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## MORE ACS COMPUTER SURVEY RESULTS

Several survey forms were received too late to be included in the last issue. Here is the data:

1. From Long Island: a decimal, variable-word-length computer, with software similar to that of the IBM 1620. Will make extensive use of read-only storage to hold micro-programs by which regular machine instructions will be implemented. The decimal add and multiply tables will also be stored in read-only memory. Hopes are that the "1620 Model III" will be about 25% faster than the 1620 Mod II and will have its complete instruction repertoire (about 60).

Main memory so far consists of 20K decimal digits (10K X 12 bits), with 10- $\mu$ sec cycle time, using straight IBM circuits, and semiconductors mounted on PC boards of own design.

There are four two-digit data registers and 32 memory address registers (high-speed core).

"My only consolation in attempting to improve on the IBM 1620 is that if my machine doesn't work right, at least I know that I have software that will."

"It should be emphasized that the popular analogy between the amateur computer builder and a radio ham is simply not valid. The complexity of even a small computer outweighs by at least an order of magnitude [ten times] the design effort necessary to construct an amateur transmitter. This is doubly compounded by the fact that: the

nature of basic building blocks is changing at a rapid rate; many commercial designs are proprietary; there does not exist 40 years of computer design history to draw upon."

2. From a Harvard sophomore: 200-Kc machine, with 13-bit words, and instructions two words long. Teletype (Model 19) input/output includes paper tape. Memory is Honeywell TC-M30, 8K words. Add speed 20  $\mu$ sec. Six registers.

Built with Motorola 700P series of ICs, and npn silicon transistors from IBM SMS boards.

"Although there are well over 150 instructions, only around 16 are basic. The others come about as follows:

a) Each basic instruction may use a literal operand, or an indirect operand; e.g., ADD1 50 means add the contents of address 50 to the AC, whereas ADD2 50 means add the number itself.

b) Each basic instruction has 5 conditional variations. For example, in addition to the conventional CLA, we have

CLA on AC = 0  
CLA on AC less than 0  
CLA on AC greater than 0  
CLA on overflow  
CLA on least order bit of AC.

These are, of course, the conventional transfer conditions. I found that they could be implemented for the entire instruction set with almost no additional hardware: three bits of the OP code, which comprises 13

bits, are devoted just for this purpose. Just before the execution of any instruction, the control checks whether or not the condition is satisfied; if not, the instruction is skipped. (This is one of the advantages of a long op code: certain bits may be devoted to specific functions.)"

"Here are some ideas I found useful in my design. Firstly, if core is used, one can kill two birds with one stone by using the selection matrix decoder as the instruction interpretation decoder; if the memory selection decoder were for a 4K (12 x 12) memory plane, then one 12-bit decoder could be used to hold the op code, while the other could generate the timing signals."

"The scheme of making every instruction conditional extends the effective instruction set, and is cheap to implement. Conditional instructions make the set much more powerful."

"The cheapest SMS cards are sold by Brooks Radio in NYC (Brooks Radio & TV Corp., 487 Columbus Ave., New York, N.Y. 10024). They sell at 100 cards for \$10. There are an average of 4 transistors per card, in addition to other goodies."

"Someone should design parallel-serial and vice-versa converters for TTY from integrated circuits; that's one thing a goodly portion of ACS members could use. The converters could be standardized to the point where the ACS could manufacture pre-drilled PC boards."

3. From California: another 200-Kc machine, but with 36-bit words, and instruction lengths the same as the IBM 7090. Input/output: Teletype, paper and magnetic tape. Also X-Y recorder for output.

Memory is 3D core, 32K. Add speed

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is less than 5  $\mu$ sec. Over 100 instructions.

"The majority of the logic will be core-diode, which is slow in some respects, but has great flexibility, reliability and power savings."

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## DO-IT-YOURSELF PROBLEMS

A one-page item on the advantage of buying digital modules instead of building them appears on page 42 of the April EEE. It points out some dandy little problems, including:

1. After final assembly, noise is found in the back-panel wiring and the noise amplitude is greater than the noise rejection of the circuitry.
2. Power-supply specs prove inadequate.
3. Signal reflections appear on back-panel wiring and intercabinet cabling. Unplanned signal delays violate timing requirements.
4. Logic-output current drives are too low to charge and discharge parasitic capacitances fast enough to meet clock-speed requirements. When fan-outs are reduced to compensate for charge and discharge times, the number of logic circuits must be increased, necessitating redesign.

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## COMPUTER HARDWARE

### IC Breadboard

Cambion has announced an IC breadboard for 16, 32 or 64 of the 14-lead DIP ICs. Although too expensive for amateur use, it can be adapted by anyone with enough patience to set 14 small eyelets for each IC, plus 14 larger eyelets just outside the smaller ones, and connected to them, for jumpers.

For a look-see at the pattern, see page 112 of the March EEE.

### 1024-Bit Memory on a Chip

A 1024-bit MOS read-only memory is now available from Philco-Ford's Microelectronics division, according to Electronics (Feb. 19, page 45). The memory array consists of 128 eight-bit words on a chip, on which is also the decoding circuitry, using 216 more MOS transistors.

Once a customer has paid the initial \$750 tooling charge for the coating and etching required for his particular interconnection needs, the chip will be available to anyone for the chip price alone, which will be about \$70 in small quantities, and \$50 in larger quantities.

A 2048-bit memory is in the works. The read-only memory has applications in subroutine storage, and table-lookup operations such as sine and code conversion.

### Adder on A Chip

An article by this title, subtitled "LSI helps reduce cost of small machine," appeared in the March 18 Electronics (pp 119-124).

This 8-bit integrated MOS arithmetic, measuring 86 by 116 mils and containing 200 gates, will be introduced by Fairchild Semiconductor as the 3800. On one chip is an input register, an adder-subtractor, accumulator register, and output buffer. No price given.

### Electronic Pocket Calculator

Hayakawa Electric hopes to introduce an 8-digit IC pocket calculator this fall. It will use miniature Digitron readout tubes, circuits with about 250 elements on a chip, total of 8 to 10 chips, and cost about \$280, Electronics says.

### Photo-Transistor

Fred Strother calls our attention to the General Electric L14B photo-transistor, which GE calls a planar silicon photo-darlington amplifier, as well as an Economy Light Detector.

Priced at 97¢ in lots of 100-199, this high-sensitivity device is described by GE as having applications in card and tape readers. Fred says it makes a fine interface.

For many applications, only the collector and emitter leads are used. A base lead is provided to control sensitivity and the gain of the device. The L14B is packaged in clear epoxy encapsulant.

### Packaging Hardware

Wade White sent a catalog of packaging hardware (Bulletin 10000B) sent from:

Plug-In Instruments, Inc.  
1416 Lebanon Road  
Nashville, Tenn. 37210

An interesting variety of hardware. Plug-in cans with transistor circuit blanks, from \$3.45 up. Two dozen models of plug-in blanks, such as a board that will accommodate six 14-pin flat-packs, for \$2.60 without drilled holes, or \$6.55 with. Several types of card-mounting files, and various other hardware.

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### PUBLICATIONS

#### Digital Design Aid

A method of designing the detailed logic of a digital system is given in "Flow Chart Methods of Logic Design" in the February Computer Design (pp 72-75). It shows how to make a flow chart from the basic considerations, then develop the

chart up to the point where it can be used for deriving equations for the logic.

The author says this method helps keep track of all the different sequences of operation, and minimizes redundancy.

### Understanding Logic

"Electronic Digital Components and Circuits," by R.K. Richards (D. Van Nostrand Co., 526 pp, \$15), explains how various components and circuits work. It gives the advantages and disadvantages of the major designs, provides alternate approaches, and compares the merits of diodes, transistors, tunnel diodes and super-conducting devices. Among the topics included are speedup capacitors, DTL components and functions, core structures and accessing methods, film-storage units, magnetic drums, discs, tapes, cards, and various switching methods.

### Binary Logarithms

In the March 1968 issue of the British Computer Bulletin (pp 282-285) is an article on "Some Applications of Controlled Shift Registers." No circuits; theory only.

The author shows how to control shift registers in such a way that they perform multiplication, division, and code conversion. The process involves various combinations of shifting, adding (or subtracting) and shifting, and shifting without adding (or subtracting).

One paragraph about binary-logarithm converters may be of interest to several who have inquired about the process involved:

"The use of logarithmic computation eases the extraction of powers and roots and simplifies multiplication and division. Mitchell has shown

that the logarithms to the base 2 of binary integers may be derived approximately by a simple shift register and a counter. This can be extended to deal with non-integral numbers as shown in the following example:

Calculate  $\log_2 13.625$

Binary  $13.625 = 1101.101$

Count number of digits to the left of binary point commencing from zero and write this as the characteristic. Ignore most significant bit of original number and place remainder of number to right of binary point as the mantissa. Thus  $\log_2 1101.101 = 11.101101$ .

This result is an approximation and techniques are available to reduce the error involved."

The reference to Mitchell is his article, "Computer multiplication and division using binary logarithms," in the August 1962 IEEE Computer Transactions, page 512.

### A Computer in the Basement?

A four-page article with this title appeared in the April 1968 issue of Popular Mechanics (pp 77-79, 209, 229), describing the ECHO computer built by ACS member Jim Sutherland, and described in Newsletter 8 (page 4).

ECHO IV will be used for family bookkeeping, by keeping track of monthly budgets and expenditures, so that when tax time comes, deductions can be identified and grouped to simplify filling out the tax forms.

ECHO will also be programmed to keep track of real time, so that events can be scheduled up to a year ahead, with one-second accuracy. It could be used in the kitchen, to increase or decrease proportions for recipes, and print out shopping lists. Jim plans to modify the kitchen cabinets to allow ECHO to take inventory automatically.

ECHO has been connected to the TV set for eventually regulating the schedule of watching. It may also be used to control the house temperature, by first querying the weather instruments outside, then adjusting temperature and humidity inside the house.

What Will You Do With Your Computer?

Even if some of the planned uses for ECHO don't prove practical, Jim Sutherland has obviously thought a good deal about what to do with a computer once it's built.

And that's a question that a great many of us may not have given much thought to. What kind of problems will we run on our machines? Matrix inversion? Hardly. But just what? One non-member is using his for stock-market analysis. It may turn out that finding uses for our computers will be even harder than building them. Unless you've got your own business, there isn't much you'll want to program in the way of business applications. And you'd soon get tired of most of the scientific types of programs, if you have no real use for the output.

If you've done any hard thinking about what to do with your computer when it's finished, let's hear about it.

HOOKUP WIRE

The telephone company uses a multi-conductor cable that is perfect for amateur computer wiring. The next time telephones are being installed where you work, try to get some of the short lengths of cable that are thrown away. Some of these "short" pieces are 20 feet long, and not worth splicing.

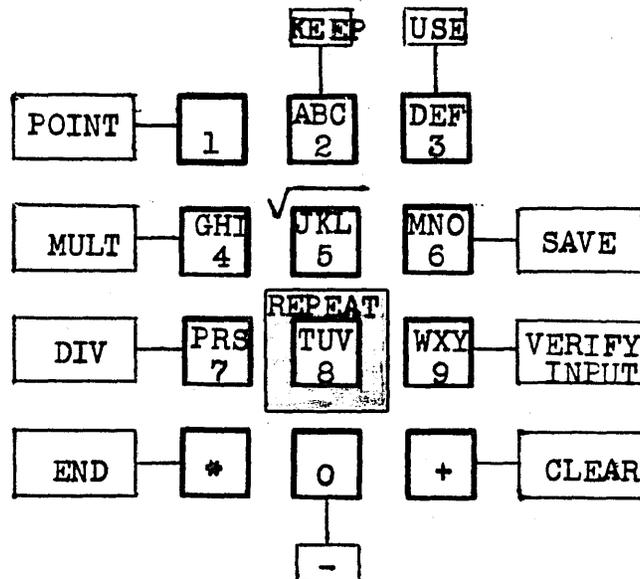
Some cables contain only a dozen of these solid 18-gage wires, in twisted pairs; some cables contain

30 or 40. In some cables, the wire insulation is solid-color, with the same 10 colors as used for resistor coding. Other cables contain parti-colored wires, which have a body of one color, and stripes of another, every inch or so, in several dozen combinations.

MINIMUM KEYBOARD

For those of you interested in a minimum input keyboard, IBM has an "Experimental Home Calculator" that uses a 12-button telephone attachment. At present, the pushbutton attachment is connected to the telephones of six Brooklyn high-school students, who do their math homework on an IBM 1710 computer 50 miles away, in Yorktown Heights, N.Y. The computer's output is voice answerback, from a magnetic-drum prerecorded vocabulary. If a mistake is made in entering the problem, the computer's voice tells the student he's made an error.

There are several versions of the touch-tone coding; here is one:



The mathematical operations are programmed by:

ADD      press + only

The Amateur Computer Society is open to all who are interested in building and operating a digital computer that can at least perform automatic multiplication and division, or is of a comparable complexity.

For membership in the ACS, and a subscription of at least eight issues of the Newsletter, send \$3 (or a check) to:

Stephen B. Gray  
Amateur Computer Society  
260 Noroton Avenue  
Darien, Conn. 06820

The Newsletter will appear about every eight weeks.

SUB	press 0	and *
MULT	4	and *
DIV	7	and *
SQ RT	5	and *
END MESSAGE	*	and *
MINUS	0	and *
CLEAR	+	and **

For example, to multiply 2 times 8, press 2 4 \* 8 \* \*, and listen for the answer.

Pressing VERIFY INPUT will make the computer repeat the entry, by voice answerback.

## PLASTICS

There are times when you may want to mount lamps a certain way, such as in a minimum-space decade, and the kind of mounting hardware you want is too expensive, or it just doesn't exist. One solution is to make the lamp-holder yourself, using some of the modern plastics that cure at room temperature.

First, make a model of the holder, from plastic or wood. Then make a mold of it, using something like General Electric's RTV-41 silicone plastic. This is recommended, as it has a "high modulus of elasticity," meaning that it's easy to separate from the original model.

Next best is GE RTV-30, with a lower modulus. At one time you could get samples of both of these silicones with a letterhead. Perhaps you still can, from the GE Silicone Products Dept., Waterford, N.Y.

Several plastics are available for pouring into the mold, to make the holder. A good one is Shell Epon Resin 828, which is mixed with Epon Curing Agent V-40, with a minimum of trouble. The result is an amber-colored plastic. For minimum light loss, the plastic can be colored black by mixing in some carbon black before pouring; other colors could also be used. You might try your local Shell plastics dealer for a sample, by using a company letterhead.

Pour-your-own plastics might also be a cheap way to make segmented readouts, either 7-segment for numeric, or up to 14 or more segments for alphanumeric. You could pour black plastic around long Lucite strips arranged in the segmented pattern, then cut the finished bar into slices and make another mold for a lamp holder that channels the light to the individual segments. Or you could mold the entire segmented display as one piece, Lucite strips and lamp-holder all together.

## HELP!

Your assistance is needed to help fill these pages. Please send me:

1. Answers to any of the problems in the early Newsletters.
2. Details of your computer, including problems and solutions.
3. Ideas about what you intend doing with your computer when it's finished. What programs are you going to run?

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