One of the transistor's latest descendants is the Bell System's 30,000-element MAC-4 "computer-on-a-chip." It's another in a long line of microelectronic developments that have come from Bell Laboratories.

The MAC-4 is so efficient that a program written on it takes 25 percent less storage space than that required by most other microcomputers. Its assembler language, C, also developed at Bell Labs, has features that make MAC-4 easier to program, debug and maintain. And the MAC-4 can handle anything from nibbles to bytes to words with its 4-, 8-, 12- and 16-bit operations capacity.

Like other one-chip computers, the MAC-4 has sufficient memory to support its varied tasks—3000 nibbles of read-only memory and 200 nibbles of random access memory coupled to 34 input/output ports.

Fabricated with the latest CMOS technology, the MAC-4 needs little power. Thus it is well matched to a variety of telecommunications applications.

It started with the transistor

MAC-4 is just one current example of the many micro-electronic devices to come from Bell Labs since we started the solid-state revolution with the invention of the transistor in 1947.

Over the past three decades, our advances in materials, processing, and devices have been vital to solid-state technology. These include:

- The Junction Transistor
- Crystal Pulling
- Zone Refining
- Field-Effect Transistor
- Diffusion
- Solar Cell
- Oxide Masking
- Thermocompression Bonding
- Photolithography
- Epitaxial Film Process
- Magnetic Bubble Memory
- Charge-Coupled Device
- Semiconductor Heterostructure Laser Used in Lightwave Communications
- Electron-Beam Exposure System

Today and tomorrow

Today, we continue to make important contributions to solid-state technology. For example, we've developed a rugged 65,536-bit RAM that can tolerate processing faults. Corrections can be made on the chip itself, so we can get more usable chips out of each manufacturing batch—and thus lower unit costs.

In materials processing, we've developed a technique for precisely controlling the growth of successive atomic layers of single crystal materials. This "molecular beam epitaxy" process is finding increasing use within Bell Labs and elsewhere in the electronics industry. We've used it to fabricate a device that permits us to double the speed of electrons by channeling them into crystal layers where they meet less resistance.

Other advances, in X-ray lithography and new resist materials, for example, promise to help place more elements on microelectronic devices and thus enhance their ability to perform important tasks.

As the solid-state revolution continues, these and other developments from Bell Labs will play an important part in it. What's important to us is the promise these advances offer for new telecommunications products and services. Like the transistor, MAC-4 and its solid-state relatives will find more and more applications in the nationwide telecommunications network.

For further information, or to inquire about employment opportunities, write: Bell Laboratories, Room 3C-303, 600 Mountain Avenue, Murray Hill, N.J. 07974.

Bell Laboratories

From Science: Service
Would you pay twice as much for the family protection you need when you could get the same coverage at half the cost?

Not likely, if you realized you were eligible for low-cost individual life insurance from Teachers Insurance and Annuity Association! The brief cost comparison chart below illustrates why it pays to shop for life insurance, and the magnitude of your TIAA cost advantage. Check to see how much less owners of TIAA 5-Year Renewable Term policies pay than persons similarly insured by the country's biggest insurers—companies that sell one third of the policies purchased by Americans each year.

### COMPARISON OF TIAA WITH THE 10 LARGEST U.S. INSURANCE COMPANIES

#### 20 Year Average Annual Costs* for $50,000 5-Year Renewable Term Policies

<table>
<thead>
<tr>
<th>Company</th>
<th>Policies Issued to Men</th>
<th>Policies Issued to Women</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Aged 25</td>
<td>Aged 35</td>
</tr>
<tr>
<td><strong>TIAA</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aetna Life</td>
<td>$91.00</td>
<td>$189.50</td>
</tr>
<tr>
<td>Conn. General</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equitable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>John Hancock</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mass. Mutual</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metropolitan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>New York Life</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Northwestern Mutual</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prudential</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Travelers</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mean Cost, Largest Companies</strong></td>
<td>$175.22</td>
<td>$299.83</td>
</tr>
<tr>
<td>% Greater than TIAA</td>
<td>93%</td>
<td>58%</td>
</tr>
</tbody>
</table>

*Based on published 1979 premium rates and dividend scales (dividends not guaranteed), adjusted for interest (5%) to recognize the time value of money. (Sources: Diamond Life Bulletins, Best's Fiduciary Compend)

The figures speak for themselves: For example, the mean cost for $50,000 5-Year Renewable Term policies issued by these insurers to men aged 35 is 58% higher than the same coverage with TIAA; and for 35 year old women it's 99% higher. Whether you choose 5-Year Renewable Term or some other plan, TIAA insurance is the best buy for you because you are a member of the academic and research community. To learn how you can give your family the most new protection for the least money just get in touch with TIAA!

### Mail Coupon or Call Collect
For more information, just return the coupon at right or, for immediate assistance, call the TIAA Life Insurance Advisory Center—collect—(212) 490-9000. An insurance counselor will discuss your personal life insurance needs, help you select the plan and amount of coverage that's right for you and your family, and send details for you to study at home. TIAA employs no sales agents and no one will call upon you as a result of your inquiry.

### Eligibility
To apply for life insurance from Teachers Insurance and Annuity Association is limited to employees of colleges, universities, private schools and certain other nonprofit educational or research institutions. The employee's spouse is also eligible provided more than half of the combined earned income of husband and wife is from a qualifying institution.

---

*Established as a nonprofit service organization by the Carnegie Foundation for the Advancement of Teaching*
LOOK... NO MENISCUS READING PROBLEMS!

The Metrohm Automatic Buret. The next best thing to an automatic titrator, at a fraction of the cost.

Had enough of inaccurate meniscus readings, manual refilling of burets and tedious stopcock manipulation? Can't afford a fully-automatic titrator? Then consider the next best thing... the very affordable, very accurate and very convenient Metrohm Automatic Buret.

Equipped with interchangeable 'snap-in' buret units (1, 5, 10, 20 and 50ml), the Metrohm Automatic Buret will perform continuous, non-stop titrations even with frequent changes of titrant. Instead of a meniscus, volume indication is provided by a clear digital display which gives direct readings to 0.01ml or 0.001ml (depending on buret size) without interpolation.

The Metrohm Automatic Buret makes possible faster, more accurate titrations and is the answer for laboratories with limited equipment budgets. It may be coupled to ancillary systems for automatic determinations of potentiometric or colorimetric end points.

For informative literature, write: Metrohm Division, Brinkmann Instruments, Inc., Cantiague Road, Westbury, N.Y. 11590. In Canada: Brinkmann Instruments (Canada), Ltd.

Metrohm Automatic Buret
NOW YOU CAN PUMP NANOLITERS!
W-P Instruments' New Model 1400 Nanoliter Pump
A small lightweight pump which is brought directly to the site at which fluids are to be delivered or aspirated. Variable rates, as low as 3 nl/min. Fluid delivery is effected by a glass micropipette, with tip diameters down to 1 micron. Electrolytes, drugs, dyes and other fluids may be displaced.

USES:
- Microperfusion
- Titration
- Bio-Assay
- Pharmacology

For more information contact:
P.O. Box 3110
New Haven, CT 06515
(203) 389-2183

Circle No. 369 on Readers' Service Card

NEW!
Estradiol-[^125]I
FROM NEN!

Straightforward gamma counting,
more sensitive than \(^3\)H
Highly specific for the estrogen receptor
Low non-specific binding

Iodo-3,17\(\beta\)-estradiol, 16\(\alpha\)\[^{125}\text{I}\]
~200Ci/mmol NEX-144L
>1000Ci/mmol NEX-144
Ethanol, in dry ice
10\(\mu\)Ci 2x10\(\mu\)Ci 50\(\mu\)Ci 2x50\(\mu\)Ci

Not for use in humans or clinical diagnosis.

New England Nuclear
549 Albany Street, Boston, Mass. 02118
Call toll-free: 800-225-1572
(In Massachusetts and International: 617-482-9595)
NEN Chemicals GmbH, Dreieich, W. Germany; NEN Canada Ltd., Lachine, Quebec

Circle No. 365 on Readers' Service Card

THIS IS AN ESSENTIAL RESEARCH TOOL . . .

Life sciences demand the best research tools.

Biological Abstracts/RRM (Reports, Reviews and Meetings) will be BIOSIS’ 1980 companion to Biological Abstracts, covering 125,000 Proceedings, Meetings, Symposia, Bibliographies, Review Journals, Monographs and much more. BA/RRM will provide the following features in addition to a full bibliographic citation:

- Arrangement of items by BA subject classification
- A "Content Summary" that displays the subject content of these items, including taxonomic names
- Author’s address
- Language of the original document

For more information on this invaluable reference tool, contact our User Services Department.

2100 Arch Street • Philadelphia, Pa. 19103 U.S.A.

Circle No. 368 on Readers' Service Card

Circle No. 366 on Readers' Service Card

21 DECEMBER 1979

1431