that it was hard to fire people. There seems to be less strict a division between analysis and coding than in the States.

I was told that there were perhaps 10 lady programmers in Japan. One Japanese distributor of American computers has three female technical sales aids out of a staff of 60. One reason stated for this was that the ladies work for three to four years, then get married, although I suspect that other, deeper forces are also at work. Lady keypunch operators are, of course, much in evidence, and I was told that they average 10-12,000 strokes an hour. In light of this fact, plus the alleged average of American keypunchers of 6000 strokes an hour, and the recent news that some American firms are sending cards to England to be punched, makes it appear that the same sort of work might well be directed toward the East.

There seemed to be no overwhelming programmer shortage although this may be partially explained by the fact that computers are not yet fully established in Japan. With sensible caution, the Japanese tend to acquire machines only after they have seen them working: the first B 5000 (in the form of a B 5500) arrived in Japan almost four full years after its announcement. Most of the commercial edp machines I saw had been installed in '62 and '63; many of them were card systems only this year scheduled to be upgraded to tapes. Discs are just beginning to make their appearance, which might cause some jealous sighs from American users.

At the Weather Bureau, I saw a 704 which has been around since 1959. Although it uses 727 tape units, the system includes no plotter: the charts are hand-drawn. My host there told me they would get a newer machine when the money is available, and such a change can be justified.

associations

One measure of how deeply imbedded computers are (or are not) in Japan is the size of the Japanese branch of the DPMA: 120 members. The only official chapter is in Tokyo. The organization shares an executive director with NOMA, puts out a thin monthly, and sponsors an annual exhibit. JUSE (Union of Japanese Scientists and Engineers) is larger and more active. Regular conferences on computing (and other) matters is held, and attended by bright, senior people from the sponsor companies (several hundred). The organization has a full-time staff and permanent quarters housing classrooms and a small-scale computer supported by six companies, and offers, for money, courses in such topics as programming, ALGOL, and Operations Research. Publications include two quality control magazines, one in operations research, and an English-language report of the JUSE statistical research group.

It just wouldn't be right to close without some comment on some technical matters outside the computer realm in Japan. The taxis, for instance, have pneumatically controlled doors which the driver can open or close just as you reach for them. The desire to do so is strong in Tokyo cabs, noted for their randomly reckless behavior. Natives speak with some pride of the kamikaze taxi drivers. The Japanese food is good, if you can get your host to lead you to it. I had three Japanese meals in 10 days, and I finally told one host that when he came to the States I was going to take him to a Japanese restaurant. The three meals do not count one steak dinner of Kobe beef, which is raised on beer and hand massaged. Don't laugh. It's superb. So is the scenery and the hospitality, and I recommend that you go there immediately.

You may want to go by way of Australia, which has the coloring of southern California, and architecture which mixes the worst of American and England, some of the finest beer and wine in the world, so-so-food, and wondrous sights (kangaroos leaping straight-up, effortlessly over a fence at sunset, emu racing through a paddock) and sounds (the insane cackle of the kookaburra). But watch out for magpies. They're big, and, at certain times of the year, vicious. Maybe they just don't like computer people, or Americans, although neither is true of the human Australians, who are especially friendly and kind.

THE 1130 FROM IBM

low prices, slow peripherals

IBM's answer to all those enterprising companies with fast $30K machines is the 1130, a desk-mounted binary computer with a memory cycle time of 3.6 usec. It performs 120,000 additions per second. Memory sizes are 4K and 8K (16-bit) words of core, supplementable with 512K words on a disc cartridge that merely slips into a slot.

Designed for hands-on operation by engineers, scientists, and those of similar ilk, the 1130 has a mathematical and statistical program package of some 25 programs, more than 50 application programs for such industries as petroleum, publishing, and civil engineering. There's a FORTRAN compiler, and the machine is upward compatible with the 360.

Peripherals include plotters with 200 and 300 points per second speeds and surface widths of 11 and 29½ inches; 80-lpm printer with a character set of 48; 14.8-cps paper tape punch and reader; and card read/punch units with speeds of 300/60 cpm and 400/120 cpm.

A 4K system with paper tape reader and punch rents for $695 per month, sells for $32,280. Add the disc file facility and rental goes up to $895, price to $41,280. Deliveries are scheduled to begin in the fourth quarter of '65.

How do you decide who gets priority on your computer?

RESEARCH | ENGINEERING | PRODUCTION | MARKETING | ACCOUNTING

new 6000 SERIES Systems

Available NOW! Shown here is a CONTROL DATA 6600 recently installed in California.
You, too, can get your 6000 Series System underway without delay.

THE SERIES 200 FROM HONEYWELL

Applications from the much-maligned payroll to an entire management information system, whatever that might encompass, are being discussed at Honeywell EDP in connection with its new Series 200, five computers in the small- to medium-scale range. "I want Honeywell to get a solid hold with the 200's in management information systems. Then we'll diversify to the scientific area," says J. Chuan Chu, vice president for Planning and Engineering.

The H-120 comes below the highly successful H-200 (more than 200 already installed, since its introduction in December '63). A 2K H-120 central processor rents for $860 a month, and sells for $38,700. The numbers then progress past the 200 to the 1200, 2200, and 4200. (The 3200, already pre-empted, shows how fast the industry is running out of numbers). An H-4200 mainframe with a half-million characters of memory rents for $26,500 a month, sells for $1,192,500. That's the range of CPU prices.

Opening some doors, we find that the top-o'-the-line 4200 has monolithic integrated circuits throughout. The extent of IC usage in the remainder of the series has not yet been determined. Cycle speeds of the main memories range from three usec (H-120) to 188 nanoseconds per character (H-4200). Respective access times are 1.5 usec per character to 375 nsec to pull down four characters—something like 94 nsec per character.

Behind the design of the upward-compatible line have been three goals: applications orientation of hardware and software, something to take advantage of the lucrative replacement market (estimated by Chu as comprising a $3-4 billion investment by users), and a favorable cost/performance ratio.

Applications orientation. More than 35 applications software packages for 12 major industries currently are available for the line, a library that continues to grow. Other answers to user needs are said to be operating systems to handle complex processing tasks, communications capabilities and increased simultaneity, and 45 peripherals that add voice-feedback, document scanning, and display capabilities.

Replacement market. The big word is still "Liberator," a one-time software conversion package for current users of the IBM 1440/01/01-G/60/10 and 7010. On the West Coast, more than 50% of last year's shipments were for this replacement market, according to the company. Liberator consists of Easytran, which accepts source programs written in SPS or Autocoder and provides a statement-by-statement translation, and Bridge, which converts 1400-series programs at the machine language level.

Cost justification. The phrases here are: "Buy only what you need" (modular hardware) and "Pay as you go and not before" (referring to the expandability of the systems). The H-120, for example, is said to be the lowest-cost mag tape system available (typical rental is cited as $2,610/month with a three-deck drive, card reader/punch, and printer). But this can be upgraded with communications and mass storage devices. Other optional features for the CPU are floating point arithmetic, financial editing, the ability to handle advanced software, eight-level code handling, and simultaneous or non-simultaneous I/O adapter. Software packages, too, are said to be based on the building-block principle, making them applicable to companies of varying sizes and with different operating procedures. An example is GRUB (Grocery Update and Billing), a five-piece package which handles on an individual basis the complete ordering and inventory control activity for grocery stores and chains.

Compilers to go with the series include COBOL, FORTRAN IV, and an internal FORTRAN translator. The FORTRAN reportedly will even run on a 16K H-120. And the COBOL, requiring 16K and four tapes, "will be cheaper" than the 800's COBOL (see June '64 DATAMATION, p. 48 for a comparison of compilation costs). How about NPL? Only if it becomes a standard, the firm says.

Peripherals for the series total 45. They include 13 mag tape units (¾- and ½-inch) with transfer rates from 7.2-88.8KC, packing densities from 200-800 bpi. Five line printers run from 450-1,260 lpm and have 96-132 print positions per line. Drum storage units have an average access time of 27.5 msec, hold 2.6 million characters, and have a 102KC transfer rate. There are also paper tape and card devices, and numerous communications terminals. Reportedly coming up: a random access storage unit using magnetic cards.

Deliveries of the H-200 began in July '64; the H-2200 will begin moving out in December. The remainder of the line has a one-year delivery schedule. A summary of system specs follows:

Model 120
Automatic I/O and communications interrupt; card reader, punch, and printer controls integrated into CPU; six index registers, decimal and binary arithmetic (five-digit add time: 105 usec; 12-bit add time: 75 usec); 2-32K characters; 1.5 usec access time. CPU lease prices: $860-2,535; purchase prices: $38.7K-114K.

Model 1200
Automatic interrupt, financial editing; advanced programing; eight-level code handling; optional floating point; 30 index registers and 16-register control memory with 250-nsec access time; decimal and binary arithmetic (five-digit add time: 33 usec; 12-bit add: 18 usec); 8-128K characters with 750-nsec accesss time; 16 I/O turnks, four read/write channels. CPU lease prices: $99K-283,500.

Model 4200
Automatic interrupt; financial editing; advanced programing; eight-level code handling; floating point is standard; decimal and binary arithmetic (five-digit add time: 7.5 usec; 121-bit add: 3.8 usec); 32-512K characters with 375-nsec access time per four characters; 30 index registers; 32 or 64 I/O trunks, eight or 16 read/write channels. CPU lease prices: $9,500-26,500; purchase prices: $427,-500-1,192,500. ■

THE MCP-1000

There's a new-look information processing system out of Itek which combines a laser, a photoscopic disc and some other less newfangled ideas to make a system of more than usual interest.

Called the MCP-1000 series (MCP stands for Memory-Centered Processor), the new system looks especially adaptable to non-numerical processing, such as translation and typesetting, as well as file conversion.

Key to the system is bulk memory, made up of 10-inch discs made of clear carbonite, a relatively new plastic. The discs are .030-inch thick, can hold 200-million bits on 3100 tracks. The storage module has four trays, each of which contains 650 discs stored upright, offering a total capacity of 5 x 10^{11} bits. Addition of two more 2.5 x 10^{11} bits-capacity modules means a total capacity of 10^{12} bits. On-line capacity with one disc reader module is 75 million characters.

The appropriate disc is selected (by something Itek calls a sickle-shaped picker) from a row and fed into the read station, a sort of lazy suzan which contains three turntables, stationed on rotating arms which place a disc under the read head. A disc can be selected while another disc is being read. (Discs are searched by address; information on the disc is selected by content). The average time required to find a disc and get it into the read station is 1.68 seconds, and maximum time is 2.58 seconds.

The discs are said to have 100 times the density of mag tape; one disc will hold the contents of two reels, so Itek is hoping that many people will want to use the new memory to store semi-permanent records which do not require frequent processing or updating. Currently, the error rate for the discs is one in 10^9, but Itek is working to bring this down. Disc cost-per-bit is claimed to be .00005¢, about 1/100 of other bulk random access devices in the same capacity range.

The system will be available in two forms: a standalone configuration, and one including a photostore control unit, which translates data into mag tape format, or formats mag tape information for delivery to the MCP.

Other units available, besides the disc reader/storage module and the mag tape interface, include a 156-billion-character mass memory, a processor, disc writer/developer, 10-channel I/0 control, and a 15-million-character drum. Systems will be in the $400-500K range, with quoted deliveries of one year.

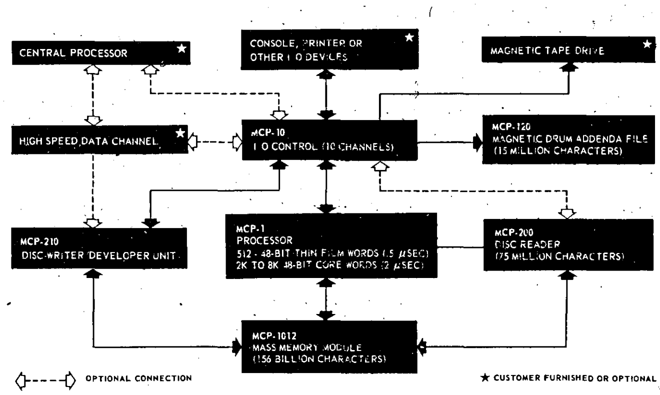
The processor, the MCP-1, is a character-organized machine with a 4096-character, thin-film, 300-nanosecond memory. The thin-film memory can be augmented on a continuously addressable basis with up to 250,000 characters of high speed magnetic core memory. For I/O operations, and where possible internally, the processor takes advantage of the word organization of the memories to achieve parallel data transfer. Residing in the thin-film memory, or built with transistors if ultra high speed is desired, are 64 general registers, any one of which can be used as a data register, accumulator, index register or modular register. This arrangement makes possible multi-level indirect addressing and indexing. There are 49 basic commands, but by taking advantage of various conditions within the machine, this can be multiplied by 64. The elemental delay time of the machine is five nanoseconds, and the shortest possible operation requires between two and three microseconds, although this can be speeded up by substituting transistor for memory registers.

Information will be recorded on the discs by a laser, capable of writing in excess of 500,000 bits per second, a speed which Itek says can be improved upon with the use of new lasers now available. A read-while-write check is made on all information being recorded.

Itek is enthusiastic about the potential of the system for high-speed sorting, and will offer a sort generator which, in the cases of digital files, will use the discs for sorting. Planned are 100- or 200-way merges which will use tracks on the discs as if they were short strips of mag tape. There will also be I/0 packages to drive standard gear, and an assembler which will use an assembler generator moving from a modified version of the current source language for a particular installation. Software is being developed by Celestron Associates, Valhalla, N.Y.

Itek was formed in 1957 with the acquisition of the Boston University Research Laboratories, and brought in ex-Mc Kinsey & Co. man, Franklin Lindsay as president

MCP-1000 INFORMATION FLOW DIAGRAM



in 1961. But the key man behind the MCP system is Gilbert A. King, formerly with IBM and International Telemeter, where early photoscopic disc work was done. The disc patents are held by Ampex, and leased to Itek.

Itek plans to open up an MCP bureau in NYC in late spring. In the works are devices which will enhance the center's chances of doing file conversion work: a scanner which will read stenotype tapes, and a stenotype machine to produce MCP format paper tape. The obvious advantage of the stenowriter is its ability to produce several characters with one keystroke.

The MCP stems for USAF-sponsored work . . . in particular from the AN/GSQ-16 Language Translator, built in 1958; its successor, the Mark II; and the AN/GYA computer program library file. ■

COMPUTER SCIENCE AT WEST POINT

part 2 : implementation

by MAJOR WILLIAM F. LEUBBERT

In the first of this two-part article, the author discussed the philosophy behind both the university and military education in the computer sciences. Actual implementation, including the curriculum, hardware, and an input technique for handling large numbers of problem decks, is discussed in this concluding portion.

As initially constituted in 1960, the Academic Computer Committee, more frequently known as the Schilling Committee (after its chairman, who is head of the civil engineering department) had membership from the Departments of Electricity, Mathematics, MA&E (Civil Engineering), Ordnance, Physics and Chemistry, and Social Sciences. Today all math-science-engineering departments are represented. The committee meets about once a month to act as a forum for development and exchange of ideas and information about computer-related instruction and to provide guidance on the development of academic software, instructional materials and training aids.

During the summer of 1961, the Dept. of Electricity obtained from the U.S. Army Signal Corps a small general purpose digital computer. This machine had been used—and abused—in field tests at the Army Electronic Proving Ground, but had been reconditioned to make it suitable for classroom use. This machine was used to teach our first full-semester elective course in digital computers. (Approximately 40% of the Second Class have for some years been receiving five hours of computer instruction as part of the basic electricity course). Even more significantly from a long-term viewpoint the RECOMP was used to teach instructors from a variety of academic departments the capabilities and limitations of computers. It was also used to conduct experimental teaching of Fourth Classmen as part of the advanced programs in both engineering fundamentals (Dept. of ES&GS) and mathematics, to run demonstrations of linear programming solutions for mathematics courses, to prepare solutions for civil engineering problems (Dept. of MA&E), for cadet research monographs (Dept. of Ordnance), and a variety of other uses. Thus, the faculty of many departments became increasingly aware of what computers could and could not do.

While all this was going on—actually ahead of it, in most cases—the comptroller of the Military Academy was planning for the utilization of a computer to solve data processing problems of the post. These include those aspects of academic recordkeeping and administration already being performed by the post machine records facility (punched card data processing). This plan wisely envisioned the academic instruction possibilities of such a system and did much both to spur the academic departments to action and to clear the way financially and administratively for the system now envisioned.

By the spring of 1962 the potentialities of the computer as an academic tool in a number of academic areas had been demonstrated. The Academic Board, sparked by General Bessell and Colonels Nicholas, Cutler, and Broshous, was ready to take action. An integrated program of instruction was planned, starting with an introduction to computers and how to use them, to be given to *all* freshmen.

Supervision and coordination of the academic computer program was made the responsibility of the Dean of the Academic Board, General Bessell (his duties are roughly equivalent to those of the Provost in many civilian universities). Day-to-day implementation of this responsibility was delegated to be performed by an Associate Professor who is his assistant for the computer science program. This Associate Professor is also Director of the Academic Computer Center.

The Academic Computer Center was activated in December 1962, charged with the mission of supporting all academic departments. Its operation was conceived as generally analogous to the library, but with obviously greater emphasis upon instruction of cadets and academic department faculty members. The Computer Center is conceived as not merely a physical location for computing machines, but rather as a common meeting ground for faculty and students of all disciplines in which computers play a major role. The computer would thus act as a nucleus or catalyst for many intellectual activities of the University.

Necessary as the equipment is, it is becoming increasingly evident that the mechanics of learning to program a computer are only a small portion of what is necessary to make effective use of them. A profound understanding of the analytic, statistical, algebraic, and logical problems inherent in the satisfactory application of this new tool to various disciplines is essential.

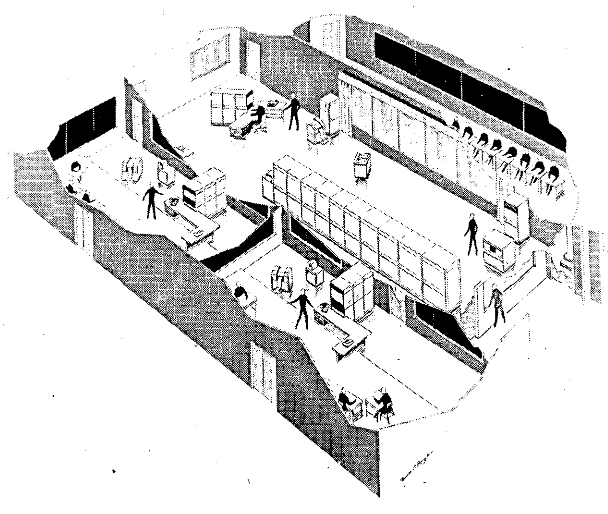
the curriculum

Based upon the concepts which the Academic Computer Committee developed it obtained academic board approval for an integrated interdepartmental effort in the computer field. At the heart of this effort is the requirement that every plebe (700-900 per year) be required to learn how to analyze and program problems for computer solution and to run them (or have them run) on the facilities of the Academy's Academic Computer Center (Fig. 1). He is also required to use the computer to solve problems in each of his major math-science-engineering courses during each of his four academic years. It is significant to note that all math-science-engineering (MSE) departments actively participate in this program. Other departments participate to a lesser extent; e.g., the Dept. of Social Sciences recently used the computer for administration of the National Intercollegiate Debate Tournament and a number of non-MSE departments and research groups are using the computer facilities to conduct statistical and correlation studies ranging from the evaluation of testing procedures through basic research on the prediction of leadership potential.

In spite of—or possibly because of—this program which integrates computer use into so many basic courses the number of specialized computer-science courses is small, consisting of only the following:

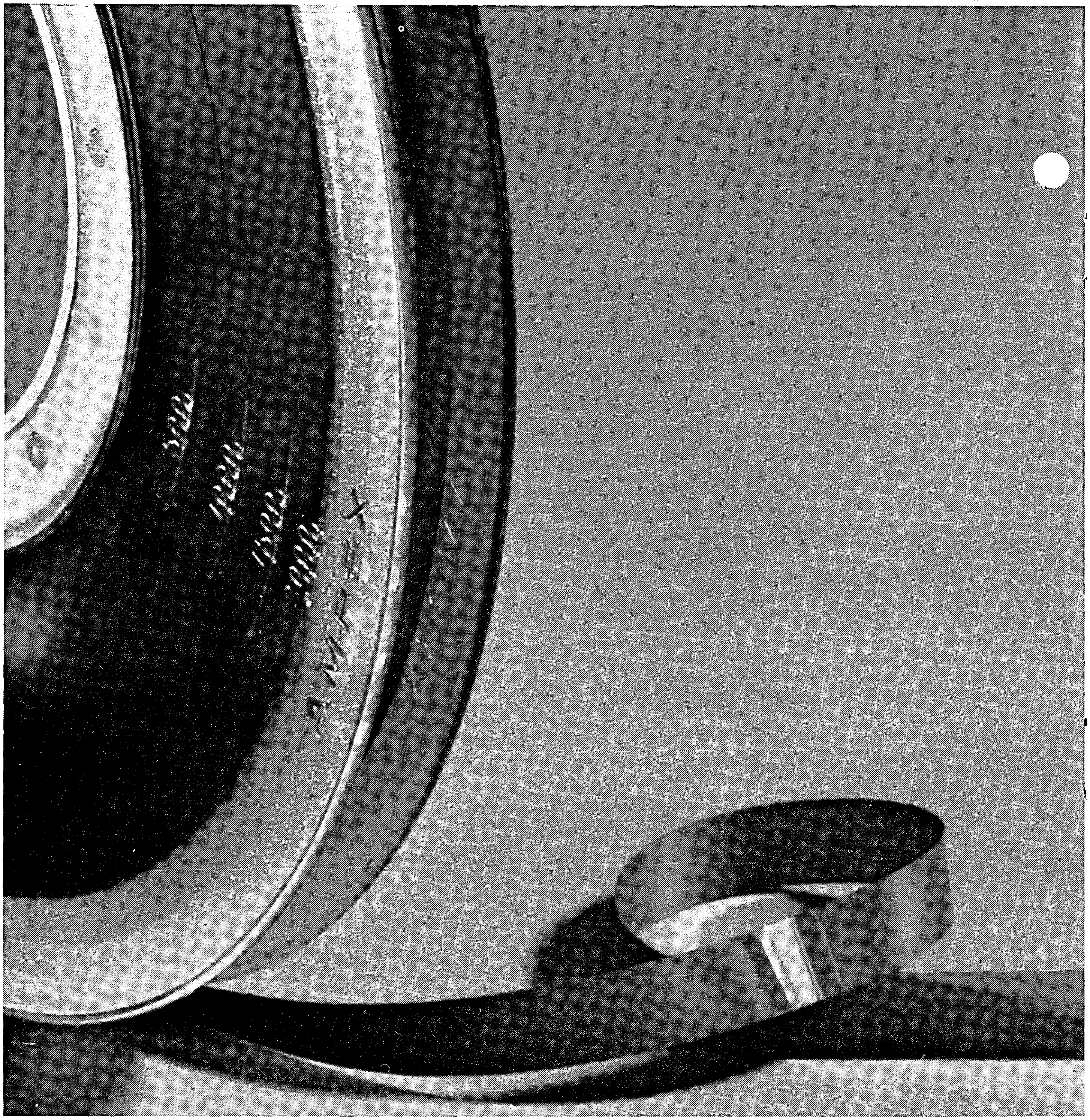
- EL-483 *Digital Computers*—An elective course presented by the Department of Electricity which emphasizes the electrical and systems aspects of digital computers.
- MA-484 *Numerical Methods with Digital Computer Applications*—An elective course presented by the Department of Mathematics which emphasizes the solution of computational problems using procedures expressed in an algebraic problem-solving language.
- OE-484 *Ordnance Special Digital Computer Project*
- EL-481c *Electricity Special Digital Computer Elective*—An elective course presented by Computer Center instructors in the form of a cadet research project conducted for the Dept. of Ordnance or Dept. of Electricity. Among projects already conducted are writing an assembler, modification of a compiler, development of statistical programs, preparation of a curve plotting routine, etc. (Only the Ordnance version was active in academic year 1963-64; only the Electricity in academic year 1962-63).

Fig. 1

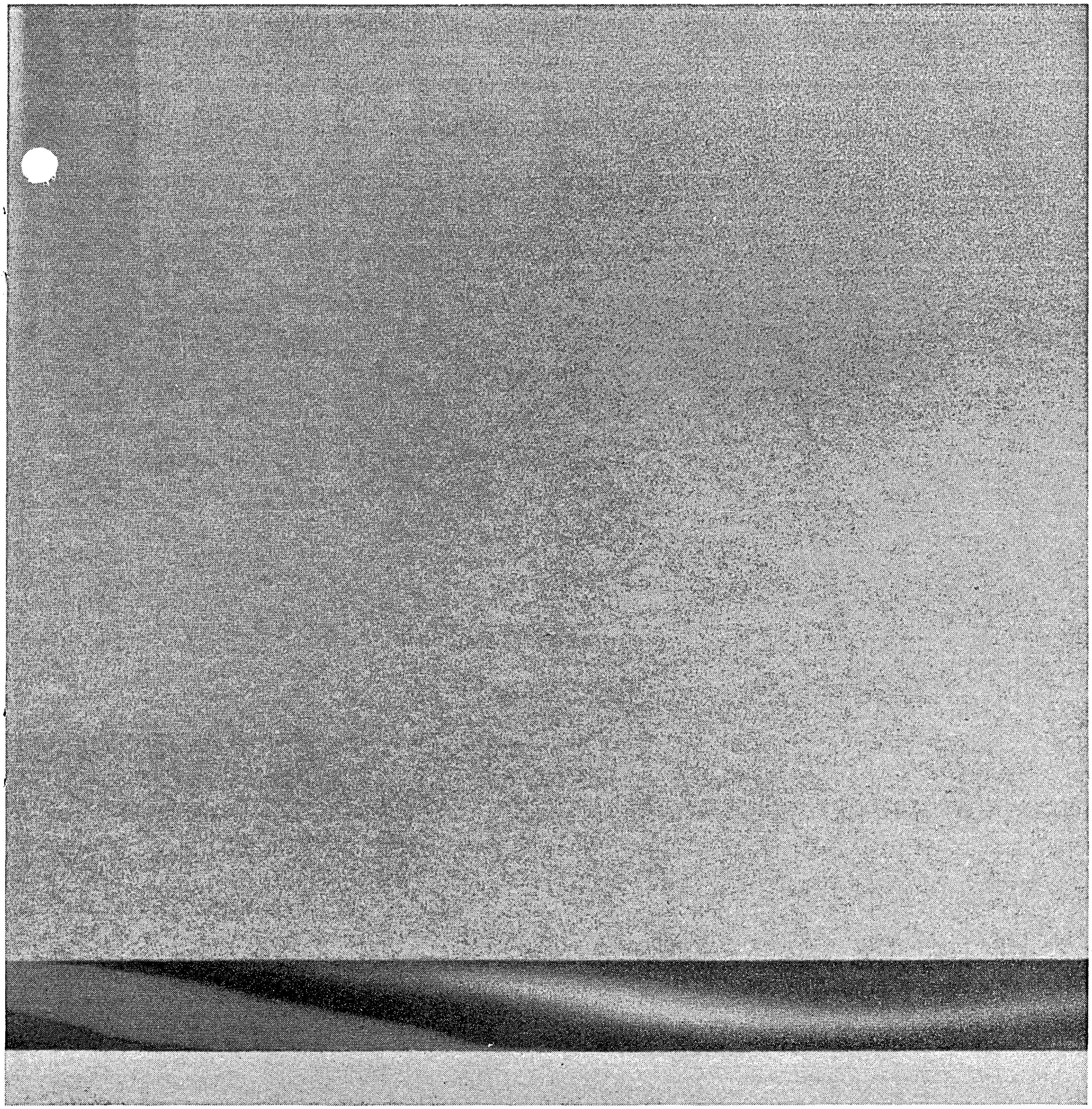


It should be noted, however, that only about 5% of the USMA curriculum is at present in the form of elective courses, the remaining 95% being core curriculum standard advanced or honors courses. The elective courses which are not specifically computer courses are, however, in many cases heavy computer users. This is particularly true of courses such as management engineering, physical chemistry, space mechanics, etc.

It is also interesting to note that the academic computer facilities are being used to an increasing extent to support the secondary mission of academic administration, both within individual academic departments and on an academy-wide basis. A major systems analysis has recently been completed by an academic management task force in order to develop a comprehensive and carefully planned system which will pick a man up when he first becomes a



Two entirely new, long-wear, heavy-duty Ampex computer tapes are now available. The two (Ampex 838 for 800 bpi applications and 832 for 556 bpi applications) are the result of an intensive 2 year development program. Using an advanced oxide formulation, these new tapes feature a mirror-smooth surface that consistently gives the cleanest, most reliable performance ever possible. The proof of the new formulation is in the using: no other tape on the market does as much to reduce 'temporary errors' and static build-up. Even the reel is new: IBM compatible configurations are available on solid



candidate for admission and maintain his records and transcript even after graduation. This system plan is a fascinating topic in itself, but is not appropriate for detailed discussion here.

The initial computer-science subcourse given to all freshmen consists of 11 hours given by the Engineering Fundamentals group, Dept. of ES&GS. This course emphasizes the basic functional organization of computers, analyzing problems for computer solution and programming and running a considerable number of problems. Last year 14, and this year 17, instructors will be teaching these topics *concurrently*.

The freshmen receive their programming introduction at the level of machine-language coding, and their first problems are programmed in machine-language absolute form. This, in itself, is sufficient basis for many people to believe that we must belong to the dinosaur fringe of computer users. However, it does not mean that we place little emphasis upon procedure-oriented compiler languages. Thanks to specially developed programming, debugging and instructional aids we are able to bring our students along so that after this short introduction they are able to solve non-trivial computer problems (for a different academic department) in our machine-oriented language, giving a man a basic grounding in the use (and thereby the limitations of) machine language coding before moving him on to compiler use. Last year about 250 sophomores made the transition to compiler use and a high percentage of all problems done by juniors and seniors were done in compiler rather than machine-oriented languages.

The advantage of this course of action, which we fully realize differs from that of most of the leading universities in the computer science field, is that it gives the student an object lesson in how exact and fine-grained instructions must be to be implemented by hardware and to develop in him an appreciation of the benefits which software such as a compiler is able to provide. During this initial phase of computer instruction and use the student is encouraged toward personal contact and rapport with the computer so that it loses its mystery and awesomeness. Later, unless he becomes a computer bug, he will depend more upon "production runs" of his problem solutions by the computer center staff. Every cadet, as part of the initial computer course is required to go through a "hands on" orientation during which he follows a problem which he has programmed through the entire processing procedure, step-by-step, even to the extent of pushing the buttons on the computer himself. This basic orientation is conducted approximately 200 times to groups of approximately five men in the shortest possible time. To accomplish this, three groups are scheduled hourly until 10 p.m., and the other work of the computer center other than that which is absolutely essential gets deferred or grinds to a screeching halt.

Then *every* cadet is given the opportunity to secure a "gray qualification card"—a sort of beginner's driving license for the computer which entitles him to sign up for individual computer use and to operate the computer during certain time blocks. During these periods a member of the computer center staff will be available to help him or to bail him out of whatever trouble he works himself into. In general gray card qualification requires basic knowledge of one programming language plus an hour or so of individual or small group tutoring in the mechanics of machine operation.

Cadets who become particularly interested in computers or who are taking elective or special project work which requires frequent access to a computer may qualify for "black" or "gold" cards. The gold card is particularly prized, for its allows the cadet to obtain the key to the computer center, open it up, and use its full facilities at times when it would not otherwise be open. Gold card qualification requires knowledge of both a machine-oriented and a procedure-oriented computer language and significant skill in the operation of the computer to include clearing of various types of card jams, tape malfunctions, etc.

Depending upon his standing in mathematics each freshman will receive his initial assignment to program a problem for the Dept. of Mathematics a few days to a month or so after he completes the basic instruction in computers in Engineering Fundamentals. The first problem is normally one of preparing part of a mathematical table using an algorithm the computational and error characteristics of which are thoroughly analyzed in class. Such problem assignments continue throughout their two years of mathematics and include such things as solving an equation, performing series expansion calculations, doing an integration and solving a differential equation. Cadets with higher standings in mathematics frequently are released from examinations to take special computer subcourses to teach them compiler use, application of computers to statistics, etc.

In Physics the computer is used primarily as a laboratory data reduction and computational tool. One of the more notable uses is in an experiment which I remember doing as a cadet myself. This is an experiment in which one measures the acceleration due to gravity by allowing a weight to fall freely in a narrow channel at one side of which there is a strip of sensitized paper. Every 1/60th or 1/120th of a second a spark jumps from the weight to a metal strip on the other side of the sensitized paper leaving a small black mark on the paper. By measuring the distances between these marks as a function of time one can readily calculate the acceleration of the weight.

When I did the experiment as a cadet I can remember spending a great deal of time setting up and adjusting the equipment, performing the experiment to get one strip with data on it in a matter of seconds, and spending the rest of the period going through laborious repetitive calculations to get the result. As I remember the result was reasonable, but not extremely accurate.

When cadets do this experiment today they make essentially the same set-up to the same equipment. However, they run the experiment five times to get five strips of data. They perform a few calculations by hand but mark-sense most of the observed results onto computer data cards and run these cards through the computer which does the laborious calculations. From this they get the results of five repetitions of the experiment and hence more accurate and meaningful results. They also get statistical information on the variability between experiments and hence a better appreciation of and basis for evaluating their experimental procedures and techniques.

A similar concept is frequently used in the physical chemistry elective course. Various experiments such as iteration experiments required relatively simple but highly repetitive calculations which required a considerable amount of desk calculator time. Today one or two calculations are done by hand or with a desk calculator and the remaining data mark-sensed onto computer cards. The computer then does the calculations leaving the student more time and opportunity to concentrate upon interpretation of results.

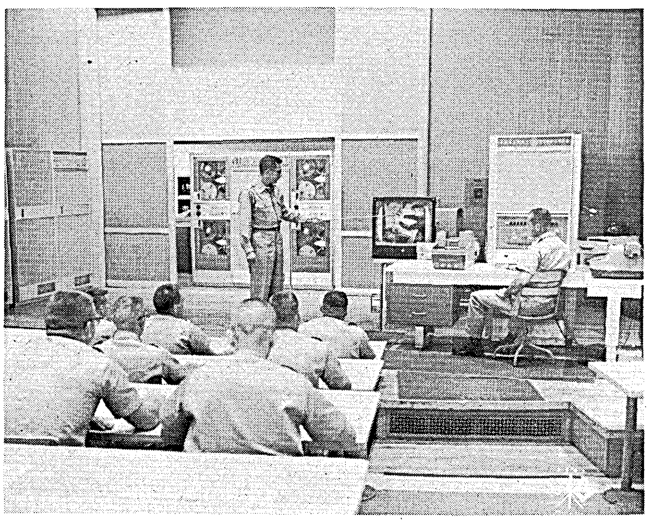
Without going through a detailed course-by-course description of how the computer is used to solve non-linear circuit problems in electricity, fluid flow problems in mechanics, rocket combustion product calculations in ordnance, steel truss or concrete design problems in civil engineering, and so on, I believe you can see how our educational plan aims at giving each cadet a well-rounded background in computers—even if he never takes even one of the courses which we have identified as specifically computer science courses.

instructional facility

When one changes emphasis from using a computer merely as a research or homework-problem-solving tool to an integral component of the instructional process in many subjects, one begins to shift his viewpoint from that of the computer center as merely a problem-solving "laundry" to an educational laboratory where the computer is a teaching machine and even an audio-visual instructional aid.

It becomes essential to make the computer center a location convenient not only for efficient running of large numbers of problems, but a convenient location for instruction—and not always computer instruction at that. Our computer center (Fig. 2) is perhaps the only one located in a 200-seat lecture hall. (Each seat has a table and working space, not just a dinky writing arm for taking notes). Although at first glance it might appear that this would be a terrible waste of prime lecture-room space

Fig. 2



it is not, for when the area is not in use for lectures, students find it an ideal working place where they can write programs, take them immediately to the computer, run them, get back diagnostic aids, debug and run again—with all the facilities, reference materials and consultant aid of the computer center readily available to them. Since an academic program may frequently require multiple classes in different subjects to use computer facilities for teaching at the same time, certain basic problems appear. This problem is being attacked from a number of aspects:

(1) *Classrooms in the Computer Center*

Fall '64 computer site construction will provide not only for a classroom overlooking the main computer, but for two additional classrooms each with a smaller "satellite computer." The classroom associated with the main computer will be provided with a multi-media audio-visual teaching system to enhance the effectiveness of instruction in this critical classroom.

(2) *Closed Circuit Television*

In the past year and a half the computer center has experimented with both live and recorded television to supplement and improve the effectiveness of computer instruction. Plans are now underway as part of the new site work to install permanently in the main computer room a remote control camera with a zoom lens and panoramic adaptor. This camera can be used to provide (a) a magnified view on a TV monitor of critical details of an operation or of the answers being printed by the computer for students in the classroom overlooking the main computer; (b) a means of obtaining pictures which can be piped over the proposed Academy-wide TV system, and (c) a means of recording TV instruction which can later be played back to supplement live instruction or as a sort of "training film" for small group tutorial instruction.

(3) *Remote Access to Computer Facilities*

In December of last year a Datanet-30 special purpose communications computer was installed in the computer center to integrate and provide mass memory and common operating system control for the main and two satellite computers. This device will also provide the capability for installing 15 remote teletypewriters in academic department classrooms and laboratories to permit data to be entered and answers returned to these locations in "real-time." Detailed systems design and initial systems programming is already underway to provide a full capability for entering and debugging programs from any or all of these remote locations concurrently. A great deal has been learned about how to do this effectively without tying up a great mass of equipment to perform functions of marginal benefit to the student at the remote station. It is anticipated that a system with the basic capabilities required will be working experimentally this spring and will become student-operational at the start of the autumn semester in 1965.

(4) *Use of Remote Input-Output Devices as Programmed Instruction Teaching Machines*

The use of remote input-output devices as programmed instruction teaching machines is not a completely new concept. The Univ. of Illinois with its "PLATO" system and the System Development Corp. have been active in research work in this field and their work has been well publicized for some time. Other research groups, such as ones in IBM, have been equally active but less publicized. These groups have brought the "state of the art" to where we believe that we will be able to program and implement an effective "teaching machine remote" from our computer center facilities by fall or winter of next year.

Those who are intimately familiar with the programming difficulties of multi-processing probably feel that we are talking through our hats in allowing time schedules like those mentioned for (3) and (4) above slip out in public. Six months ago, I too would have pooh-pooh'ed these dates. However, after having learned a great deal about some of the less obvious capabilities of our specialized communications computer, some of the short cuts and simplifications which investigators in this field have succeeded in finding, and having evaluated the capabilities of our programming staff, I can truthfully state that I believe them to be realistic—certainly not pessimistic, but not overly optimistic either.

computer center equipment

To those intimately familiar with the capabilities and limitations of equipments typically used in computer centers it must also be clear that we must have an unusual complement and organization of equipment for our center. This is true.

We have neither followed the obvious path of concentrating all our resources on the single biggest computer we could obtain, nor squandered our resources on multiple (and possibly incompatible) small machines, each more-or-less chosen for its presumed applicability to the requirements of a given department. Instead we have obtained a moderate capability main computer (a GE-225 with auxiliary floating point arithmetic hardware, 8K words of memory, 900-lpm printer and 1000-cpm card reader), two reduced capability compatible computers (stripped-down GE-225's with 8K words of memory, 300-lpm printer and 400-cpm card reader) and a Datanet-30 communications and systems control computer with 8K words of memory, direct core-to-core interrupt access to each of the three machines, a random-access disc file, six magnetic tapes, and convenient access to multiple external communications devices.

The system (its last elements arrived in December 1964) will be organized so that the systems control and communications processor will perform all system monitor, accounting, remote terminal control, and disc file or tape inquiry functions. Both the main 225 and the two classroom 225 satellites will have access to the disc file and tape mass memory facilities on a time-shared basis. Whenever appropriate (e.g., during large data processing runs on the main computer) the tape transports may be shifted to the main computer.

The fundamental concept of operation of this multi-machine system is quite straightforward. In a large single-computer system a monitor or operating system remains continuously in memory to perform certain basic control and housekeeping functions. In our system these functions, to include control of the system library, are allocated to the Datanet-30.

During remote operation the Datanet-30 will be completely responsible for gathering information from remote sites and assembling it on the disc file. When a complete data file or program is assembled and ready for processing the Datanet will notify a GE-225, load it with the appropriate program or programming system and turn over to it the task of running the problem. When the 225 has sent the appropriate answers to the disc file and has completed running the program it notifies the Datanet which then returns the answers to the appropriate remote device and performs the necessary wrap-up and accounting functions for the problem. This description is a bit oversimplified but basically accurate. It ignores such factors as what happens when a problem takes a "long" time to run on a 225, when it becomes tied up in a tight loop, or when control is lost in the program. However, the solution of the rather subtle problems involved in those cases is beyond the scope of a general presentation such as this.

A significant factor is the fact that the Datanet not only performs communications functions, but permits each of the 225's to act like a larger and more capable computer than it really is. Thus, we believe that we will get the advantages of a multiple-machine decentralized system without paying the terrible cost in reduced capabilities which is normally associated with splitting one's resources among multiple machines. Probably the cost per million instructions performed is larger and our ability to do extremely large problems is less than had we invested all our effort in a single large machine, but the cost per unit of student instruction effectiveness will, we believe, be significantly less.

mass preparation of input

A potentially serious practical problem in the implementation of an academic program such as that which we are pursuing is the fact that it will not be unusual to have 250 students in a class at the same instant of time preparing programs which they should turn in at the end of the period to be returned to them at the start of the next attendance at the same class. Moreover, on a given night of the week perhaps 1,000 students may desire to prepare computer input (programs or data) at the same time.

If students are to prepare this input themselves either at keypunches or at remote teletypewriters the number of such devices required and hence their cost would be astronomic. If professional keypunch operators were hired the peak loads of utilization, cost and possibility of transcription errors by the operators would still create a major problem. Moreover, students might lose some of the feeling of intimacy and rapport with the machine we strive so hard to achieve. For six months last year we served 1,500 student programmers with only two keypunches. Today we have only four—and no professional keypunch operators.

What is and was needed is a very cheap and simple method whereby each student can with little or no equipment prepare cards in his own room or in any classroom. This method should be so simple that it is readily understood and performed initially by freshmen so that they can turn in their first problem for computer solution after only three hours of their initial 11-hour computer course.

The only data collection techniques which seem to meet this requirement are mark-sense and port-a-punch. Mark-sense is cheaper and requires less equipment but has a reputation for erratic reliability. Port-a-punch requires special, expensive pre-scored cards which cannot stand rough handling. Some sort of stylus and card holder are usually used, although when necessary a plain rectangular toothpick can be used to punch cards.

Unfortunately it is not normally convenient to mark-sense or port-a-punch alphabetic information. Making a symbol such as a decimal point normally requires three separate marks. However, as always, necessity was the mother of invention and I was able to devise a combination of a specialized mark-sense card and a computer routine to decode it which together permit convenient mark-sense preparation of either machine-oriented instructions (Fig. 3) or compiler statements (Fig. 4). Fig. 3 shows that the instruction ADD 500 is to be placed in memory location 101. The format in Fig. 3 provides greater flexibility of marking and can be used for referring to symbolic memory locations and addresses. Fig. 4 shows mark-sensing of the CADETRAN/FORTRAN compiler statement, Y=A*X**5+B*X-(D/D)+3.5. Letters are mark-sensed merely by making a mark, the identification of the particular letter on the card. The letter will be one of three colors (blue, green or red) at one of nine positions. A second mark is then made in the loop of the same color at the top of the same column. This position is also marked with A-I, J-R or S-Z. It specifies which third of the alphabet the character is in while the other mark specified which of nine possibilities within that third was the specific letter. 3x9=27, or enough possibilities for the entire alphabet plus one extra symbol (/). Although this sounds complicated to describe it is readily learned by example in a few moments and one can mark cards quite rapidly. Punctuation marks are coded as a single mark which is analyzed and replaced by the equivalent punched card code in the computer program. Frequently used compiler words such as READ, WRITE, DIMENSION and so forth are also coded as single marks. We recommend marking with a special electrographic test scoring pencil, but students soon find that reliable results can be achieved with any reasonably soft pencil and a little care.

The first semester we used these cards (Jan-Jun '63) we were afraid that we would not get satisfactory reliability

Fig. 3—Mark-Sense instruction card marked for loading into memory location 101 and containing the instruction ADD500.

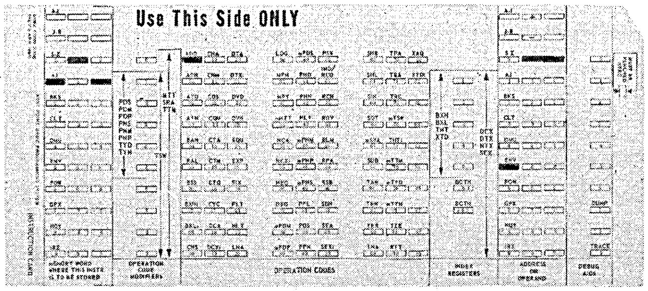
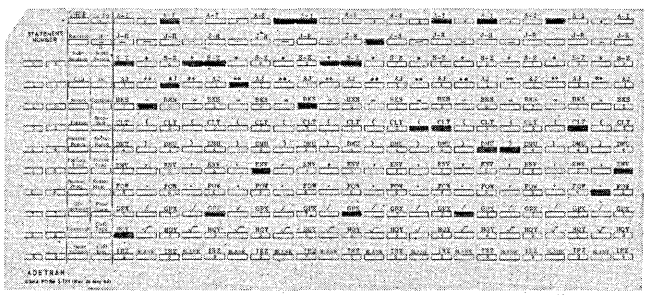


Fig. 4—Mark Sense Statement Card for CADETRAN/FORTRAN compiler marked Y=A*X**5+B*X−(C/D)+3.5.



from mark-sense cards so we also made and used near-identical port-a-punch cards. However, the mark-sense cards were both cheaper and more satisfactory so we have dropped use of the port-a-punch back-up cards. For convenience of those students who do have easy access to a keypunch our programming systems permit conventional keypunched cards prepared by copying directly from coding sheets to be intermixed with these mark-sense cards.

Students may obtain mark-sense cards at the computer center or at academic department offices. Each is issued a number of green cards with his name and student identification prepunched. This is used to print his name automatically at the top of the program listing, answer sheet and/or memory dumps produced by the computer while solving his problem. He places this green card at the top of his deck, a yellow card mark-sensed with the starting instruction of his program (if it is not the first instruction of his deck), his data cards (also mark-sense, if desired) and finally a red card. He can put a rubber band around this deck and turn it in to an academic department or to the computer center. There the deck will be run through an IBM 514 mark-sense reproducing punch to convert the pencil marks to punches, run on the computer and returned to him with computer-annotated listing answer sheet and/or memory dump as appropriate.

This mark-sense technique has been extremely successful over the past two academic years and is recommended to any university which feels the pinch of the "key punch explosion."

The color coding of the control cards (which are not too different in effect from the control cards used in most large monitor systems) has been extremely valuable in minimizing human errors and permitting rapid sight-checking of the completeness and proper assembly of incoming problem decks.

student programming languages

Our decision to introduce beginning students to programming at the machine-language level left us with certain major problems. We were not dealing with just those students who were particularly interested in or adept at math-science-engineering subjects, nor were we dealing with just the top half of the class. We were dealing as well with those who had low aptitude and interest in mathematics and computers (even though they might be excellent students in English or foreign languages).

We did not desire to make writing a straightforward mathematical program in machine language as easy as writing it in a compiler language—but we did want to get students "on the air" as soon as possible with power enough to handle non-trivial problems, and we wanted to be able to isolate their mistakes and aid them in debugging as rapidly as possible. For this reason our attention was drawn to floating-point interpreters and to the concept of simulating a simplified academic design single address computer (SADSAC) on our GE-225. We were willing to use up the entire 8,192-word memory of our 225 to get a 1,000-word memory simulated computer with the most complete, sophisticated and easy to use set of error checks, diagnostics and debugging aids which we could devise.

The card deck which goes into the computer is checked for correct sequence (e.g., green card first, no instructions after yellow card). Each card is checked for both format (e.g., all necessary fields marked, no multiple punches except where appropriate) and syntax (e.g., every SEX instruction must cite an index register, every PDM instruction must have an operation modifier of value 1-5). In those cases where there is a reasonable chance of satisfactory correction of an erroneous instruction not only is an error indicated by a trial, correction is made, e.g., for a PDM (print data multiple) instruction if no operation modifier is given to specify how many locations to print the instruction is set to five, the maxmum permissible number. During loading if the program counter goes beyond the end of memory an error is sensed.

During execution the effective address of each instruction (basic address + index, if any) is checked. The operand in the cited memory location and the operator in the accumulator are checked for a type of information compatible with the particular command being executed. If the operation is arithmetic its value is checked for compatibility with the instruction (e.g., square root must have positive or zero operand) and the values of both operands and the result are checked for legitimate range (not outside the range $\pm 10^{56}$). When an instruction is to be fetched to the instruction register its memory location is checked in advance to make sure that there truly is an instruction there. If a card is read into the computer under program control after problem execution begins it is checked to determine whether it is compatible with the instruction which read it, and an optional check is made against an optional memory location which can be marked on the card and the address field of the instruction which reads it (i.e., the memory location to which it is to go). And so on.

At any time during program execution a dump may be called for either by means of a special "dump" mark on an instruction card at that point or by depressing the "dump" switch on the console. When the dump occurs all instructions come out in instruction format, all data in data format, all alphanumeric headings in alphanumeric format, and all memory locations which contain the original memory clear condition are suppressed.

At any time during program execution any of seven varieties of trace may be called. These traces include not only the standard but lengthy and time consuming trace of every instruction executed, but more compact and practically useful special traces of instructions only the first time they are executed in a program, traces of transfer instructions which cause a change in sequence, traces of specially flagged instructions, and various combinations of these traces.

During loading, a count of loading errors is maintained and during execution a count of execution errors. If the errors exceed a threshold value (normally five) the problem is kicked off the machine with an automatic memory dump. (This automatic abort is subject to override). At the end of the problem an accounting card is punched out, supplying student and problem identification, number of loading errors, number of execution errors and method of problem termination (e.g., programmed halt, manual abort by operator, automatic abort because of excessive errors, etc.).

The system is deliberately designed either for demonstration and teaching applications where one desires to step it through a problem phase by phase or for large-scale, high-volume production where an operator loads the card reader with as many student decks as it will hold and desires them to run through automatically from problem to problem without operator intervention.

These features, the ability to accept either mark-sense or keypunched instruction, data and alphanumeric cards, and many other features such as built-in trigonometric function instructions in the SADSAC simulator make it a convenient teaching system with sufficient power to do a wide range of student problems.

There are in addition a number of optional features to the SADSAC which add to its usefulness. For example, for graphic outputs there are both printer plots (crude but fast) or Calcomp plots (made with a digital incremental plotter with a resolution of 100 points per inch, but much slower). A variety of features such as automatic scaling and labeling of axes are provided as options. In addition 100,000 words of auxiliary memory is provided on tape in 1,000 blocks of 100 words. This extra memory can be well used for storage of additional instructions, large tables, or lengthy alphabetic printouts. Two hundred of the blocks are protected (read-only) storage for storage of library routines, instructor files, etc.

The original version of SADSAC was written in quick-and-dirty fashion in the GECOM compiler language, then hand tailored in assembly language to make it fit in the 8,192 GE-225 words available. After two academic years of experience we decided to clean up its internal organization, improve its internal precision and round-off characteristics, provide a better method of handling alphabetic information such as headings, provide an optional double-precision (14-digit) fixed point arithmetic mode of operation, provide minor language extensions to facilitate the preparation and use of grader routines, and make other minor changes recommended by users as a result of experience. This improved version, known as Common SADSAC is undergoing advanced debugging now, its specific improvements are being taught to instructors, and it will be put into general use at the start of next semester.

For the old version of SADSAC we had two assemblers which permitted transition from absolute coding to symbolic and relative address coding. Unfortunately, these assemblers required different instruction card formats from those used for absolute input to the SADSAC simulator. This plus the fact that extra card-handling was required and the system was not as adaptable to large-scale production runs of problem solutions tended to limit their use.

It is one of our objectives to allow each cadet to progress from machine-absolute to symbolic to compiler programming with a minimum of delay once basic teaching points had been developed. The new version of SADSAC therefore has a symbolic assembly capability (known as SASSY SADSAC) which is built right into one version of the SADSAC simulator. This assembly capability can be used with no change in the input instruction or data cards (except to fill them in with symbolic rather than numeric addresses), no changes in problem deck assembly or processing procedures, and no changes in switch setting, operating procedures, or the ability to handle large volume problem solution production runs.

When desired (e.g., for teaching demonstrations) the binary output of the assembly phase may be punched and used as input to the execute phase of SASSY SADSAC, but normal operation will be assemble-and-go.

Among the niceties provided by SASSY to aid in instruction are:

(1) Complete freedom to mix absolute, relative and symbolic instructions in the same program deck.

(2) Parallel printout of symbolic and absolute forms of the instruction to impress the student with their equivalence and with the fact that pseudo-instructions do not generate true instructions, but merely information used to control the assembler.

(3) A symbol table which provides complete cross referencing to each instruction which utilizes a particular memory location name.

The solution to providing a similar transition to compiler use probably will not be available for general student use until the start of the spring semester. Two complementary tacks are being taken to this:

(1) Extend the SADSAC simulator's capability to include compiler functions, initially by adding an arithmetic statement compilation function to SASSY. This will be followed by completion of a small FORTRAN compiler to generate SADSAC programs which can be run directly by the execute phase of the SASSY SADSAC. This version will be know as CADETRAN SADSAC.

(2) Extend the capabilities of the CADETRAN/FORTRAN compiler (which generates direct GE-225 binary programs) to accept symbolic and absolute SADSAC instructions as well as FORTRAN-type statements. This version will be known as CADETRAN 225.

It is our expectation that a student who uses symbolic SADSAC will be able to learn the basic syntactic rules of FORTRAN arithmetic statements and begin to apply them immediately in the context of familiar SADSAC programming and operating techniques—without any sharp transition from assembler to compiler. As he learns input-output operations, DO loops and so on he will be able to drop machine-oriented instructions and use compiler statements exclusively. During this period the meaning of the compiler statements and any "black magic" implications which they might engender will be effectively counteracted by the fact that each compiler statement will generate familiar SADSAC instructions.

Once the student is using full compiler capabilities he will soon chafe at the memory restrictions of SADSAC and want to expand to problems which involve large tables, matrices, etc. With no changes in programming techniques, but hopefully with an excellent background in how a compiler does its work, the student can then switch to the CADETRAN 225, a general-purpose FORTRAN compiler. ■

WORLD REPORT

SMALL-SCALE HARDWARE INUNDATES EUROPE

Convinced that the small computer market holds the key to success in Europe for the next 12 months, most machine makers are dipping into their design bags for new releases. The object seems to be to provide a mag tape installation for between $150-175K. First on the scene in February was the National-Elliott combo with the 4100, as forecast in last month's Datamation. Almost within hours of its release, Honeywell countered with its 120 processor, cheapest of the new micrologic 200 series. Other systems are expected shortly from Univac and Bull-General Electric. Reports from their respective market strongholds in Germany and France suggest answers to IBM's 360/20 are on the way.

In the race for cheap computing, "big brother" hit the jackpot with its 1130, selling for a basic $36,750. This comes at a time when dp educationalists throughout Europe are struggling to overcome personnel shortages and to get a crash programme of training underway in high schools, technical colleges and universities. As a result, the market potential must be measured in thousands of machines.

For all markets outside North America, IBM is to make the 1130 in Greenock, Scotland, thus honouring a long voiced threat to manufacture in the U.K. Full scale production in this area will also help counter anti-IBM pressure in the politically-sensitive British computer climate. It also helps make Scotland (population, 5.1 million) an important manufacturing centre. Honeywell's computer manufacture for Europe is already concentrated there, and National and Burroughs operate major plants for their electronic machine divisions. To tempt the new technologies into the area the Scottish Council offers attractive development and investment terms, particularly to electronic firms.

$330-MILLION CONTRACT LURES DEFENSE SUPPLIERS

Prospects of $330 million in hardware costs for NATO's immense ground environment and defense system – code name, NADGE – has produced three consortia in hot pursuit for the contract. Stretching from Norway to Turkey, NADGE will form one massive data collection, reduction, computation and display network. Groups fighting for the order are: (1) AEI (U.K.), Elliott Automation, Litton Industries, CSF (France), ITT (Europe), and Univac; (2) Marconi (U.K.), Hughes Aircraft, CFTH (France), Selenia (Italy), Hollandse Signaal-Apparaten (Dutch Philips Associates), and Telefunken; (3) Westinghouse NADGE Assoc. incorporating Decca Radar, Westinghouse Electric International, IBM (France) and IBM (Italy).

A further $30 million has been budgeted by West Germany for home defense systems. No "holy alliances" are expected to bid here, for government ruling gives preference to local manufacturers.

CHOICE OF U.S. MACHINES MAY LIGHT 'TILT' SIGN

The flash-point of mounting politico-industrial tension has been reached with a possible decision by the British government to buy U.S. machines (U-490)

Continued on page 71

Powerful new computer. Only $695 a month. Only from IBM.

Our new 1130 Computing System has approximately 20 times more power than our best previous desk-size digital computer.

But it rents for less than half. And is backed by IBM programming and services.

We tailored the 1130 to the needs of the small-budget engineering or scientific worker. It also helps printers and newspapers cut the cost of computer-directed typesetting... and serves the accounting needs of many smaller businesses.

The 1130 is fast. It comes with a big, new direct-access file. It utilizes the improved micro-circuitry developed for IBM SYSTEM/360. And it rents for as little as $695.

Look what that buys you: Paper tape in and out. A high-speed CPU with 4K 16-bit words of core storage. FORTRAN and a new 1130 Symbolic Assembler Language to speed programming.

For an extra $200 a month, you can double core storage to 8K.

For $880 a month, you get a basic card system that gives you 300 cards/min. in and 80 columns/sec. punched out (400 and 160 for $995/month). A new printer (80 lines/min. alphanumeric; 110 lines, numeric) goes for $275/month.

The new direct-access disk storage lets you put over half a million words of data on a single interchangeable disk cartridge. A basic disk model rents for $895/month. You can transfer up to 35,000 words per minute on or off the file. Since the disks are interchangeable, a disk system is the ideal solution for an open-shop operation.

With the disk feature, you can use a monitor programming system that takes over much of the routine housework involved in operating a computer. The monitor lets you stack jobs—in any sequence—and lets the computer process them automatically.

It lets you run a shop more efficiently by reducing turnaround time from the origin of a problem to its solution. You put the monitor on the disk—it occupies less than 20% of the disk's capacity, leaves over 400,000 words or 800,000 characters for your programs.

Over 40 separate programs for the new 1130 come in seven tested application packages. Included among these are mathematical and statistical programs, COGO, petroleum engineering exploration, geophysical programs and automatic typesetting programs.

Other features: a console printer (15.5 cps) and keyboard... utilities and subroutines programs... double precision and floating point arithmetic.

You can get a 1627 Plotter for generating graphs, maps, flow charts, engineering drawings direct from digital information in the system.

And check these standard features—yours at no extra cost—with every model of the 1130: Parallel data transfer... Parallel arithmetic ... Automatic program interrupt... Three index registers... Overlapped processing... Indirect addressing... Multiply and divide... Parity checking... Double-precision instructions... Boolean logic.

But it won't make coffee. Sorry.

IBM®

CIRCLE 28 ON READER CARD

Continued from page 69

for a large-scale social security job. ICT has already stated its intention to raise Cain if this goes through. The contract, worth an eventual 20 megabucks, is from the Ministry of Pensions and National Insurance. First order, though, is for one system of a projected seven.

Authorisation for computer purchases are usually agreed between the ministry concerned and the financing body, Her Majesty's Treasury. The new Labour administration, though, has created a Ministry of Technology, responsible for boosting computer and machine tool industries, among others. Projects such as MPNI may provide the first of a series of head-on clashes between Govt. departments in disagreement on specific contracts. Who will have the casting vote is anybody's guess.

$1 MILLION TO FIX ATLAS SOFTWARE

One software house, asked advice on a personal basis by systems programmers at London Univ., estimates that close to $1 million is needed to get the school's Atlas computer software out of a jam. The situation seems so ripe (it was even written up in the London Observer) that other manufacturers are making overtures to London Univ., *sotto voce*, suggesting the whole thing be flung out the window.

Central to the problem is the supervisor, which sorts big and small jobs according to storage and peripheral availability. The result should be an optimum program mix for up to about eight jobs. But the wacky supervisor is unable to handle lots of little jobs – which disappear into the machine, and there's no telling when they might spew out again. Large, single-stringer scientific jobs, though, are going through reasonably well. But as a result, for every eight-hour shift only two to four hours of productive work is reportedly being averaged.

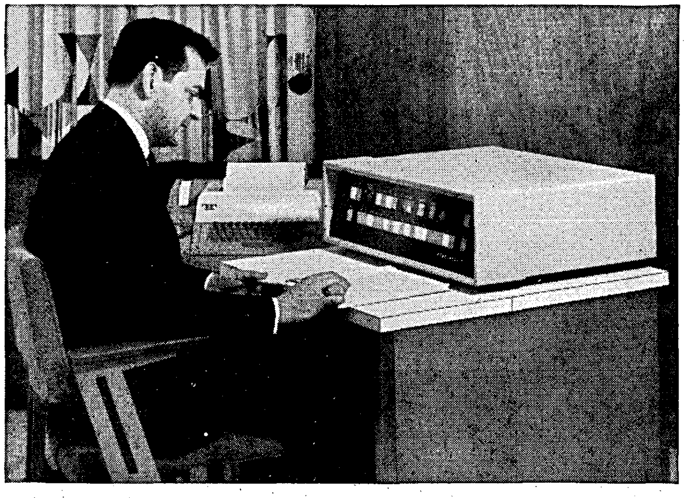
CDC-AUSTRALIA WINS ORDER WITH PARLAY POSSIBILITIES

Control Data has won the contract to supply two 3100's to the Totalizator Agency Board (an off-course betting agency) in Melbourne, Australia. Generally regarded as the most lucrative contract Down Under in the past 12 months, the order has great potential. It puts CDC in the post position for four more orders in Australia and New Zealand, as well as with the New York Racing Assn., hopeful of getting off-track betting facilities. The contract, worth $1.45 million, includes 200 input units linked on-line by private phone lines.

ODDS & ENDS

ICT is expected to announce soon a micrologic machine at the low end of its 1900 series . . . SNCF (French railroad) has ordered twin Univac 1108's for nation-wide, real-time passenger and freight control. Univac has a rumored backlog of 12 1108's for the Continent. In the U.K., a $3-million 1108 deal has been reported with the National Engineering Lab, government-sponsored centre for machine tool research. Main selling point was APT III availability . . . One of Europe's plum customers, the giant Shell Oil, has ordered a mixed bag of Honeywell 200's and 620 process controllers for various Continental operations . . . Elliott Automation is to manufacture Data Discs in the U.K.

Announcing the Honeywell 20 Digital Control System



Its low cost, new programming language, accuracy, and speed offer practical solutions to real time system needs.

Designed to handle a wide range of real time and scientific applications, the Honeywell 20 System incorporates either of two central processors—the H21 with a memory cycle time of 6 microseconds or the H22 with a cycle time of 1.75 microseconds. The Honeywell 20 is available either as a component for user systems or as a fully integrated control system. Prices start at $21,000 for a central processor with input/output typewriter and integral tape punch and reader. A typical small control system with a 4K core memory, analog and digital input/output subsystems, A/D and D/A converters, real time clock, and an input/output typewriter costs approximately $55,000.

The H20 System includes a number of hardware and programming features seldom found in a low-cost system:

18-Bit Word Length—plus parity and memory guard bits.

Single Word Instructions—provide 8192 directly addressable core locations.

CONTROLWARE—advanced software package, featuring CONTRAN, also includes FORTRAN II and CAP assembly system.

Core Memory Capacity—2048, 4096, 8192 or 16,384 words of memory prewired for field expansion.

Priority Interrupts—up to 32 hardware levels, with up to 144 interrupt lines per level.

Direct Memory Access—independent path to memory for external I/O operations on a fully buffered, cycle-steal basis.

Three-Address Register Commands—three-address arithmetic and/or logical operations with single word, one cycle, instructions.

Hardware Multiply—a standard feature.

Power Failure Protection—automatic program shutdown and restart without loss of data.

CENTRAL PROCESSORS

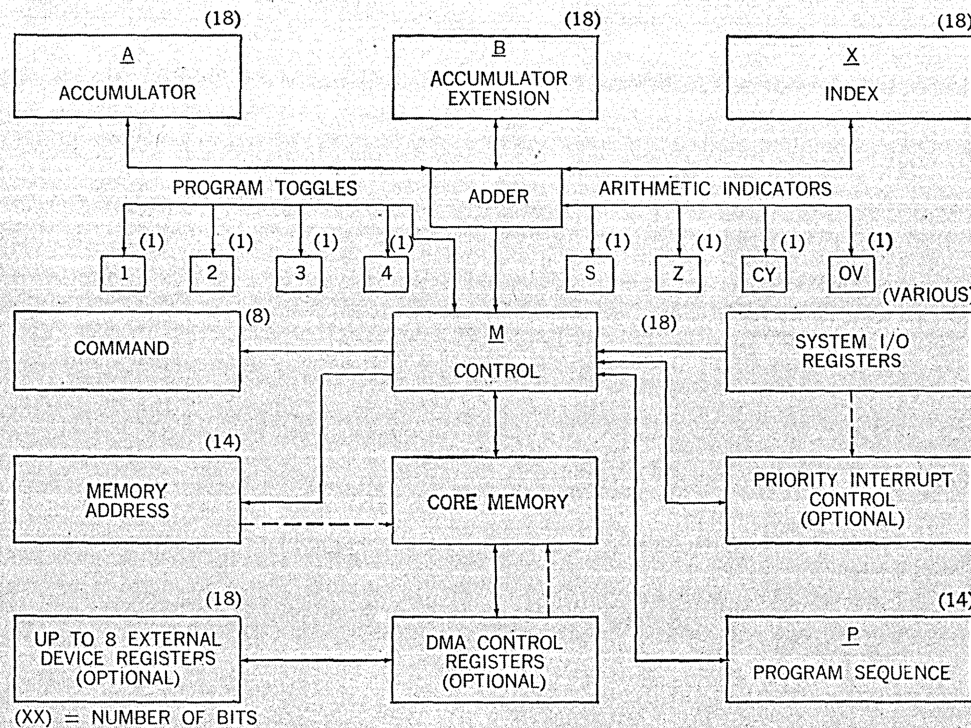
Type—Binary, 2's complement arithmetic, single address.

Typical Operating Speeds—(In microseconds, including memory accessing and indexing.)

	H22	H21
Add	4.8	12.0
Logical	4.8	12.0
Load/Store	4.8	12.0
Multiply	25.0	54.0

Circuitry—Hybrid circuit construction using microcircuit techniques and silicon semiconductors. Environmental: 32-120°F.

Memory—Magnetic core, random access.



INTERNAL REGISTER DIAGRAM—The internal register organization of the Central Processor is shown in the block diagram. Programmed input/output data is transferred in parallel via the M register to or from core memory without disruption of arithmetic registers. Four arithmetic indicators facilitate testing of zero, sign, carry, and over-flow conditions. Four program toggles provide a convenient means of setting and checking program flags. The optional direct memory access registers provide an independent path to memory for high speed devices.

Address Modification—Indexing, indirect addressing.

Parity—Checked or generated on all memory, character input/output, and high-speed direct memory access operations.

Options—Multi-level priority interrupt, direct memory access, auxiliary drum memory, magnetic tape unit, high speed paper tape punch, and reader.

INPUT/OUTPUT SUBSYSTEMS

Low-Level Analog Inputs—Standard scanning speed of 200 points per second with an overall accuracy to within ±0.05% full scale on 0 to 50 mv range. Expandable to 1024 inputs.

High-Level Analog Inputs—Scanning speed up to 8,000 points per second with an overall accuracy to within ±0.025% of reading ±1.5 mv on 10 volt range. Expandable to 256 inputs.

Digital Inputs—Transfer speed up to 360,000 bits per second (contacts or voltage levels); up to 1440 inputs in modules of six; up to 240 pulse input counters per system.

Analog Outputs—Solid state D/A converter provides 10-bit resolution; up to 120 outputs in modules of one; up to 720 stepping motor drivers in modules of three.

Digital Outputs—Transfer speed up to 360,000 solid-state switching operations per second, each output individually buffered; up to 1440 outputs in modules of six; on-off (latching) and pulse duration (10 milliseconds to 1 second) types.

CONTRAN

CONTRAN (CONtrol TRANslator) is an advanced compiler-level language combining the most desirable features of FORTRAN IV and ALGOL 60. It is a new concept in multi-programmed, time shared, real time programming.

CONTRAN solves the complex programming problems normally encountered in: the use of a shared primary memory with auxiliary bulk memory; linkages to executive control; responses to asynchronous external interrupts; inter-program communication; compilation and debugging of both related and unrelated programs while the system is performing on-line control.

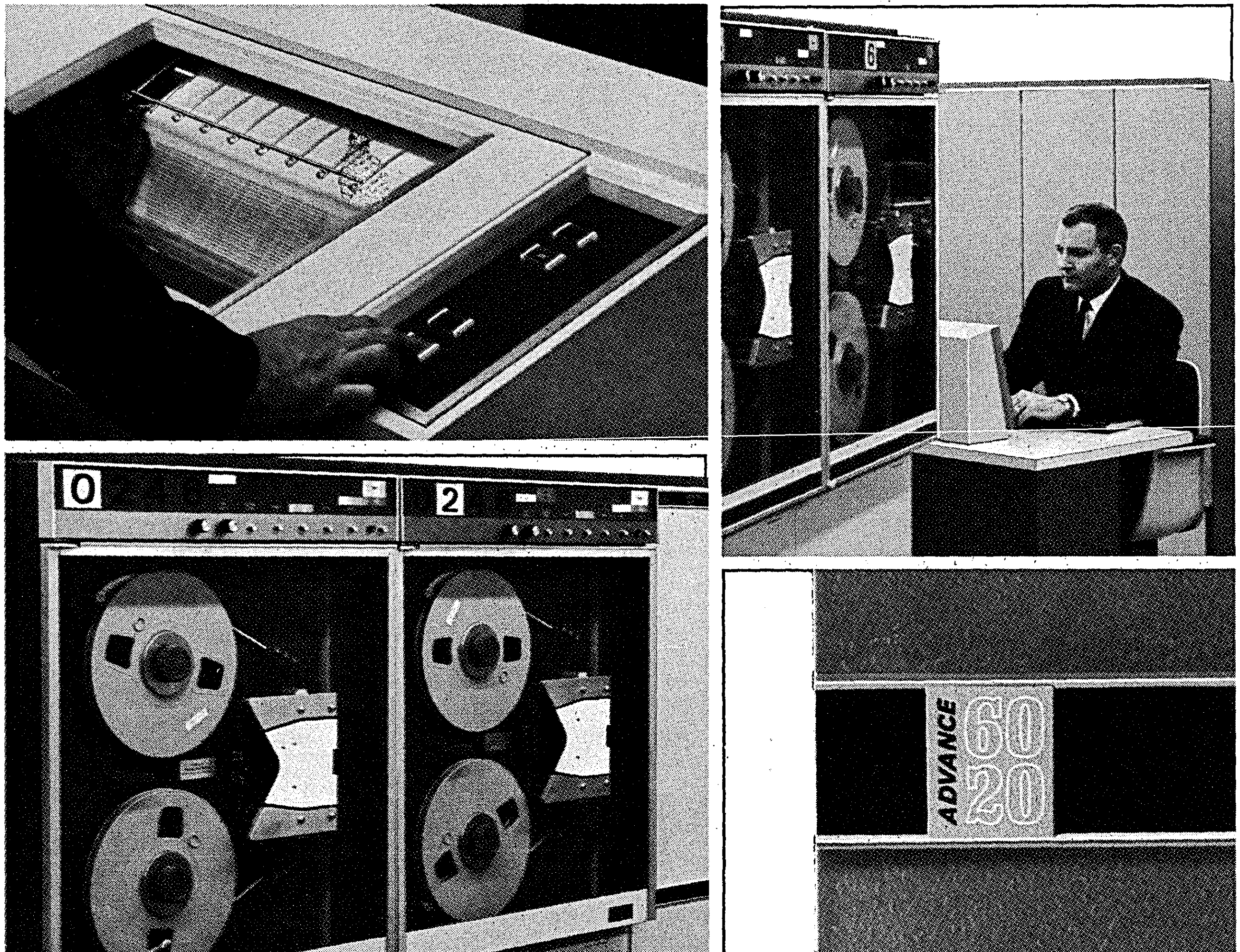
System programs can be added, deleted or modified on-line providing new opportunities for "live" studies. For the first time, entire real time systems can be programmed in compiler-level language.

For more information, write to

Honeywell

Special Systems Division, Pottstown, Pa. 19464

CIRCLE 29 ON READER CARD



From ASI's continuing program of new product development

This computer offers more productivity per dollar than any in its class–the ASI 6020

Compare the computing systems offered in the low cost scientific and on-line systems range. Other computers offer some important features, but only the *ADVANCE* Series 6020 from ASI offers *all* of the features required to best satisfy your needs. Consider the complete instruction repertoire with rapid execution times such as—add 3.8 microseconds, double precision add 12 microseconds.

Three index registers and successive indirect addressing simplify programming operations. ☐ Multilevel interrupts are provided for control requirements—real time, data communication, etc. ☐ The Programmed Instructions feature allows special subroutines to be handled as hardware instructions. ☐ Input/output rate of 180,000 words per second per channel. ☐ A memory with a 1.9 microsecond cycle time which is directly addressable to 32,768 24-bit words. ☐ One pass FORTRAN II and one pass symbolic assembler allow for complete batch processing without operator intervention. ☐ Low purchase price of $73,500 for the central processor, $79,500 for basic system including typewriter, paper tape and buffered input/output channels. ☐ As is true with all computers in ASI's *ADVANCE* Series, the 6020 is packaged to offer a versatile and completely modular method of installing the system to meet your exact needs.

We would like to tell you more about the 6020 and ASI's Customer Support Program which helps you get the most out of your computers. In addition, you may wish information on the larger member of the *ADVANCE* Series, the high performance 6040 Computer. Contact an ASI representative today.

ASI

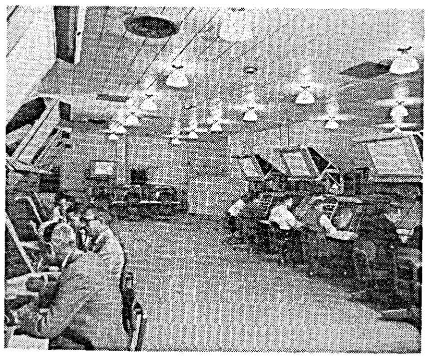
ADVANCED SCIENTIFIC INSTRUMENTS
DIVISION OF ELECTRO-MECHANICAL RESEARCH, INC.
8001 Bloomington Freeway, Minneapolis, Minnesota 55420

CIRCLE 30 ON READER CARD

NEWS BRIEFS

FAA EVALUATES AIR TRAFFIC SIMULATION DISPLAY SYSTEM

An air traffic simulation and display system, developed by Radiation Inc., Melbourne, Fla., has been delivered for evaluation by FAA traffic controllers at the National Aviation Facilities Experimental Center (see photo) in Atlantic City, N.J. It is expected to aid in the solution of current problems and the development of future proce-



dures and semi-automatic equipment for traffic control over major U.S. cities. The first Radiation-produced display system in operation is planned for Jacksonville, Fla., in 1967.

The system at NAFEC consists of eight 19-inch CRT consoles; an IBM 7090 will be tied into the system later this year. With the system, the controller can receive more detailed data per aircraft than is available on present-day radar scopes. The CRT displays information on up to 60 aircraft, and can plot flight paths and draw maps of airway and geographic locations. Control areas can encompass up to 400-square-mile plots. The controller can also edit out data to isolate aircraft at any altitude or position under this control.

The system will also be used to evaluate advanced computer methods for reporting aircraft positions and calculating their progress in relation to other aircraft.

AUTOVON TO JOIN AUTODIN IN WORLDWIDE NETWORK

Installation of switching centers for the worldwide Automatic Voice Network (AUTOVON) has been undertaken by Automatic Electric Co., Northlake, Ill., under a 21-megabuck contract from the AF Electronic Systems Div., Bedford, Mass. The network is part of the Defense Communications System, which also consists of AUTODIN, the digital network.

When completed in 1967, there will be 22 overseas AUTOVON switching centers, each with 100 to 1,000 lines and trunks, expandable to 2,000. A call to any point on the network will take only 10 seconds. Other capabilities: multi-continent conference calls with up to 30 phones, automatic pre-emption of inter-office phone lines for high-priority calls, and hot lines that ring a pre-determined phone as soon as a caller picks up his phone.

In addition to the switching centers, the AUTOVON system will include transmission media and terminal facilities for graphic communications. It is also adaptable to broadband switching to accommodate high-speed data transmission. The system is capable of switching up to 108,000 cycles per second, compared with 4,000 cps through normal switched networks.

VOTE COUNTING MACHINES 'SHINE' IN RECOUNT TEST

The efficacy and accuracy of vote-counting machines received a sort of boost recently when a recount was ordered and carried out in San Diego, Calif. A Votronics vote counter made by Cubic Corp., San Diego, was used last November; in a district contest, more than 110,000 votes were cast; and there was a margin of only 169 votes.

The original "loser" paid $1,377 for a manual count, the winner paid $691 for a machine count, and the net difference in the final tally was five votes —"significantly small," according to the county registrar of voters. The official margin was lowered to 115 votes, from 169, largely because of decisions based on ballot interpretations.

The county reported that it saved $228K in the Nov. 3 election by using the machines; a neighboring county reported savings of $82K in the same elections using the same machines.

JAPAN MOVES TO BOOST OWN COMPUTER INDUSTRY

The Japanese computer industry has received the support of the local Ministry of International Trade and Industry, which intends to lend the type of assistance that will make it a growth industry. Plans include the pooling of resources of domestic makers to become competitive with foreign manufacturers—the production of improved hardware and software.

MITI has also stepped up loans by the Japan Development Bank to the Electric Computer Co., which finances rentals for domestic manufacturers. These loans are up from 2.3 billion to 3.5 billion yen for the coming fiscal year. Anticipated domestic production valued at 25 billion yen in fiscal '64 compares with 39 million in FY-57.

CALL FOR PAPERS, MEETINGS ANNOUNCED

The problem of reprogramming will be discussed at an ACM special interest symposium following the IFIP meeting in New York City. The group will convene June 1-3 in Princeton, N.J. Contact Mrs. L. R. Becker, Applied Data Research Inc., 759 State Rd., Princeton, N.J. 08540.

First U.S. meeting of the International Federation for Documentation will be Oct. 10-16 at Washington, D.C.'s Sheraton-Park Hotel. Deadline for papers to be presented is June 10. For information: Secretariat, 1965 FID Congress, 9650 Wisconsin Ave., Washington, D.C. 20014.

Annual meeting of the Users of Automatic Information Display Equipment will be at the Holiday Inn, New York City, Oct. 11-14. Deadline for papers is July 15. Submit to C. L. Bannister, program chairman, 1965 UAIDE Annual Meeting, R-COMP-RRL, NASA/Marshall Space Flight Center, Huntsville, Ala. 35812.

ANALOG SIMULATIONS AID AIRCRAFT DESIGNERS, PILOTS

Two analog simulation systems to aid the aircraft industry were recently announced. Complete in-flight design computations, simulating changes in airplane control characteristics at supersonic speeds—although the plane is actually traveling at a lesser speed—will be handled by an analog computer made by Systron-Donner Corp., Concord, Calif. It will be part of Boeing's 2.5-megabuck research program on the Supersonic Transport.

A second simulation run by the Battelle Memorial Institute, Columbus, Ohio, has reportedly demonstrated the promising potential of an advanced instrument system aimed at safer takeoffs and landings for jet aircraft. Instead of supplying static information, the new instrument would provide a pilot with the optimum angle of attack, based on the plane's acceleration force.

WARM BODIES STILL NEEDED, "AUTOMATION" STUDY SHOWS

Of more than 200 corporations (employing 825,000) responding to a recent survey, 75% indicated that "automation" has added new jobs in their companies in the last year. Largest growing category: programmers. The study by the Manpower Research Council of Manpower Inc., Milwaukee, Wisc., covered the manufacturing, service, retail, banking, and insurance industries.

Among respondees, 43% believe that "automation" will increase the number of jobs in the next five years, 28% foresee a drop, and 29% see no change. What are the major factors limiting the expansion of automation in firms? The work doesn't lend itself to automation, say 41%; automatic equipment is too expensive, say another 26%; and organized labor, according to 15%.

● A clearing house of information about computer-assisted instruction has been established by Entelek Inc. under a contract with the Office of Naval Research. The firm is compiling brief descriptions of lesson programs, teaching logics, and system characteristics. To register with the project: Entelek Inc., 42 Pleasant St., Newburyport, Mass. 01950.

● A Visual Search Microfilm File with products and parts information for design engineers has been installed at the AF Electronic Systems Div., Bedford, Mass. Stored are 150,000 catalog pages from more than 3,500 vendors. In 1.5 minutes, the pages can be searched, an item located, and a hard-copy produced. This contrasts with an average of 65 minutes for a manual search, assuming the catalog was available.

● The Univ. of Arizona continues its support of an on-going study of the performance, design, and organization of hybrid computer systems under a one-year $12,588 grant from the Air Force Office of Scientific Research. Heading the study group is Dr. Granino A. Korn, EE prof.

● Four Morse code translator and Teletype converters have been delivered by RCA to the Army Electronics Commands Labs, Ft. Monmouth, N.J. The rack-mounted units accept hand and tape-sent TT messages, will drive 100-wpm teleprinters, and can be modified to operate a strip recorder or letter-by-letter display. They also provide automatic, electronically-controlled line feed and carriage return signals.

● A study of the noise patterns of auto accidents has been undertaken by the Computer Research Dept. of the Cornell Aeronautical Lab., Buffalo, N.Y. The search is for sounds that would trigger an automatic accident detection and surveillance system. Under a $70K contract with the U.S. Bureau of Public Roads, scientists will study the causes of accidents by using TV and mag tape to record the actions of drivers and vehicles prior to an impact. This requires the discrimination of false alarms from the real sounds that would set off the recording mechanism in time to catch the driver panicking.

● IBM's QUIKTRAN time-sharing service will be available from a Los Angeles datacenter beginning the third quarter of '65. Already announced is the availability of this service from New York City, starting the second quarter. A 7040 will be in L.A.

● The eighth Teleregister (now Bunker-Ramo) airline reservation system will go to Irish International Airlines. Linked to the computer at Dublin airport will be more than 100 agents sets in Dublin, Cork, Limerick, Birmingham, Glasgow, Manchester, and London. It reportedly will be capable of handling up to 11,000 inquiries per hour.

● The entire supervisory control product line of North Electric Co., Galion, Ohio, has been purchased by Radiation Inc., Melbourne, Fla. The hardware has been marketed under the names Paricode and Locotrol. Sales for the line in '64 exceeded $3 million, and presently operating systems are said to exceed 5,000. Largest is the soon-to-be-completed system for Colonial Pipeline.

● First coast-to-coast user of Western Union's Broadband Exchange network is the Associated Press, which is sending stock market quotes from New York to a subscriber newspaper in Hawaii. Transmission rate is 1,050 wpm. RCA Communications Inc. handles transmission from San Francisco to Hawaii. Western Union also announces intra-state transmission of data on mark sense cards for the Louisiana State Highway Dept. Applications include payroll and cost information, and material and fuel inventories.

● Two IBM 7074's at the Internal Revenue's computer center at Martinsburg, W. Va., will be joined in October by a 360/62. The system will include 256K characters, disc file, and Hypertapes.

● A message switching system capable of handling 225,000 messages a day is on the air at British Overseas Airways Corp., London. It was developed by Collins Radio Co., Dallas, Texas, and will handle traffic for such BOAC partners as Qantas, Air India, Air Canada, and South African Airways.

● Two oil fields of the Continental Oil Co., are being monitored and controlled by an IBM 1710 control system situated 15 and 80 miles from the fields. The system can turn each of the fields' 57 wells on or off, pump oil into storage tanks, test it, and ship it out by pipeline. In case of a malfunction, operations are shut down and a control station is notified of the condition and its location.

● An advanced version of ATOLL (Acceptance, Test, Or Launch Language) for the multiprocessor, real-time checkout system of the Saturn V Apollo is being developed by Mesa Scientific Corp., Inglewood, Calif. The language will enable launch system engineers to write vehicle system and subsystem test procedures in test-oriented language statements. The project is underway at NASA Huntsville.

● A dual RCA 301 system has been selected by United Press International for automatic typesetting and accounting functions. UPI, which publishes no paper, dispatches news to subscribers in two forms: all caps unjustified Teletype copy and manually-hyphenated and unjustified Teletypesetter tape. Outside consultant was CEIR Inc.

Engineers at the Sperry Gyroscope Co., Great Neck, N.Y., last week described Sperry's Sceptron pattern recognizer which is said to be capable of differentiating between spoken English words "six," "sex," and "sick" . . .

— News item

The Rhyme of the Ancient Mechanism

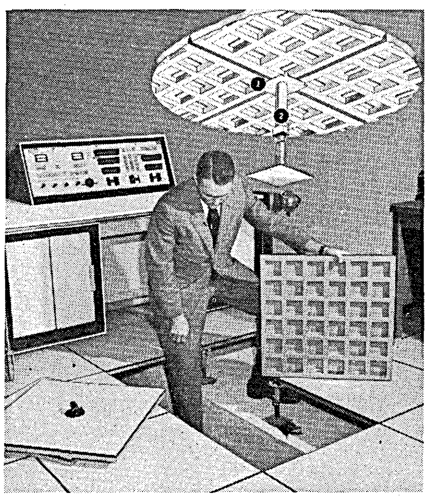
A pattern machine whose ear failed it
Lies interred, a mechanicide victim;
Its programmer heartlessly flailed it,
Believing it'd purposely tricked him.
Foredoomed was its Sceptronic chrome hide
When he said to it, "Sixty-six wrenches;"
It ordered up philtre and bromide
For it thought it heard "Sexy, sick wenches."

David W. Kean

NEW PRODUCTS

computer floor

Improved construction reduces floor thickness to 1¼ inch, eliminates need for stringers, and includes new four-lug pedestal to grip panels. Design incorporates sound deadening and grounding pad. TATE ENGINEERING INC., ARCHITECTURAL PRODUCTS DIV., Baltimore, Md. For information:



CIRCLE 200 ON READER CARD

binders

New line of binders for both burst and unburst materials is available in variety of materials and sizes, features several different locking mechanisms. BOORUM & PEASE, Brooklyn, N.Y. For information:

CIRCLE 201 ON READER CARD

control computers

The H21 and H22 are small-scale processors available in consoles or racks for system integration. Respective memory cycle speeds are six and 1.75 usec, and directly addressable storage is 2-8K (18-bit) words of core. Operating temperatures are 32-120°F. A drum that holds 64-512K words is also available. Software includes CONTRAN, a control translator, and FORTRAN II augmented with process control statements. HONEYWELL SPECIAL SYSTEMS DIV., Pottstown, Pa. For information:

CIRCLE 202 ON READER CARD

plotter/printer

Mag tape-driven COMPIX converts digital data to contours, line plots, bar charts, engineering drawings and tone shades for half-tone representation, on- or off-line. Continuous, dotted, and dashed lines of varying width provide multiple plot capability. Annotational and textual alphanumerics are offered in any type font, size, and at any angle. It will reportedly produce 50 12 x 18-inch documents/hr., regardless of complexity, and simultaneously transmit duplicate documents to remote locations over standard facsimile circuits. UNITED AIRCRAFT CORPORATE SYSTEMS CENTER, Farmington, Conn. For information:

CIRCLE 203 ON READER CARD

portable punch

Electro Mechanics Corporation's Model 80A card punch is now available as the Model 2600, offered by WRIGHT LINE, Worcester, Mass. For information:

CIRCLE 204 ON READER CARD

PRODUCT OF THE MONTH

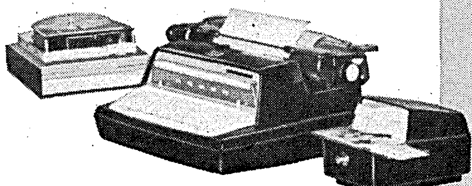
Rated at 1,200 items a minute, the Class 407 is an 18-pocket MICR document sorter. It is said to reduce the number of sorting runs in a bank, cut the number of times that documents are handled, as well as number of balancing operations.

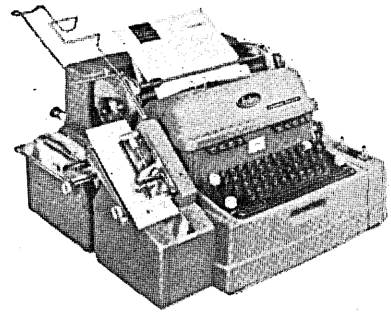
"Throughput" speed is said to average 60,000 items an hour. Each pocket holds 2,000 items, and feeder capacity is 3,000, permitting long runs. For off-line sorting, it can read and sort on a whole field, partial field, or digitally. Documents can be selected and sorted on any whole or partial field basis to as many as six pockets while a digital sort is performed. The unit can also recognize that the last significant digit of a number has been sorted, see that further sorting is unnecessary, and place the document is a "zero kill" pocket.

When on-line to a 315 computer the 407 will read documents directly into the mainframe for automatic preparation to all subsequent depositor statements and bank records. Machines may be multiplexed for a multiple sorting facility with either the standard 315 or the 315 RMC. THE NATIONAL CASH REGISTER CO., Dayton, Ohio. For information:

CIRCLE 205 ON READER CARD

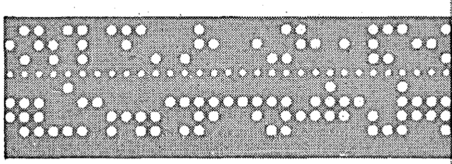
Compare the two leading tape processing systems*



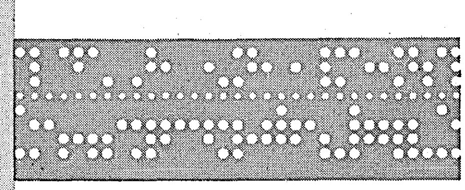


SCM TYPETRONIC® 2816™		FRIDEN FLEXOWRITER
30 CPS	Reading Speed	10 CPS
30 CPS	Punching Speed	10 CPS
10 CPS	Printing Speed	10 CPS
X + 40%	Throughput Speed	X
Yes	Buffered†	No
Yes	Solid State Circuitry	No
Low	Noise Level	High
Complete	Modular Construction	Limited
Yes	Variable Carbon Control	No
Today's	Styling	?
Photo-Electric	Type of Reader	Mechanical

†operates during the carriage motion



*FULLY PROGRAMMED—READ—WRITE—PUNCH SYSTEMS capable of reading, processing and punching data in punch tape or punch card format. For further information write: SCM Corporation 410 Park Avenue, New York, N.Y. 10022 Dept. D35



SCM®

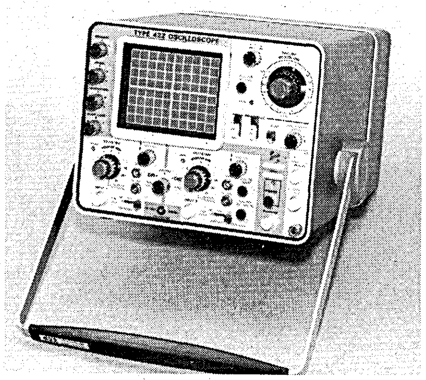
something for nothing SDA T.M.

THE KEY TO SMALL BUSINESS AUTOMATION

CIRCLE 41 ON READER CARD

portable scope

Type 422 has a bandwidth of DC to 15 Mc, dual-trace operation, and weighs 20 lbs. Dimensions are 6¾ x 8½ x 16 inches deep. Applications in-



clude testing and servicing computers, telemetering and instrumentation gear. TEKTRONIX INC., Beaverton, Ore. For information:
CIRCLE 206 ON READER CARD

renumbering software

RENO reorganizes an existing program (which was probably written with arbitrary statements) into a logical order, or breaks the chain in linked programs. Number overlapping, where chained programs are used or where a new program is constructed using parts from many existing programs, is circumvented. Using sources written in such languages as FORTRAN, ALGOL, GECOM, COBOL, the software punches a complete new source, lists new and old programs side-by-side, and lists new and old statement numbers of labels. COMPUTER LANGUAGE RESEARCH, Dallas, Texas. For information:
CIRCLE 207 ON READER CARD

industry software

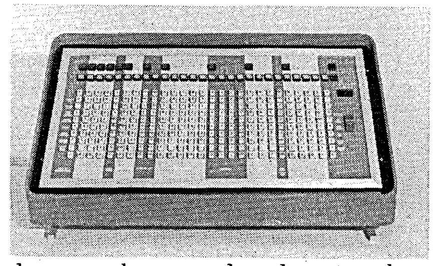
Propriety program for electric utility industry permits representation of large electrical networks by smaller "equivalent" networks for more effective analysis and study. CEIR INC., Arlington, Va. For information:
CIRCLE 208 ON READER CARD

microfilm printer-plotter

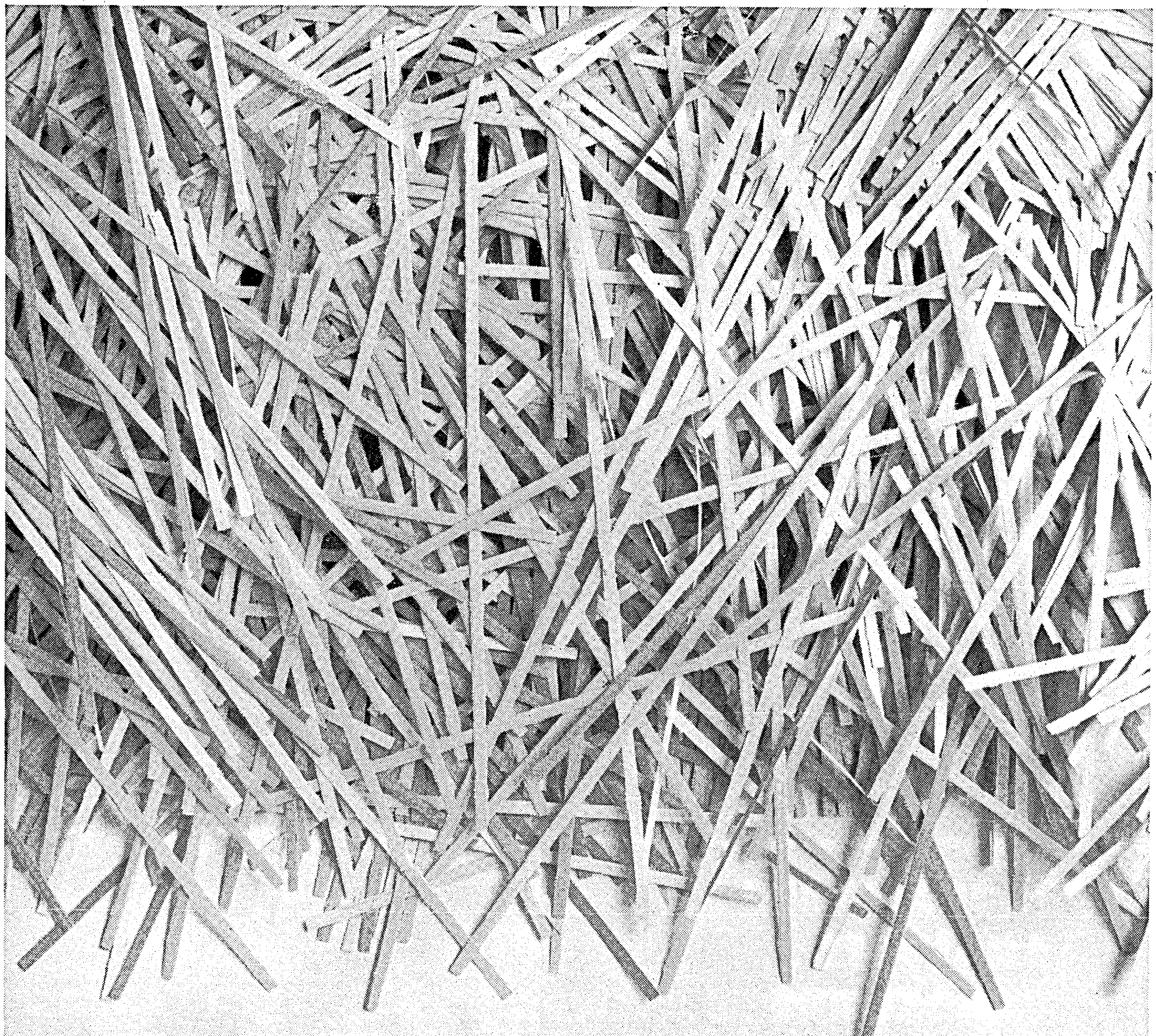
DIGIPRINT, with on- and off-line capabilities, prints up to 85,000 cps and plots more than 5,000 line segments/minute. System includes symbol generator with 64-character set (128 characters available); line generator with 512 x 512-point matrix (1024 x 1024 available); 16- or 35mm microfilm with rate of five 11,000-character frames/second; and CRT display. System supplies page formatting with automatic positioning of 135 symbols/line, up to 80 lines/page. BCD or binary input available. BURROUGHS CORP., Ann Arbor, Mich. For information:
CIRCLE 209 ON READER CARD

tape, card punch

The TPU-28 is a 28-bank keyboard unit with which, in the standard unit, one or two entry columns can be used to set up supervision circuits so that preprogrammed fields must be filled with data before punching will occur. Lights are lit over the columns where



data must be entered, and go out when data is entered. Automatic characters can be preprogrammed and punched at beginning and end of each block of tape. Delivery: 30-60 days. DIGITAL ELECTRONICS INC., Kansas City, Mo. For information:
CIRCLE 210 ON READER CARD



Medial strips are pure, 100% waste.

FORMSCARDS are the only continuous tabulating cards made without a medial strip between the cards. That's important to you and here's why:

Consider the medial strip. By itself, it weighs next to nothing. But 100,000 medial strips are equal to the weight of 15,384 FORMSCARDS, the cards without strips. How much money do you waste shipping medial strips around?

The medial strip is only ¼″ wide. But now look at 100,000 medial strips. That's quite a bit of footage. In fact, in the time it takes to process 100,000 conventional cards with medial strips, you can process 107,692 FORMSCARDS. How much time do you waste processing medial strips?

The same applies to all your continuous tabulating card operations. You waste time bursting medial strips. You waste time storing them. And finally, when you're all through shipping, processing, storing and bursting medial strips, you have to waste more time and money throwing the miserable things out.

FORMSCARDS don't have medial strips. They're all business, no waste. They work perfectly at any speed over any high-speed printer—any bursting equipment. They're available in 20 different sizes and with as many multiple copies as required for your system. They come to you sealed in plastic for shipping and storing protection and they have advantages you didn't dream possible.

Right now, drop us a line and we'll send you our brochure telling the whole amazing FORMSCARD story. Or, if there's a rush, give us a call.

Forms inc

Forms, Inc., Willow Grove, Penna.
Phone: OLdfield 9-4000/Area code 215.

NATIONAL BUSINESS FORMS ASSOCIATION
FROM COAST TO COAST
MANUFACTURER-MEMBER

CIRCLE 52 ON READER CARD

NEW LITERATURE

SOFTWARE FOR PROCESS CONTROL: Brochure describes program preparation aids, standard on-line functions and debugging aids, program compatibility with GE MONITOR system and includes description of process assembler language and FORTRAN II compiler for GE/PAC 4000. GE PROCESS COMPUTER SECTION, Phoenix, Ariz. For copy:
CIRCLE 130 ON READER CARD

DEMAND DEPOSIT ACCOUNTING: Eight-page brochure describes 315-100 series computer system. Illustrations include system flow chart and 19 reports for audit, control and management of checking account processing. THE NATIONAL CASH REGISTER CO., Dayton, Ohio. For copy:
CIRCLE 131 ON READER CARD

ANALYSIS OF SYSTEM: Brochure describes and contains excerpts from 150-page *Auerbach Standard EDP Report's* analysis of the RCA Spectra 70. Included are characteristics, performance features, and limitations of each item of equipment and software. Also includes an evaluation of the system's monolithic integrated circuitry and stored logic control systems. AUERBACH CORP., Philadelphia, Pa. For copy:
CIRCLE 132 ON READER CARD

DRUMS: Data sheet describes mechanical, electrical, recording and playback characteristics, price lists, service changes and purchasing terms of utility and economy drums. BRYANT COMPUTER PRODUCTS, Walled Lake, Mich. For copy:
CIRCLE 133 ON READER CARD

APOLLO/SATURN STORY: 32-page brochure describes the Apollo/Saturn project, its test and development programs, and the application of company equipment within these programs. BECKMAN INSTRUMENTS, INC., Fullerton, Calif. For copy:
CIRCLE 134 ON READER CARD

LOW-PRICE COMPUTER: Features, field proven standard options and instructions are included in booklet for $18,000 PDP-8 integrated circuit computer. DIGITAL EQUIPMENT CORP., Maynard, Mass. For copy:
CIRCLE 135 ON READER CARD

NEW LITERATURE . . .

HYBRID SYSTEM: TRICE/440 hybrid computing system is a digital differential analyzer that can handle hybrid problems in real-time. Among applications covered in brochure are aerospace simulation, sampled data and optimization of multiparameter systems. RAYTHEON CO., Lexington, Mass. For copy:
CIRCLE 136 ON READER CARD

TAPE DRIVE: Eight-page bulletin gives specifications and describes the TM-7 and 7200 tape memory system. AMPEX CORP., Redwood City, Calif. For copy:
CIRCLE 137 ON READER CARD

SEMINAR PROCEEDINGS: 258-page volume provides proceedings of the May '64 Design Automation Seminar held by Mesa Scientific Corp. Technology and economics relating to design automation are examined by senior engineers and engineering managers. Cost: $15. MESA SCIENTIFIC CORP., Santa Ana, Calif.

REFERENCE SOURCE: 116-page book, *A Guide, Bibliography and Critique of U. S. Defense Information Sources,* lists names of publications, addresses, subscription rates, describes contents, and comments on value of various periodicals to scientific and management interest groups. Cost: $7.00. DATA PUBLICATIONS, Wash., D. C.

DISC FILES: Data sheet for Models 80 and 800 random access disc files includes descriptions and specifications. Model 80, designed for medium to small scale systems, uses interchangeable disc kits, containing six discs with storage capacity of 24 megabits. Model 800, for medium-to-large computers, offers storage capacity from 60-200 megabits. ANELEX CORP., Boston, Mass. For copy:
CIRCLE 139 ON READER CARD

VARIPLOTTER: Four-page brochure describes the features and specifications of the 30″ x 30″ Series 205 Variplotter x-y recorder. For analog x-y recording in range and simulator applications, the series is available in both single and dual arm model. ELECTRONIC ASSOCIATES, W. Long Branch, N.J. For copy:
CIRCLE 140 ON READER CARD

Man on the move... to Mesa

Charles Yingst, senior analyst/programmer.

"I've worked for two of the largest computer and aerospace firms. Why did I move to Mesa? Simple.

Desire to do stimulating work in a hard-charging, profit-oriented environment. So, today I'm working harder than I ever have in my life. And liking it. Because everybody works at Mesa. Even our division manager, Jack Graham, has a programming background. Like Jack, everybody here is a real pro."

Mesa on the move... in systems programming

Development of an advanced version of ATOLL for Saturn V, Fortran IV compilers for various computers, design and implementation of programs for Mariner, and NASA's Mississippi test facility are some of the projects that create immediate nationwide opportunities for specialists in:

- Language formulation
- Compiler development
- Range data reduction
- Automatic checkout
- Communications systems
- Monte Carlo, simulation applications
- Space trajectory programming
- Heat transfer, structural dynamics problems

So Mesa needs more analysts, programmers

Current openings are for seasoned professionals, though inquiries from unusually well qualified less senior people are welcomed.

Personal growth potential within Mesa's uniquely stimulating environment: unlimited.

All aboard at Mesa enjoy the advantages of small-company flexibility, employee orientation, and participation in company growth, along with big-company benefits.

For an immediate interview, write in confidence to Robert D. Hauk, Client Services Headquarters, 1833 East 17th Street, Santa Ana, California 92701.

Other operations at Inglewood, Pasadena and San Diego, California, Houston, Huntsville and Washington, D.C. An equal opportunity employer.

MESA SCIENTIFIC CORPORATION

CIRCLE 90 ON READER CARD

people IN DATAMATION

■ Milt Stone was replaced as director of Management Information at Northrop Corp., Beverly Hills, Calif., by Paul Wierk, formerly with Norair division.

■ Vico E. Henriques, director of standards of the data processing group, Business Equipment Manufacturing Assn., has been appointed a member of the National Academy of Sciences, National Research Council Information Panel 423.

■ Ralph S. La Montagne has been appointed manager, federal marketing operation for GE's computer department. His headquarters will be in Wash., D.C.

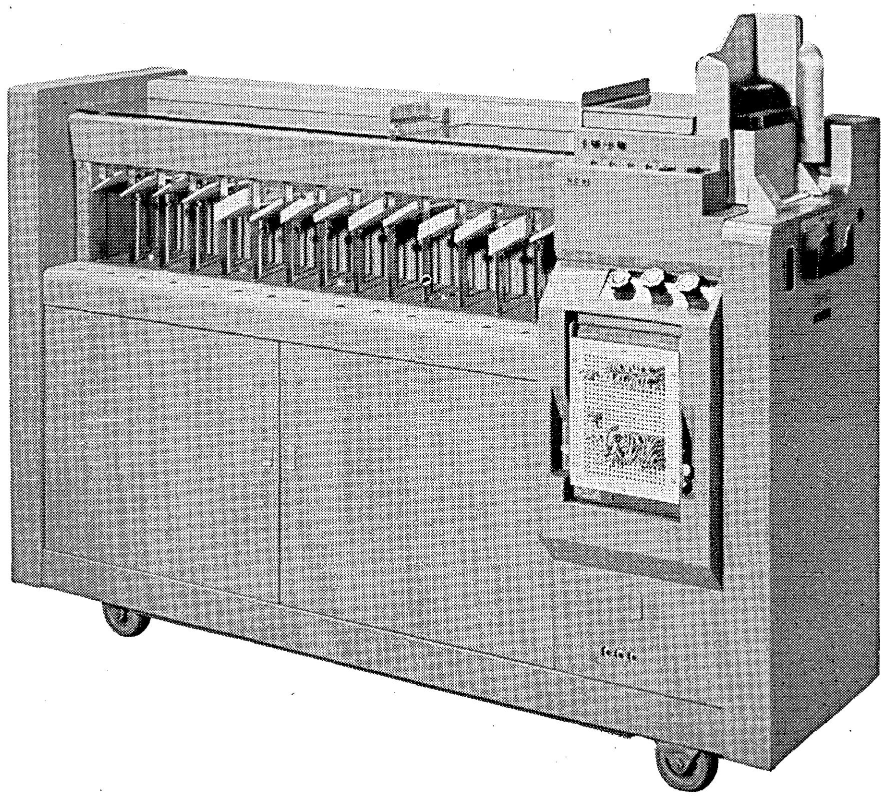
■ IBM has appointed two executives to head newly formed divisions: John W. Haanstra has been named vp of the Systems Development Div., and Clarence E. Frizzell, president of the Systems Mfg. Div. Also, Dr. Emanuel R. Priore has assumed the post of vp and chief scientist.

■ Clair C. Lasher has joined UGC Instruments, Inc., Shreveport, La., as president and chief executive officer. He was formerly manager of foreign computer operations with GE.

■ Roy H. Lynn will become vp of Computer Sciences Corp., El Segundo, Calif. and Armig G. Kandoian will head Communication Systems Inc., Paramus, N.J., formerly ITT Communication Systems, Inc., as vp and gm. General Lynn had been serving as president and Mr. Kandoian as Engineering vp of the N.J. subsidiary prior to its acquisition. Alvin E. Nashman has been named vp and gm of System Sciences Corp., Wash., D.C., formerly ITT Intelcom.

■ Emil R. Borgers, Dan L. McGurk, and Robert P. Adams have been named vp's of Scientific Data Systems, Santa Monica, Calif. Mr. Borgers moved up from Director of Programming, Mr. McGurk was formerly Director of Marketing, and Mr. Adams was Director of Development Engineering.

This machine leads a double life.



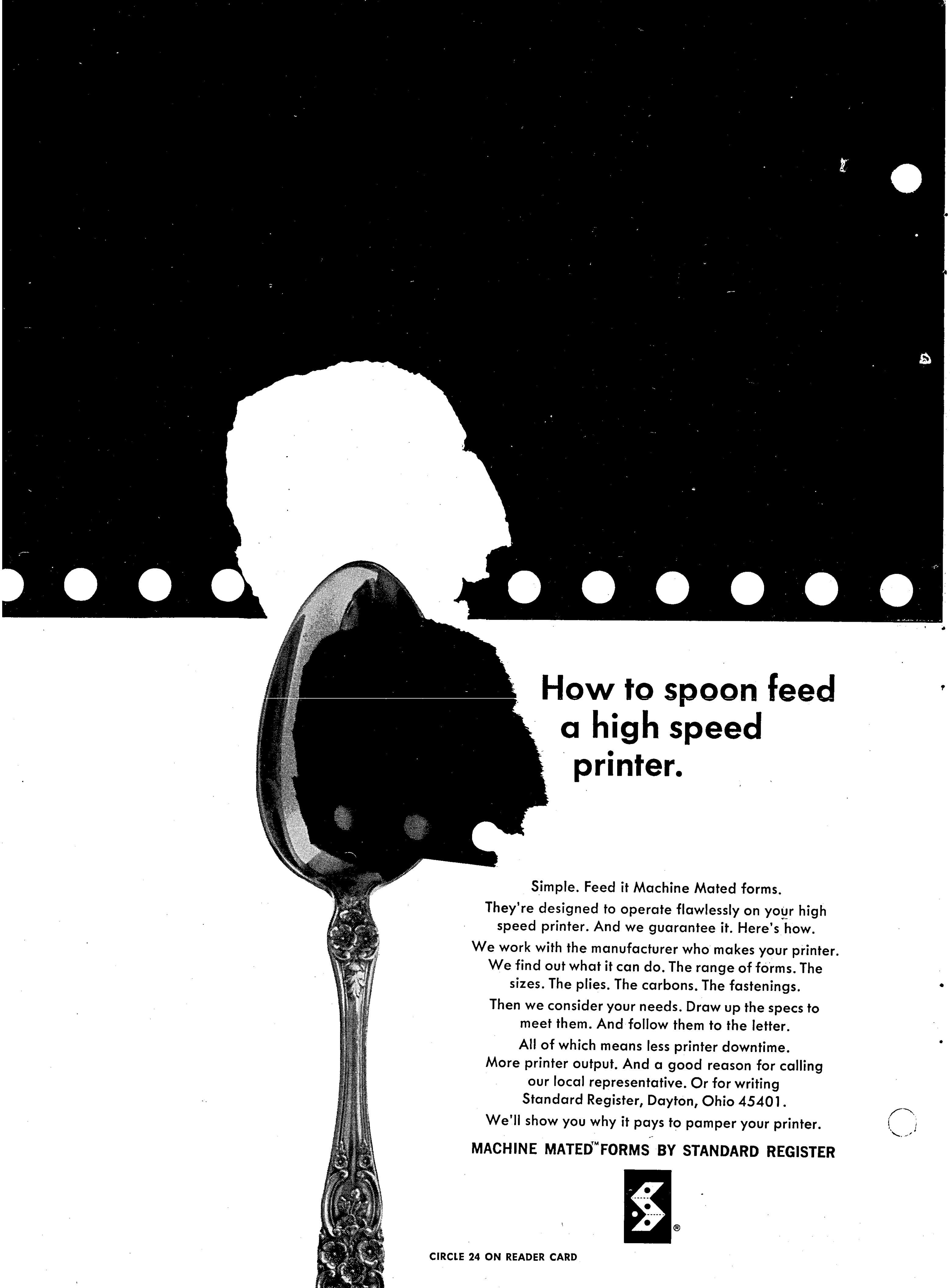
Our new NCR 406 Sorter can serve you with abilities that go well beyond sorting. It can also do sequence checking, file verification, and numerous selection routines at a rate of 1000 cards per minute. The NCR 406 is so flexible that it can accomplish anything that can be done on the primary feed of a collator—but at a much faster speed.

If you investigate the many advantages of this remarkable new machine, we think you'll soon be planning a full-time schedule for an NCR 406 Sorter in your own tab or data processing installation. Your local NCR representative will be glad to give you full details and a demonstration. Or write for our informative booklet, SP-1560, NCR, Dept. A, Dayton, Ohio 45409.

NCR

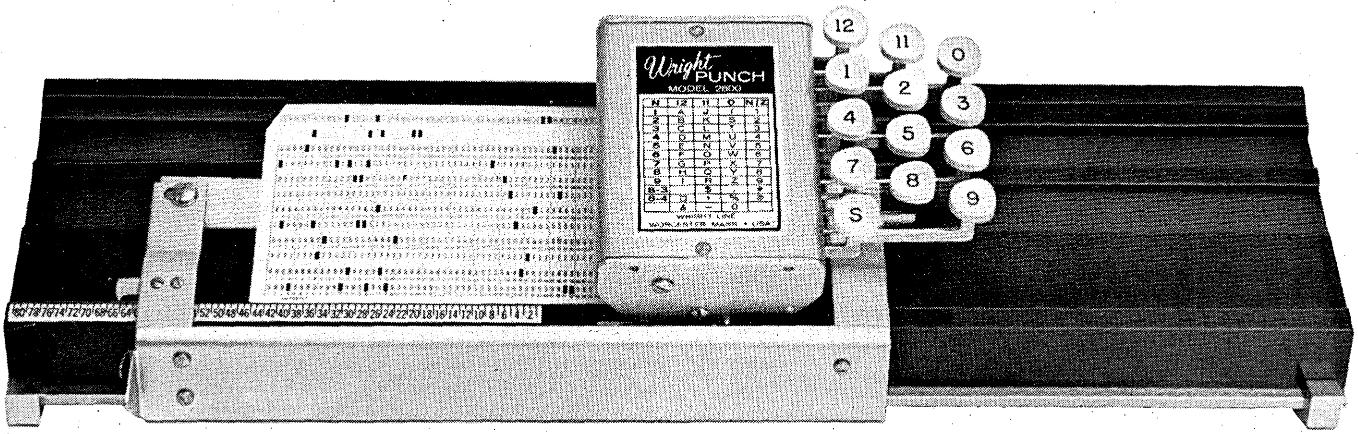
VISIT THE NCR PAVILION AT THE NEW YORK WORLD'S FAIR IN 1965. THE NATIONAL CASH REGISTER COMPANY ®

CIRCLE 45 ON READER CARD


How to spoon feed a high speed printer.
Simple. Feed it Machine Mated forms.
They're designed to operate flawlessly on your high speed printer. And we guarantee it. Here's how.
We work with the manufacturer who makes your printer. We find out what it can do. The range of forms. The sizes. The plies. The carbons. The fastenings.
Then we consider your needs. Draw up the specs to meet them. And follow them to the letter.
All of which means less printer downtime. More printer output. And a good reason for calling our local representative. Or for writing Standard Register, Dayton, Ohio 45401.
We'll show you why it pays to pamper your printer.
MACHINE MATED™ FORMS BY STANDARD REGISTER
CIRCLE 24 ON READER CARD

Introducing

Wright PUNCH
Model 2600



the only portable, precision 80-column card punch for data recording anywhere

▪ versatile, easy to use ▪ handles 80-column and shorter cards ▪ positive-action punches eliminate sticking ▪ lets you add or recreate data ▪ cost $159.00 Now, standard 80-column cards (and shorter ones of any length) can be punched in or outside the data processing department — with the unique, low-cost, portable Wright Punch. Ideal for a wide variety of on-site recording applications — including Stock Requisitioning, Production Control and Inventory Control — the Wright Punch also serves as a valuable auxiliary card punch in the installation where it can be used for adding information to previously punched cards and for recreating data from damaged cards.

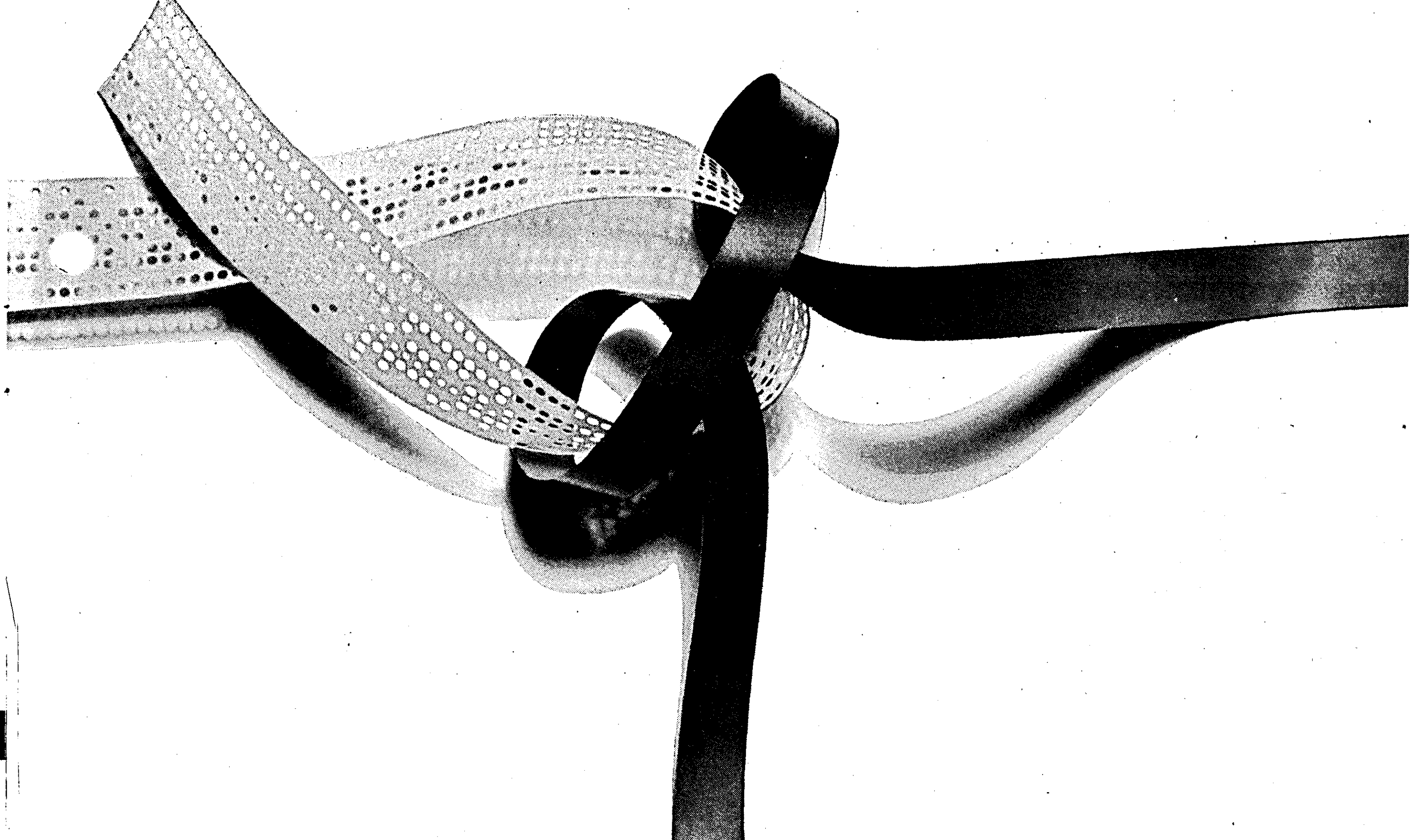
The new Model 2600 can punch a two-card set with carbon paper without requiring adjustments to the mechanism. Punches, which are contained in an all-mechanical punch head, are positively driven, both up and down, by the key levers; thus, the problem of punches sticking is completely eliminated. Cards can be inserted from either side of the punch head and are held securely in place at both ends for accurate punching. At just $159.00, the Wright Punch will prove an indispensable addition to every data processing department and wherever on-site recording is required. Write now for details about the Wright Punch — the only portable precision card punch on the market. We'll be happy to arrange a free demonstration in your office.

Wright LINE *DATA PROCESSING ACCESSORIES*

170 GOLD STAR BOULEVARD, WORCESTER, MASS. 01606

IN CANADA: Wright Line of Canada, Ltd., 80-82 Industry Street, Toronto 15, Ontario

CIRCLE 47 ON READER CARD



***"Management by Exception,"* by Lester R. Bittel, McGraw-Hill, New York, 1964, 320 pages, $8.95.**

To the data processing specialist engaged in developing computer-based management information systems, the contents of this volume may seem in many ways curiously archaic. The title itself, "Management by Exception," has a slightly antique ring, reminding those of us whose concern with systems predates the computer of a sturdy but oft-neglected legacy. Here, for computer people accustomed to paying homage to such pioneers as von Neumann, Eckert, Mauchly and the rest, will be encountered another —and perhaps unfamiliar—set of names to conjure with: Frank Bunker Gilbreth, Frederick W. Taylor, Henry Laurence Gantt, and the other giants of management improvement of the pre-computer era. A strong source of appeal in this book is that it identifies many basic precepts and principles of management which, though antedating the advent of the stored-program computer, retain a significant relevance for today's problems. With much of the present-day computer literature so hopelessly specialized and tending to become more so with each passing year, Mr. Bittel's book has the dual merit of providing a classic overview of the managerial process and offering the computer systems analyst a perspective no longer obtainable within the narrowing confines of his own specialty.

According to Mr. Bittel, who is, not so incidentally, the editor-in-chief of *Factory* magazine, management by exception may be formalized into six distinct phases:

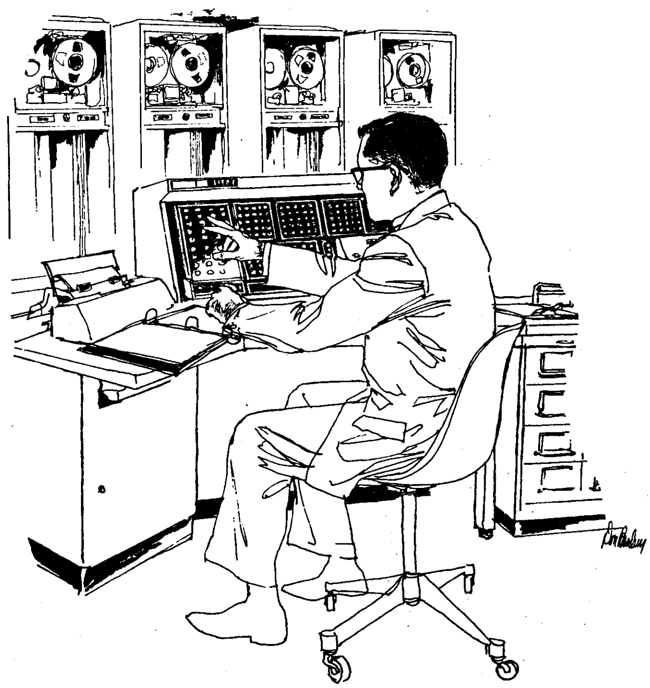
1. "The measurement phase, in which you collect and assess the facts of your total operational situation."
2. "The projection phase, in which you carry forward and present data to forecast future conditions and to set goals, prepare plans, and revise organizational structures."
3. "The selection phase, in which you select those vital and economically available measures that will best indicate the organization's progress toward its objectives."
4. "The observation phase, in which you periodically observe and measure the current condition of critical performance indicators."
5. "The comparison phase, in which you make comparisons between actual and expected performance in order to identify exceptions, analyze causes, and report the need for action to the appropriate authority."
6. "The action phase, in which you complete your decisions and take action to either control or exploit the exceptional conditions."

And guess what? A discussion of all this with scarcely a reference to computers! The magnitude of this "tour de force" is evident when one realizes that Mr. Bittel has managed to complete his description of the comparison phase with only a two-sentence mention of PERT. Though one strongly suspects that such an exclusion is largely a reflection of the author's unfamiliarity with the applicability of computer techniques to management by exception, it remains roughly the equivalent of a modern-day survey of nursery rhymes without mention of Doctor Seuss.

As a concession to the unignorable presence of computers as a managerial aid, there *is* one chapter titled "Operations Research, Computers, and Information Systems," but, judging from Mr. Bittel's approach to this topic, we are fortunate there is not more. Operations research, for example, is defined as "the use of advanced mathematical theories for solving managerial problems." And, "stated in mathematical terms, a computer program seems like black magic and the computer like an oracle in a black box." Or, "people have read too many gee-whiz articles about computers, and they've heard some computer jargon, loaded with science fiction terms: complicated expressions like 'biquinary coding'." If Mr. Bittel's world of pre-computer management methods is unknown to many computer people, it is equally evident that the world of electronic data processing lies shrouded in mystery for the author.

Actually, the book would have been strengthened by eliminating not only this unfortunate chapter, but all the other chapters in Part 4, which seem to have been included as a sort of after-thought. To hold forth for 320 pages seems to be extracting an inordinate amount of mileage out of the fundamentally simple notion of management by exception. Aside from the lack of understanding of that young whipper-snapper, the computer, this prolixity is certainly the major flaw of Mr. Bittel's book. Further criticism must be made, however, not of structure but of style, for this is a treatise larded with barbarisms and cliches. The author states the obvious with gusto ("Reports are designed to convey information: management by exception reports are designed to convey exceptional information") and is not a man to be deterred by a mixed metaphor ("Computer addicts are usually eager young Turks who chaff at the company's sacred cows"). Offsetting this are excellent references and many quotations from the leading theorists of modern management, from Gilbreth through Clarence Randall to Peter Drucker.

—R. V. HEAD



NEW FIRMS & mergers in DP

A firm to act as agent in arranging leasing and licensing agreements has been formed by John F. Banzhaf III. Computer Program Library, in New York City, will prepare and maintain listings of copyrighted programs available for leasing, and distribute these lists to members of the dp field. It will also arrange and negotiate leasing and cross licensing agreements with other computer users.

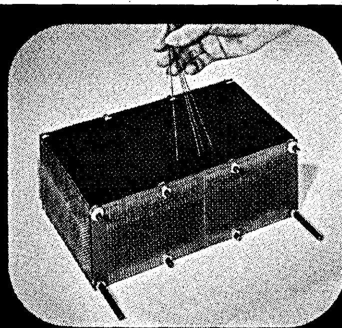
Agreement in principle has been reached for the acquisition of Forms Inc., Willow Grove, Pa., by American Bank Stationery Co., Baltimore, Md. The former will be operated as a subsidiary.

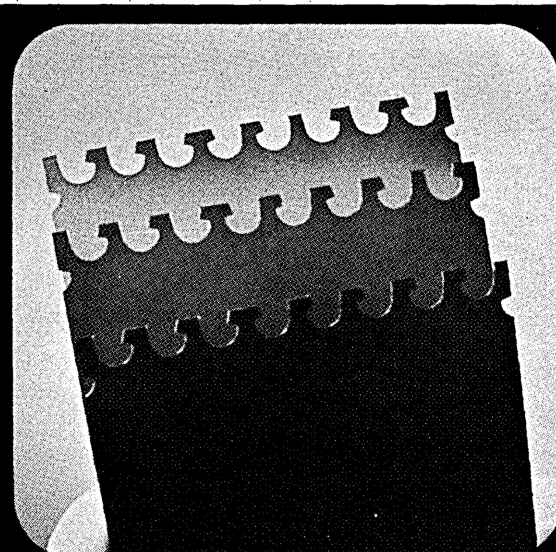
The software firm of Computer Language Research has been formed in Dallas, Texas, by Francis W. Winn. He was formerly director of R&D with Fritz W. Glitsch & Sons Inc., Dallas. First program is RENO, which reportedly solves the problem of number overlapping where a new program is constructed using parts from several existing programs.

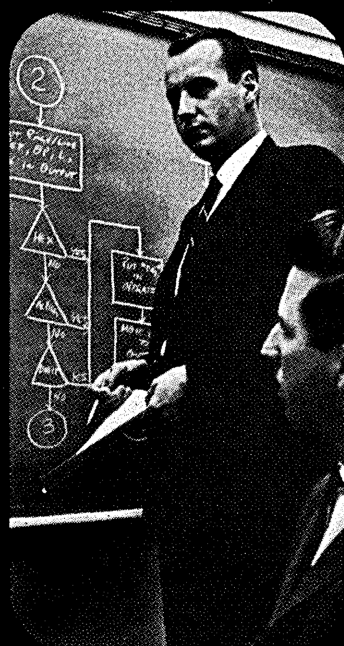
To act as brokers in the sale of excess computer time, the firm of Time Brokers Inc. has been formed in New York City. President is William P. Hegan. The firm will also broker used computers.

The Memory Systems Div. of Indiana General, Keasbey, N.J., has been acquired by United Telecontrol Electronics Inc., Farmingdale, N.J.

Agreement in principle has been reached for the acquisition of Datron Systems Inc., Kingston, N.U., by Data Trends Inc., Parsippany, N.J. Datron makes card readers and punches, I/O adders, others.







MOVE UP

IN DIGITAL SYSTEMS AT NCR, LOS ANGELES

You can build a bigger future in an organization that's moving today. Join the NCR Electronics Division and go to work now creating ideas and hardware for NCR markets in more than 120 countries. You'll share technical challenges with the men responsible for such successes as the NCR 315 EDP System, the CRAM magnetic-card concept in random-access memories, the 420 Optical Journal Reader, and the NCR 315 RMC—the first commercially available system with an all-thin-film main memory. And you'll go as far as your ideas can take you. NCR is moving forward, moving fast. Time now to make your move.

DESIGN AUTOMATION

DESIGN AUTOMATION SUPERVISOR / Requires previous supervisory experience in programming for design automation, good understanding of engineering and hardware problems, BS degree in math, engineering or related field.

DESIGN AUTOMATION PROGRAMMERS / Requires previous experience in programming for design automation, good understanding of engineering and hardware problems, BS degree in math, engineering or related field.

PRODUCT ENGINEERING

POWER SUPPLY DESIGN / Intermediate and senior level positions are available for circuit designers experienced in worst-case design of solid-state power supplies. BS or MS in EE required.

PACKAGING / These positions entail layout and design of packaging for computer systems. Applicants must have previous experience with electronic computers or electromechanical devices. Background in miniaturization utilizing thin films and integrated circuits is desirable. BSEE required.

VALUE ANALYSIS / These intermediate and senior level positions entail organizing and conducting value-analysis projects on company products. Work also involves assisting in locating new products and services, and participation in design and producibility review. Requires BS in engineering and three years' experience with electronic computers or electromechanical devices.

ADVANCED COMPUTER DEVELOPMENT

MECHANISMS DEVELOPMENT / An opening is available for a specialist in analysis and design of complex computer mechanisms. Must have knowledge of applied mechanics and high-level mathematical ability. PhD required.

CIRCUIT DESIGN / Openings are available at all levels for design of advanced integrated-circuit computers. Must have good knowledge of transistors and worst-case circuit design techniques. BS or MS in EE required.

ARRANGE IMMEDIATELY FOR INTERVIEWS DURING IEEE CONVENTION, NYC, MARCH 22-25

For a confidential interview at the IEEE Convention in New York, please send a resume immediately, including training, experience and salary history, to Bill Holloway, Personnel Dept. If time does not permit sending a resume, call the NCR suite between March 22 and 25 at the New York Hilton, 247-4750.

NCR

The National Cash Register Company
ELECTRONICS DIVISION
2806 W. El Segundo Blvd., Hawthorne, Calif.
Telephone: Area Code 213-757-5111

An equal-opportunity employer

CIRCLE 91 ON READER CARD

Continued from page 23

the need for a massive integrated management data system to keep tabs on the many programs it now funds and/or administers. These include the Job Corps, the Community Action Program, VISTA (Domestic Peace Corps), and training and educational projects administered by the departments of Labor, Commerce and HEW.

The postulated computer, to be located in Washington and eventually linked to OEO's regional offices by transmission lines, will constitute in effect a huge "information bank" on these programs and the people they are intended to help. Selection of the equipment is expected to be made within 30-60 days.

BROOKS BILL STILL NOT DEAD

Rep. Jack Brooks of Texas has re-introduced a slightly revised version of HR 5171, the bill first proposed in the 88th Congress to provide for government-wide coordination in the procurement and use of ADP systems. HR 5171 expired from slow strangulation in the Senate after having passed the House in mid-1963. Its successor, HR 4845, contains virtually the same language, with the addition of two sections.

The first of these designates the Bureau of Standards as technical consultants to the central coordinating agency to be set up within the General Services Administration. It also provides for the B of S to submit recommendations relating to the establishment of uniform federal standards for dp equipment, techniques and computer languages -- a provision which could have very widespread ramifications.

The second states that the administrator's authority under the bill "shall not be so construed so as to impair or interfere with the determination by agencies and other users of their individual automatic data processing requirements." This language was presumably included to pacify those apprehensive souls who see dangers in vesting too much pomp and power in a GSA computer "czar."

The prospects for 4845's passage in the current session of Congress are considered favorable, or at least better than they were last time, by its advocates, but tricky shoals remain to be navigated. Much may depend upon the outcome of hearings to be conducted by Sen. McClellan's Committee on Government Operations, and upon the contents of the BuBudget's report on government ADP operations.

Griffing, Inc.

CAREER opportunities are available within a broad scope of positions with nationally recognized leaders in Research and Development, Operations Research and Data Processing fields.

FOR EXCEPTIONAL professional and financial advancement possibilities, we invite you to explore the areas most appropriate to your experience and professional objectives.

- BUSINESS PROGRAMMERS
- SYSTEMS APPLICATIONS
- SYSTEMS PROGRAMMERS
- OPERATIONS RESEARCH
- REAL TIME SYSTEMS
- SCIENTIFIC PROGRAMMERS
- DIGITAL/LOGIC DESIGN
- SYSTEMS ANALYSTS
- SOFTWARE SYSTEMS
- MATHEMATICIANS

We have an unexcelled reputation for matching your professional capabilities and goals to the right position, junior, intermediate or senior, and for conducting negotiations on the highest ethical level. All expenses paid by our clients. Courteous, confidential attention to your inquiry. Write:

GRIFFING, INC.

Computer Staffing Consultants

519 Shoreham Bldg. Washington, D.C. (202) RE 7-4754

CIRCLE 87 ON READER CARD

CPC T.M.

OFFERS NATIONWIDE OPPORTUNITIES

for computer professionals who seek:

- GREATER CHALLENGE AND EXPERIENCE
- PROFESSIONAL ADVANCEMENT AND RECOGNITION
- INCREASED COMPENSATION
- ASSOCIATION WITH PROGRESSIVE ORGANIZATIONS

We are currently conducting recruiting and search assignments which offer outstanding opportunities and compensation for commercial, scientific and engineering professionals who are qualified for positions as:

- DIRECTORS/MANAGERS OF DATA PROCESSING
- ASSISTANT MANAGERS OF DATA PROCESSING
- TECHNICAL ASSISTANTS TO THE MANAGER
- MANAGERS OF SYSTEMS ANALYSIS
- LEAD SYSTEMS ANALYSTS
- SENIOR/JUNIOR SYSTEMS ANALYSTS
- MANAGERS OF PROGRAMMING
- SOFTWARE PROGRAMMERS
- LEAD PROGRAMMERS
- SENIOR/JUNIOR PROGRAMMERS
- MANAGERS OF COMPUTER OPERATIONS
- CONSULTANT MANAGERS & CONSULTANTS
- SALES/SYSTEMS REPRESENTATIVES
- SERVICE CENTER MANAGERS & SALESMEN

All of our fees are assumed by our client organizations. All negotiations are handled in complete confidence. Call or write to assure a prompt review of your qualifications.

COMPUTER PERSONNEL CONSULTANTS, INC.

135 South La Salle Street • Suite 1460
Chicago, Illinois 60603 • Phone: 312: 236-0900

CIRCLE 86 ON READER CARD

I'd rather switch than fight!

Are you fighting non-progressive management . . . the lack of professional environment . . . the lack of exposure to diverse, sophisticated applications . . . advancement opportunities . . . or the lack of recognition for a job well done? Or perhaps your battle is insufficient remunerations for your technical competence . . . or a simple case of geographical location? If so, our solution may interest you.

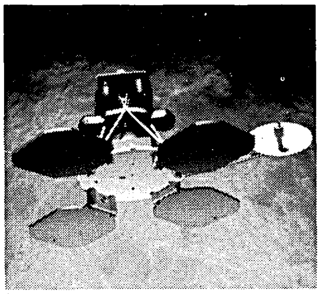
If you are a professional, not a pugilist, seriously considering new employment opportunities, write in confidence, outlining education, experience and objectives to:

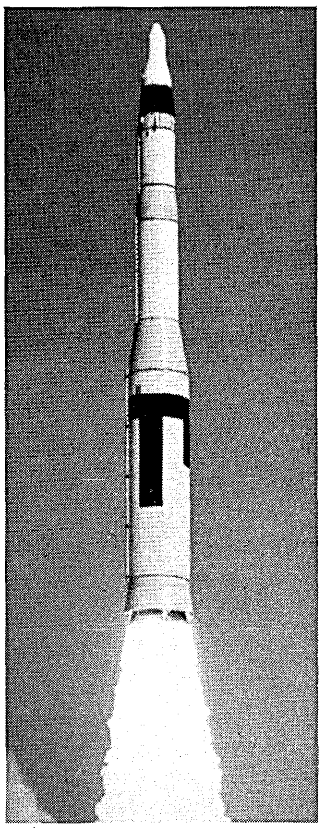
Donald D. Coghlan
edp personnel, inc.
"exclusively data processing"
230 N. Michigan Ave. Suite 205
Chicago, Ill. 60601 Ph. (312) 782-0857

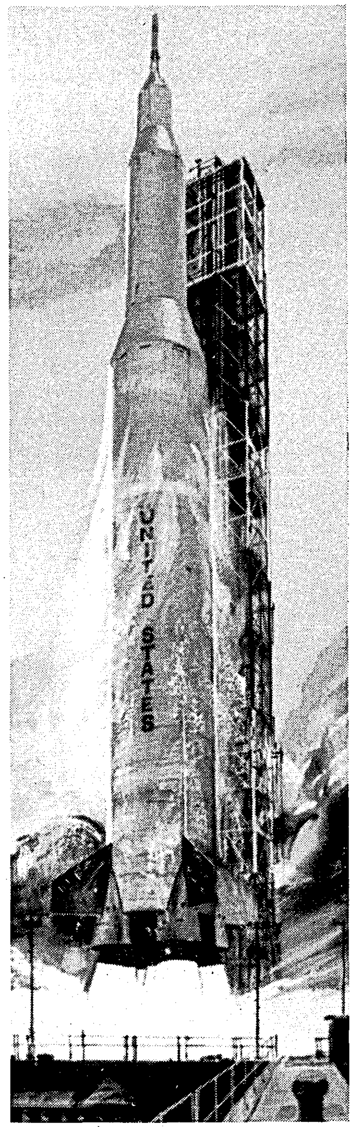
CLIENT COMPANIES ASSUME OUR CHARGES

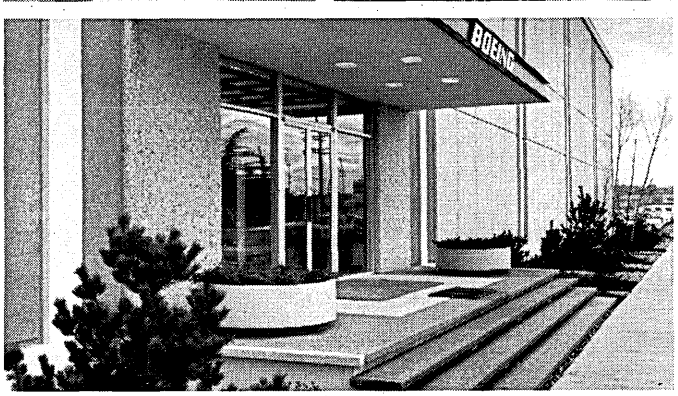
CIRCLE 85 ON READER CARD

Computer Systems Engineering Openings









Computer Center, Seattle

The Boeing Company's Aero-Space Division — major contractor for the NASA Saturn V launch vehicle, USAF Minuteman ICBM and NASA lunar orbiter — has a number of challenging openings for qualified graduate computer systems engineers. Requirements are a B.S., M.S., or Ph.D. in engineering, physics or mathematics, preferably with experience in computer applications, computer systems analysis or related fields.

These assignments are at the Boeing Computer Center in Seattle, one of the largest and most complete industry computer facilities in the free world. Additional positions are available at Huntsville, Ala. and New Orleans, La.

Computer Applications — Develop digital computer systems for calculating trajectories and trajectory optimization, guidance and control, loads and stresses, and temperature distributions.

Design and implement real time and near real time spacecraft performance computer programs. Assignment will involve coordination with other contractors and participation in space flight control.

Analyze and design computer programs and information processing systems to be used in support of operational command and control systems. Experience in the fields of information retrieval or query languages is desirable.

Computer Systems Analysis — Evaluate, develop and implement programming languages and compiler systems for scientific computing systems. Experience in large scale systems, design and development of compilers or major applications programs is desirable.

Develop and implement software systems for small and medium size computers used for on-line data acquisition and processing, military and space systems simulation and crew training simulators.

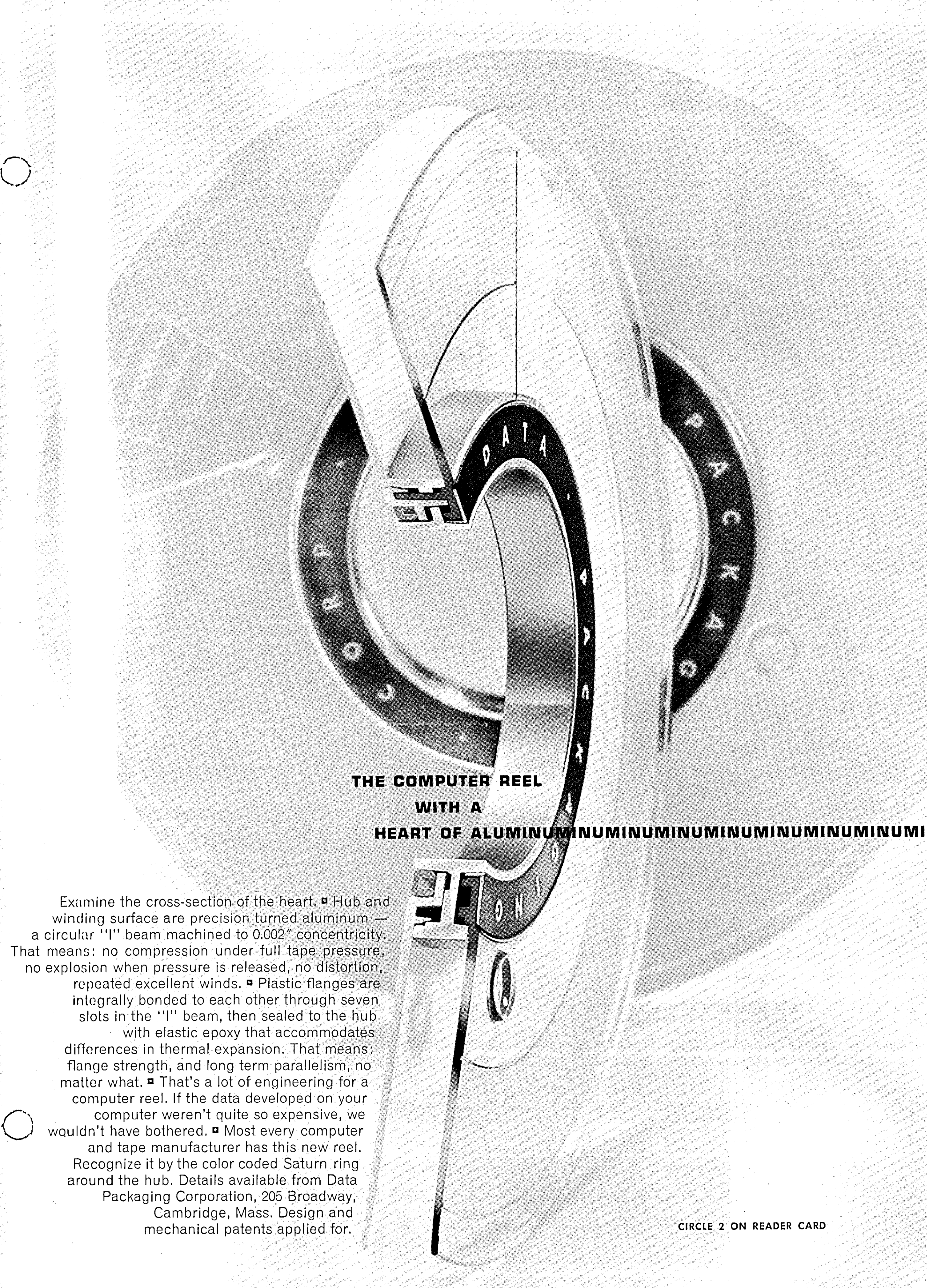
Analyze and define the requirements for digital hardware systems, specify the computer configuration required and evaluate present and proposed systems in a continuing program to advance the Division's computing facilities.

Salaries are competitively commensurate with your experience and educational background. Travel and moving allowances are paid to newly hired personnel. Boeing is an equal opportunity employer.

Send your resume, today, to Mr. Lawrence W. Blakeley, The Boeing Company, Aero-Space Division, P.O. Box 3822 - DAB, Seattle, Washington 98124.

BOEING

AERO-SPACE DIVISION


DATA PACKAGING CORP.
THE COMPUTER REEL
WITH A
HEART OF ALUMINUMINUMINUMINUMINUMINUMINUMINUMINUMINUMI
Examine the cross-section of the heart. ▫ Hub and winding surface are precision turned aluminum — a circular "I" beam machined to 0.002″ concentricity. That means: no compression under full tape pressure, no explosion when pressure is released, no distortion, repeated excellent winds. ▫ Plastic flanges are integrally bonded to each other through seven slots in the "I" beam, then sealed to the hub with elastic epoxy that accommodates differences in thermal expansion. That means: flange strength, and long term parallelism, no matter what. ▫ That's a lot of engineering for a computer reel. If the data developed on your computer weren't quite so expensive, we wouldn't have bothered. ▫ Most every computer and tape manufacturer has this new reel. Recognize it by the color coded Saturn ring around the hub. Details available from Data Packaging Corporation, 205 Broadway, Cambridge, Mass. Design and mechanical patents applied for.
CIRCLE 2 ON READER CARD