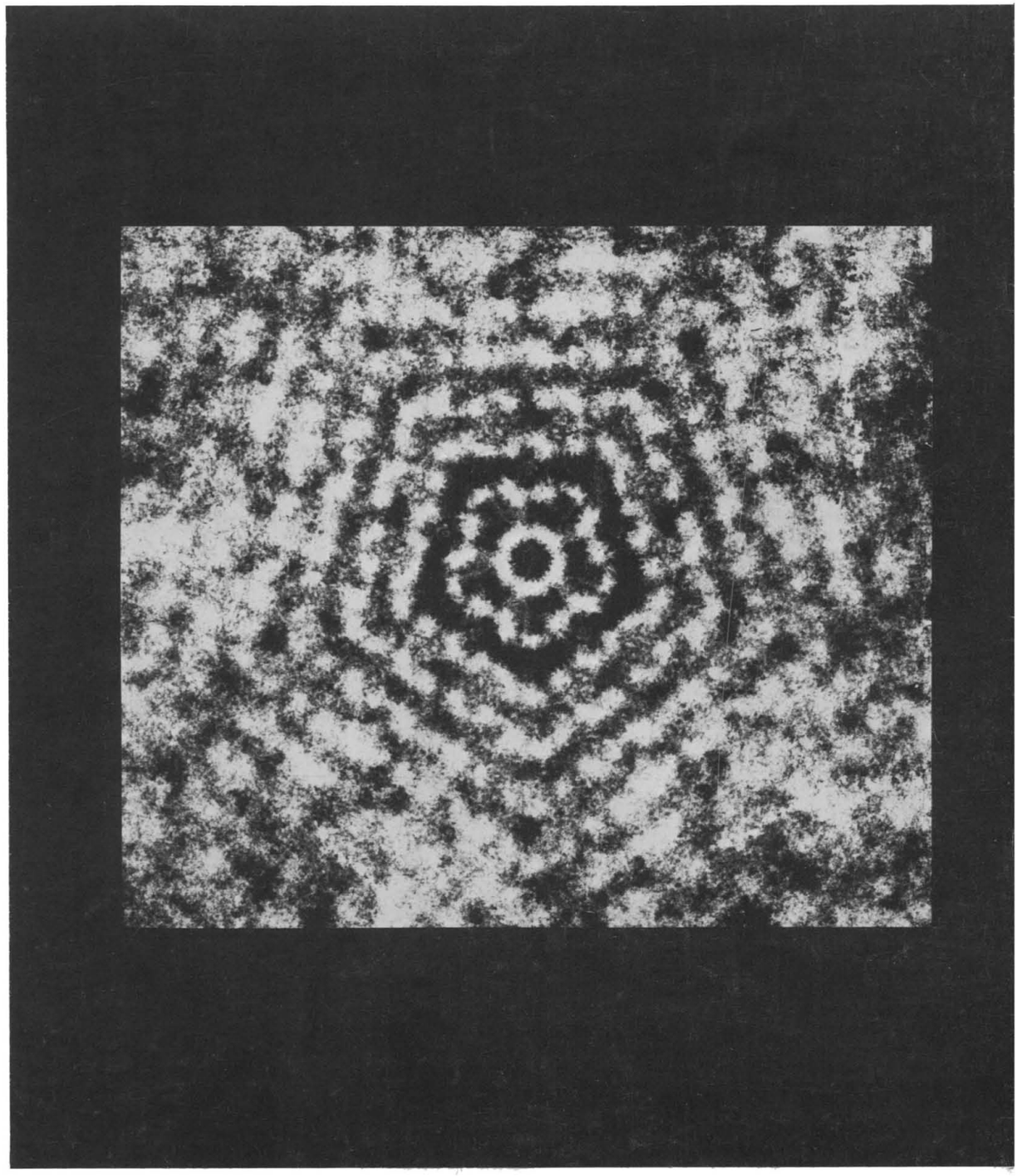
# SCIENCE

3 June 1966

Vol. 152, No. 3727

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

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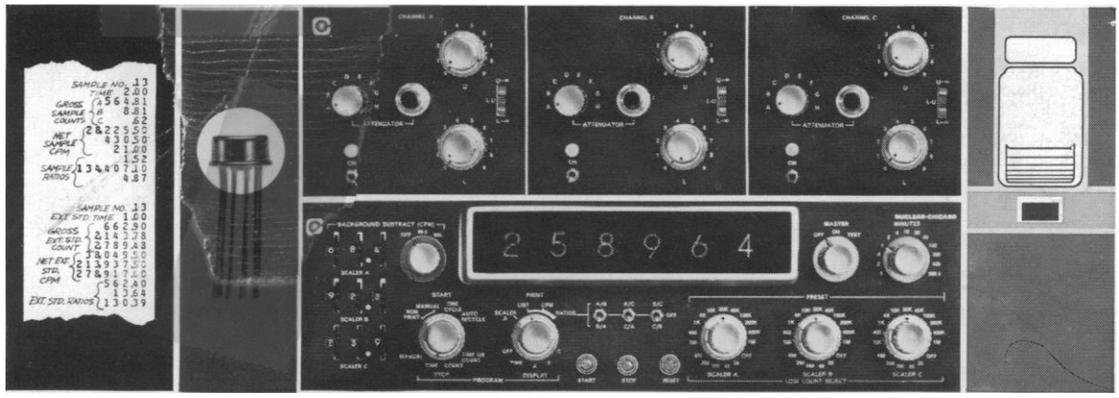

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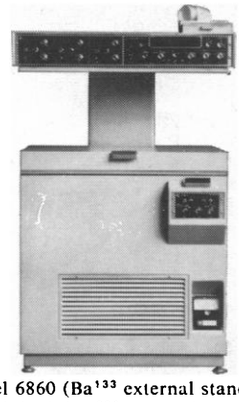

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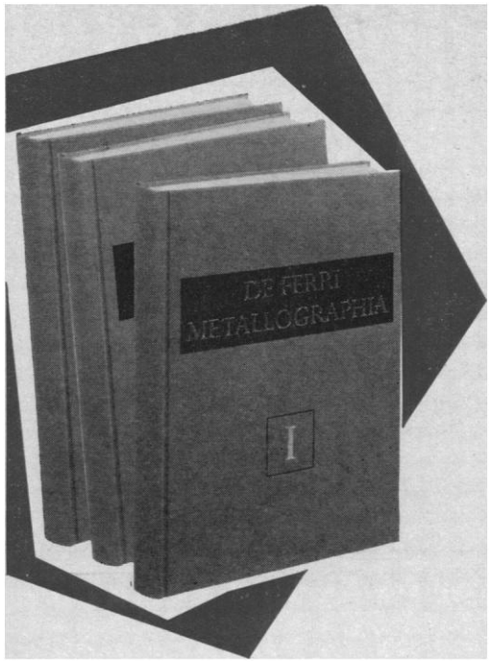


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# SCIENCE





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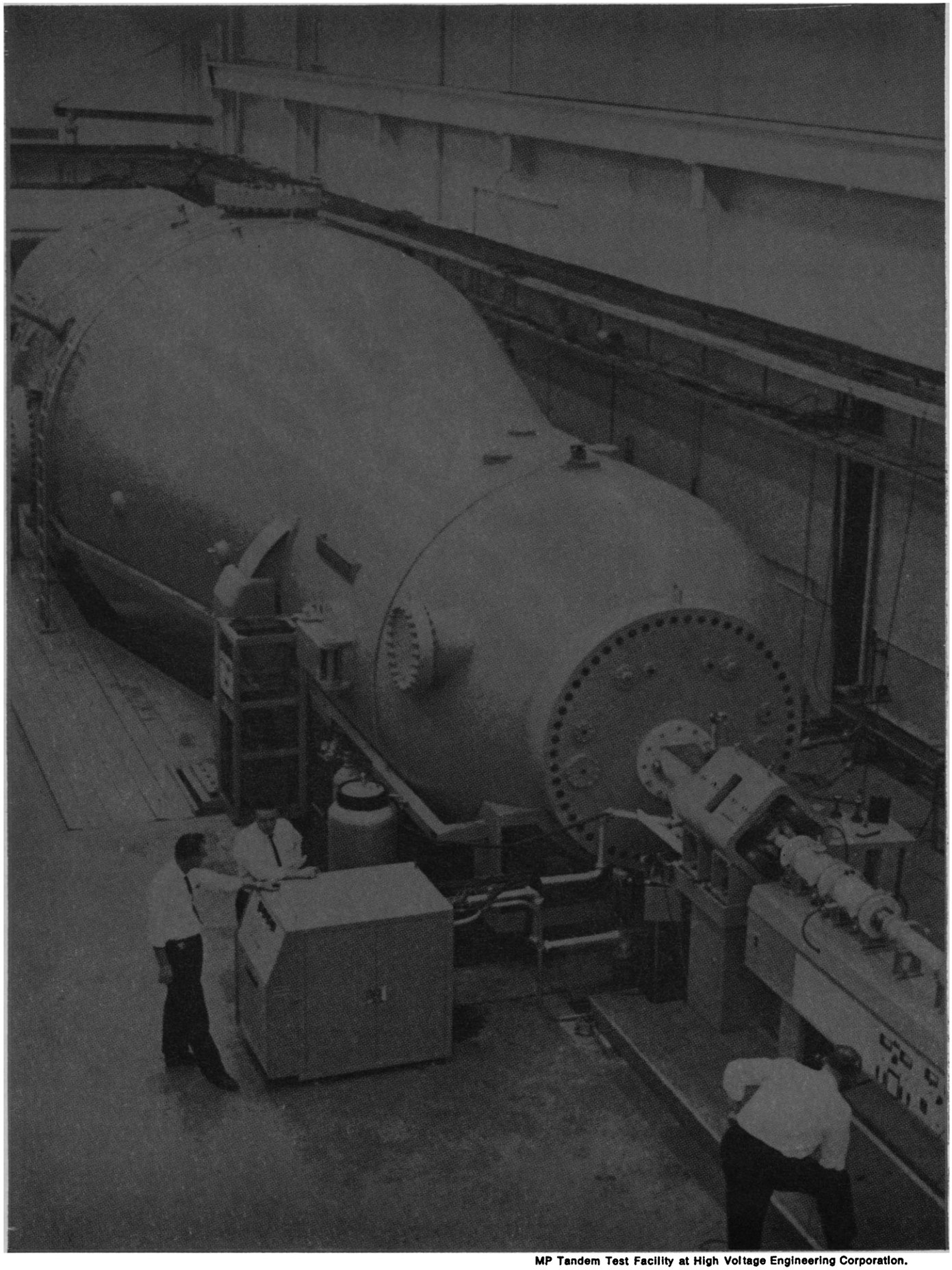
# AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE





**COVER**

Packing of virus particles about a unique fivefold axis was observed with the electron microscope. The symmetry of the five successive views, obtained from rotating the original through multiples of 72 degrees about the center of the pentagonal group, is emphasized by photographic superposition (about × 500,000). See page 1381. [Gregory Milman, Harvard Univeristy; Betty G. Uzman, Anja Mitchell, and Robert Langridge, Children's Cancer Research Foundation and Harvard Medical School]



MP Tandem Test Facility at High Voltage Engineering Corporation.

## New opportunity for heavy element research:

# Uranium ions accelerated to 200 MeV by HVEC Emperor Tandem

Uranium ions have been accelerated to record-high energies exceeding 200 MeV during heavy-ion performance tests of the first completely assembled Model MP "Emperor" Tandem. The tests were carried out at HVEC's MP Tandem Test Facility at Burlington.

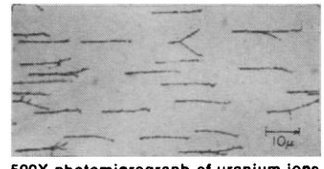
Calculations indicate that uranium ions at the energies achieved can create coulomb excitation in the nucleus of stationary uranium atoms. This is the first instance of uranium ion acceleration to energy levels sufficiently high for bombardment and examination of the nuclei of even the heaviest naturally occurring elements.

The MP heavy-ion performance tests were initial. We believe that further optimization of the system will allow demonstration of the machine's capability to accelerate uranium ion beams to energies of several hundred MeV . . . and the possibility of causing other interactions, including nuclear fission.

Such significant achievements are opening up entirely new fields of heavy element research . . . and offer the promising prospect that, with the Tandem Van de Graaff, nuclear scientists will soon be free to choose *any* specific pair of nuclei from among the multitude of possible pairs for controlled collisions and precise experimental examination.

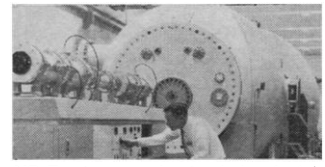
Seven MP Tandems have already been ordered from HVEC. Five are now being installed. They will join the more than 30 Tandem Van de Graaffs now engaged in important research throughout the world. This wide acceptance of the Tandem as a basic tool for nuclear research is due to its inherent precision, versatility and ease of particle choice for nuclear experimentation. The MP Tandem is the most recent embodiment of the Tandem concept. It offers, for the first time, a proven and comprehensive approach to heavy element research.

A new booklet describing the MP heavy-ion performance tests contains a number of very interesting photomicrographs of recorded particle tracks. For a free copy and detailed information about HVEC particle accelerator systems and components, write to our offices at Burlington, Massachusetts or Amersfoort, The Netherlands.




500X photomicrograph of uranium ions accelerated by MP Tandem striking photographic emulsion plate at 10 degree incidence. Note frequent collisions with atomic nuclei in emulsion.

MP Tandem accelerator being installed at Yale University has accelerated proton beams of 20 microamperes in the range from 10 to over 20 MeV. Acceptance tests are now in progress.



MP Tandem accelerator being installed at Atomic Energy of Canada Ltd. Chalk River Laboratories achieved 15 MV terminal voltage during initial test of the electrostatic structure.

HIGH VOLTAGE ENGINEERING

# Kodak reports on:

**an interesting position for a supplier of light-sensitive materials . . . a bargain for atomic absorption spectroscopy . . . betterment for all without a revolution**

## Explain it to the fellows, Tom

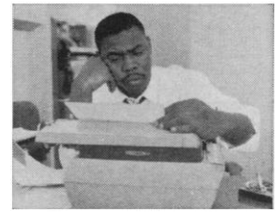
Ask a lawyer about holographs. He will tell you that in Scotland, Quebec, Louisiana, and in most of continental Europe a holograph is valid without being attested by witnesses, being a document wholly in the handwriting of the maker. If he is a patent lawyer, however, he may only groan and launch into bitter complaint about overwork and a hopelessly lengthening backlog. This indicates that he understands all too well the new meaning of holography because he is working for one of the hundreds of organizations where implausible but nonetheless feasible ideas are popping fast on how to use the new lensless photography, or laser photography, or wavefront reconstruction, or whatever it's called in the latest article where some reporter strives valiantly to explain holograms.

(Yes, holography does permit making perfectly respectable photographs through ground glass. Yes, stereoscopic photographs. Stereoscopic singles, unpaired. Why not?)

As one might guess, we are finding the mail and the switchboard loaded with oh-by-the-way-type questions about materials on which to make holograms. Nobody can be blamed for wanting to sound casual about the subject. Maybe it *will* all blow over. Maybe nothing will come of it. Too bad so to conclude and then turn out to have been wrong.

Which leaves us, as a leading supplier of light-sensitive materials, in an interesting position. To advertise that we offer the perfect material for holography would seem timely but unfortunately would be sheer nonsense. Holography represents such an entirely different viewpoint on the nature of photography—such an entirely different collection of viewpoints, in fact—that even defining what you want the photographic material to do may be half or three-quarters of the battle. And useless to the next holographer on the phone.

*If it would help to try talking it out with someone who understands photographic materials, try 716-325-2000, extension 2720, which connects you with Eastman Kodak Company, Special Applications, Rochester, N.Y. 14650. We begin each conversation with a clean sheet of the note pad and a certain type of carefully cultivated memory loss. Meanwhile, pity poor Tom Freeman. He has a tough assignment. Here he is trying to write an article for our men on the road that will tell them what to reply when a customer asks about holography.*



## A revelation to the keepers of the flame

Devotees of the triumphantly booming cult of atomic absorption spectroscopy need *1-Pyrrolidinecarbodithioic Acid Ammonium Salt* but call it "APDC," or "APDTC," or even spell it out as ammonium pyrrolidine dithiocarbamate. Our well-meaning efforts at consistency of nomenclature for all EASTMAN Organic Chemicals seem to have succeeded in concealing that as EASTMAN 9279 it is available in superior quality at a bargain price of $8.95 for 25 grams or $32.30 for 100 grams from Distillation Products Industries, Rochester, N. Y. 14603 (Division of Eastman Kodak Company). It is reported to extract nearly 30 different metals from dilute aqueous into more concentrated ketonic solution for feeding into the flames now being widely lit in the name of analytical economy.

*Since there is a minimum order of $10, you might check for other* EASTMAN *Organic Chemicals that need replenishing.*

*Prices subject to change without notice.*

## Open-ended color

Your friendly aerial photographer wants to serve you. Your friendly aerial photographer could be a great corporate enterprise operating all around the world, or he could be an earnest chap with a government-surplus aerial camera and a devoted wife willing to operate the 1945-model manual-rewind processing tank and to peel a few potatoes for dinner while the hypo works. There are also some mighty reliable aerial photographic firms standing between these two in scale. Yours is the choice.

The chances are that you will get much more for your money from the vast information capacity of color than from the tones of grey that the best black-and-white photography can deliver. The aerial photographer, however, hesitates a bit to sell you too hard on color. For good reasons he dreads an immediate revolution.

So we cook up a plan we call the KODAK AERO-NEG Color System and say to the aerial photographer:

We'll furnish you an aerial color film that you can process to a color negative in your manual-rewind processor. A negative, unlike a positive transparency, is only the beginning instead of the end. For mapping where color can cut the costly ground control data required, the color negative can be printed on a new glass color plate we are introducing for just this purpose. For mapping of places where the color isn't that much help, a decision can be made to print the color negative on black-and-white glass plates of the proper size and flatness for the stereo-plotting equipment. For mosaics of color prints on paper and for all the non-mapping purposes to which color prints from the air are going to be put, aerial color negatives can be printed to KODAK EKTACOLOR Professional Paper and processed in 7½ minutes with an astonishingly simple device called the KODAK Rapid Color Processor. Where only black-and-white prints are needed, the same color negative gets printed to KODAK PANALURE Paper. And if by chance positive film transparencies are wanted after all, they can still be made by printing the negative to KODAK EKTACOLOR Print Film.

*A gent named E. G. Tibbils, whose address is simply Eastman Kodak Company, Rochester, N. Y. 14650, can help you find your aerial photographer.*

**This is another advertisement where Eastman Kodak Company probes at random for mutual interests and occasionally a little revenue from those whose work has something to do with science**

# Look at COREX® pipets this way. It can pay you 50% in savings.

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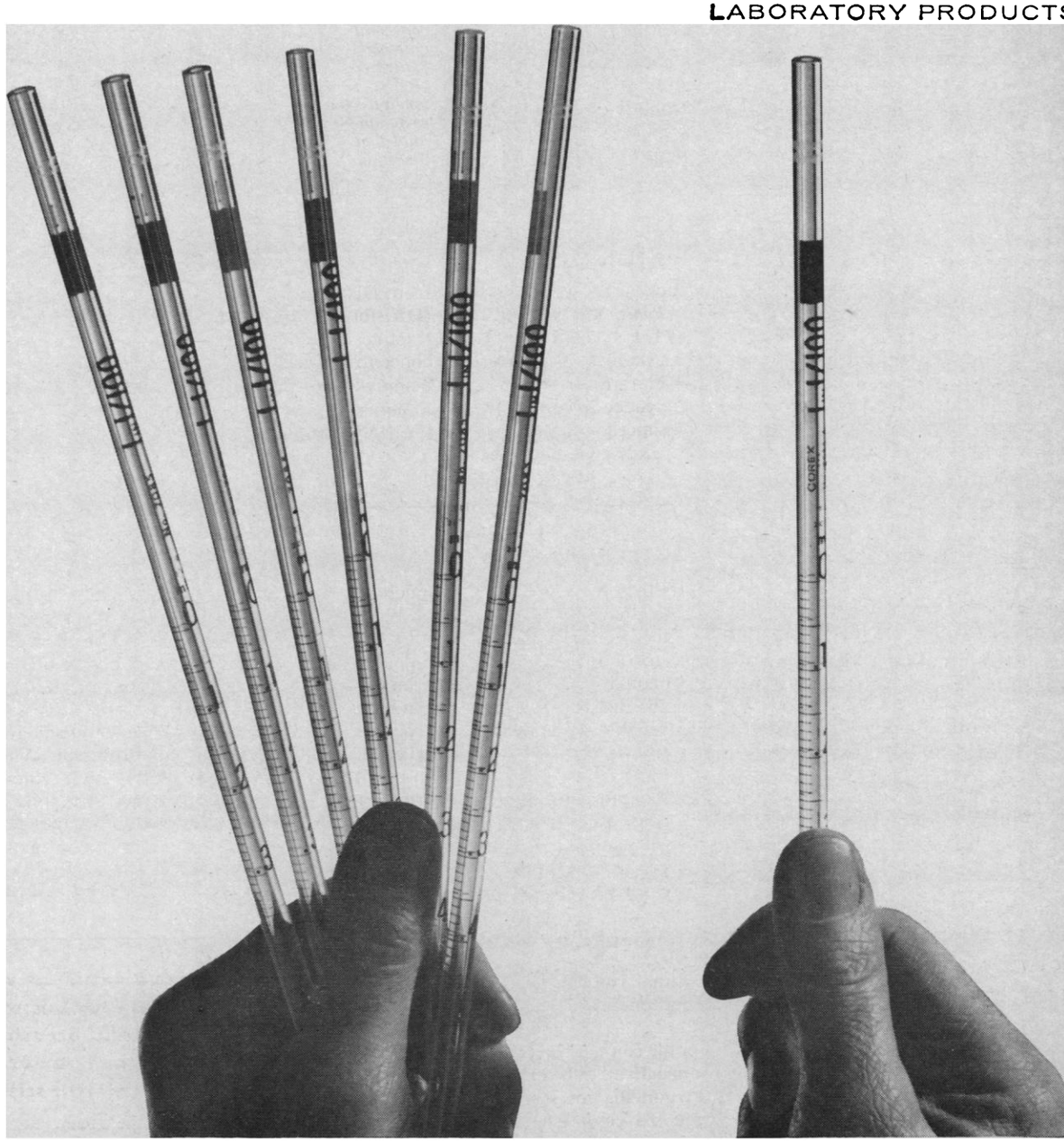


# New PAR Lock-In Amplifier Measures Signals in the Presence of Noise by Crosscorrelation

Transistorized Lock-In Amplifier — Model HR-8

The PAR Model HR-8 Lock-In Amplifier represents a significant advance in signal processing equipment for experimentalists who must measure low-level signal intensities in the presence of noise. It employs the theoretically optimum technique for signal recovery, and can be incorporated into a large class of experiments in which the signal of interest is, or can be made periodic, and in which a reference voltage related in frequency and phase to the signal can be obtained. The Model HR-8 first amplifies and bandlimits the input signal and then crosscorrelates it with the reference signal, suitably phase shifted and shaped. The crosscorrelation of input and reference signals yields a DC output voltage proportional to the signal of interest, while the crosscorrelation of the reference and noise results in no net DC voltage. The system can also be described as a continuously integrating, highly sensitive, phase conscious voltmeter, the response of which is "locked" to that particular frequency and phase at which the signal information has been made to appear.

*Technical Features:*

**Frequency Range:** 1.5 cps to 150 KC continuously tunable in 5 ranges.

**Time Constants:** 11 values in 1-3 sequence extending from 0.001 to 100 seconds. Single or double section RC filtering.

**Pre-Amplifiers:** Interchangeable low-noise pre-amplifiers, operable either within the HR-8 or remotely, are used.
Type A: Differential 10 megohm input.
Type B: Low impedance transformer input for low source impedances.

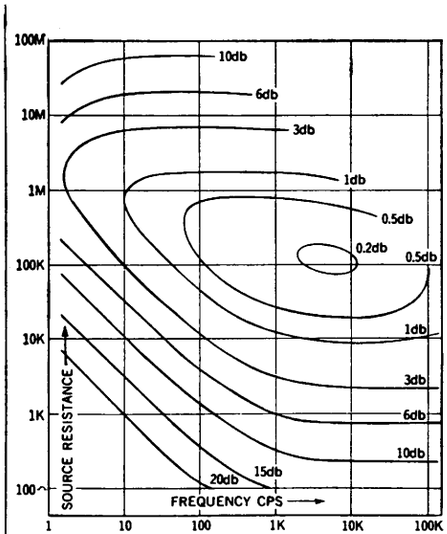
**Sensitivity:** 21 calibrated full scale ranges in 1-2-5 sequence.
With Type A Pre-Amplifier: 100 nanovolts to 500 millivolts rms.
With Type B Pre-Amplifier: 1 nanovolt to 5 millivolts rms.

**Output:** ± 10 volts full scale, single-ended with respect to ground. Will drive galvanometric and servo recorders.

**Frequency Selective Amplifiers:** Notch network in negative feedback loop used in both signal and reference channel tuned amplifiers. Reference channel Q of 10. Signal channel Q adjustable from 5 to 25 with calibrated dial (no gain change with Q adjustment).

**Phase Adjustment:** Calibrated 360° phase shifter, providing continuous rotation as well as a four position quadrant switch which shifts phase in 90° increments.

**Price:** $2,250 with either Type A or Type B Pre-Amplifier.



Contours of constant noise figure for a typical PAR Type A preamplifier plotted to show dependence on frequency and source resistance at 300° K. Amplifier operated single-ended.

*Write for bulletin No. 120 on the HR-8 or ask for information on PAR's complete line of Lock-In Amplifiers and accessories.*

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could get polio?" he answered, "It's possible."

Upon examination of chiropractic textbooks in current use we find that chiropractic claims that such illnesses and diseases as allergies, diabetes, heart trouble, tonsillitis, and cancer can be cured by adjusting or manipulating the spinal column. It is not surprising that the three-judge court, in a unanimous ruling, stated, "There has been no showing here that the state has done more than necessary to protect the health of its citizens." The court's opinion also noted, "If the education obtained in chiropractic schools does not meet the standards of the United States Office of Education it may well be that the legislature of Louisiana felt that in the public interest a diploma from an approved medical school should be required of a chiropractor before he is allowed to treat all the human ailments chiropractors contend can be cured by manipulation of the spine." Chiropractic must demonstrate the validity of its claims before it can deserve the endorsement of the scientific world.

J. SABATIER

*134 North 19 Street,*
*Baton Rouge, Louisiana 70806*

## Algebra and Illusion

The disillusionment evident in E. N. Gilbert's "Information theory after 18 years" (15 April, p. 320) is very different from the usual tone of the articles on this subject. For the past 18 years we have been hearing of the great scientific accomplishments that were going to come out of information theory. Yet at this late date the author of this sympathetic but realistic review is unable to cite a single, tangible, scientific achievement that has resulted from information theory ("The results are still almost exclusively on paper").

This is a shocking fact. Information theory is a theme that has been successfully exploited in hundreds of grant applications and thousands of papers (". . . a page count in the journals devoted to information theory shows that the field is still growing"). Yet these elaborations of the original idea (which was a good one) have been almost entirely sterile and useless. What went wrong? How can we avoid these same mistakes in the future?

The same threat of scientific sterility has arisen in many different areas. Information theory was the forerunner of a whole series of mathematically oriented new "sciences." This new math started with "game theory" and continues on through the latest fad, "simulation." In all these there is a very high proportion of pseudoscientific nonsense. This is privately acknowledged by the competent people in these areas. Many scientists, however, are not aware of this situation because statements in an algebraic language look very much alike, whether they make any scientific sense or not.

What can working scientists learn from the fact that, in 18 years, the widely heralded information theory has failed to produce a single, solid, scientific accomplishment? This much at least: There is no magic in mathematical languages. The claims that are made for "computer simulation" and the rest of the new math should be taken with a grain of salt.

IRWIN D. J. BROSS

*Roswell Park Memorial Institute,*
*Buffalo, New York 14203*

## "Amerind"

June Helm's use of the term "Amerind" in her book review (1 April, p. 58) reminded me of an incident I learned of while reading through the Frederic Ward Putnam papers. Putnam, curator of the Peabody Museum of American Archaeology and Ethnology at Harvard University, served as vice president representing the United States at the 13th International Congress of Americanists held in New York City in 1902. At a dinner meeting in the St. Denis Hotel on 25 October, the menu was printed on birch bark with the items designated in anthropological terms. The appetizer was listed as "Amerind Siouxp." During the after-dinner speeches Putnam remarked, "Amerind' seems to have been placed where it belongs —in the soup."

On the back of his menu there appears a note appended, probably, by his daughter Alice Putnam, which reads, "End of Amerind as a name for Indians." In spite of Putnam's dislike for the term and his effort to eliminate its use, "Amerind" has persisted in the literature and has found its way into the larger dictionaries.

RALPH W. DEXTER

*Department of Biological Sciences,*
*Kent State University, Kent, Ohio*

# "Low-level counting"

# You can now buy the instruments that experts developed for their own demanding research.

An assemblage of experts doing research in low-level counting techniques needed (but could not find) instruments that met their exacting requirements. So, as you just might surmise, they solved their problems over the years by developing several rather distinctive low-level counters—*not* to develop instrumentation for the sake of developing instrumentation (or even for the sake of selling it), but only as functional, reliable means to ends. And then, inevitably, as they used this equipment in their own research programs, they de-bugged it. Result: user-designed, user-perfected, user-seasoned, low-level counters which can do what no existing instruments can do. Now as other workers see these counters working in our laboratories, we get, with increasing frequency, requests for duplicate copies. Accordingly, we are now making these counters available (not reluctantly, it should be noted) to others with similarly exacting requirements. For the specifics, read on.

## Precise measurement of low-energy beta emitters.

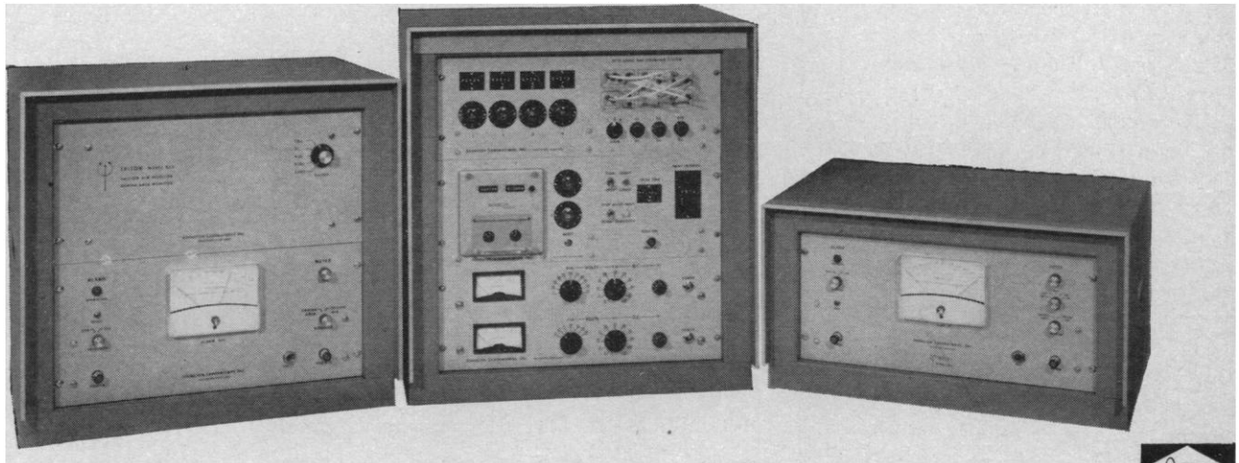
The Beta-Logic Gas Counting System was specifically designed for carbon-14 age-dating, natural tritium and low-level tracer analysis. The system utilizes proportional internal gas counting. A three-channel pulse charge analyzer provides data on the energy distribution of counts and allows simultaneous measurement and correction for contaminant activities such as $H^3$ and Rn in $C^{14}$ samples. A two-channel printer records the number of counts for each of the preset time periods, which repeat automatically. Four independent scalers accumulate during each run. The energy analyses are accomplished through the use of computer-type logic circuitry.

This is an ideal system for serious work requiring maximum counting efficiency and low-background levels for utmost sensitivity. For complete data: request bulletin GC-10.

## Tritium air and gamma area monitors.

Johnston Laboratories has perfected two instruments for tritium air and gamma area monitoring: the Model 755B Triton, and the more sensitive model 855 Triton. The Model 755B Triton accurately monitors airborne beta-emitting radioisotopes such as $H^3$, $C^{14}$, and $Kr^{85}$ or, alternatively, ambient low-level gamma radiation. The design of this instrument eliminates the errors usually associated with tritium air monitors and provides a new high level of accuracy and reliability. Its exceptional stability and sensitivity also permit analytical applications when incorporated into the closed atmospheric circuits of controlled environmental experiments. The 755B Triton may also be used as a low-level gamma monitor with much higher sensitivity than most gamma survey meters. For much more information: request bulletin 755B.

The Model 855 Triton, more sensitive than its progenitor above, is ideal where the measurement of extremely small amounts of gaseous radioactive contamination is a necessity. This instrument is particularly suited for monitoring the maximum permissible concentration of tritium in air ($5\mu c/M^3$) since the sensitivity is 10 $\mu c/M^3$ full scale. It can also serve to measure other beta emitters and is a very sensitive gamma area monitor too (.05 mr/hr. full scale). Ask for bulletin 855 for complete data.



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# Penny Wise, Pound Foolish

The United States enjoys world leadership and is confident of its role. More precisely, we are overconfident. The spirit of urgency that followed Sputnik has evaporated. A mood of relaxation has taken over that perhaps will not be broken until again we feel mortally threatened.

The spirit of the times is manifested in many ways; one of them is in the support of scientific research. The nation is willing to gamble future scientific leadership in order to "save" a few hundred million dollars. Every field of science is feeling the consequences of budgetary tightening. Many competent scientists cannot obtain support for their research. The morale of the scientific community has been damaged.

A glaring example of our willingness to fumble away world leadership is recent action on the Mohole project. A House of Representatives Appropriations subcommittee headed by Representative Joe L. Evins has eliminated funds for the drilling platform from the National Science Foundation budget for fiscal 1967 (*Science*, 13 May). Last month a Senate committee considered the matter further, but even if it reports favorably, a determined fight will be necessary if the project is to be saved.

On the surface, what is involved is a delay on a contract for a drilling platform. This would "save" about $20 million in fiscal 1967. In fact, what is involved is forfeiture of world leadership in exploration and exploitation of the deep-sea bottom. What is at stake are trillions of dollars worth of resources. We are aware of a tremendous resource of manganese nodules on the bottom (*Science*, 7 Feb. 1964). What is beneath the crust-ocean interface could be fabulous. It does not require much imagination to visualize exploitation by completely automated mining and concentrating operations on the sea bottom, with energy derived from underwater nuclear power stations.

Ostensibly the Mohole drilling platform is being constructed mainly to permit drilling to the Mohorovičić discontinuity, but the platform would create another exciting capability—the possibility of obtaining exploratory cores of the deep-sea bottom generally. It would create an opportunity to evaluate economic potentials beneath the bottom and to explore a host of scientific questions concerning the history of the earth.

The Mohole project is highly visible, and, hopefully, the appropriations cut will be restored, but our basic position will be good only if we are excellent on a thousand frontiers. The larger and more important issue is whether we have the wisdom to support "little science." In the past we have harnessed a reasonable fraction of our potential. We have been leaders in fundamental research. We have been able to attract some of the best talent from abroad. We were able to support many of the world's top scientists in their homelands. Associated with academic research has been the training of industry's and government's scientific talent. A by-product of the grants system has been development of a great instrumentation industry helpful to all segments of science, including industry, and beneficial to our balance of payments. Coupled with our competence in science has been technological strength, which is at the core of financial and military strength.

Support of research has produced disproportionately large benefits. The nation should ask itself, "Is the 'saving' of a few hundred million dollars worth the endangering of world scientific leadership?"

—PHILIP H. ABELSON

Report from

**BELL LABORATORIES**

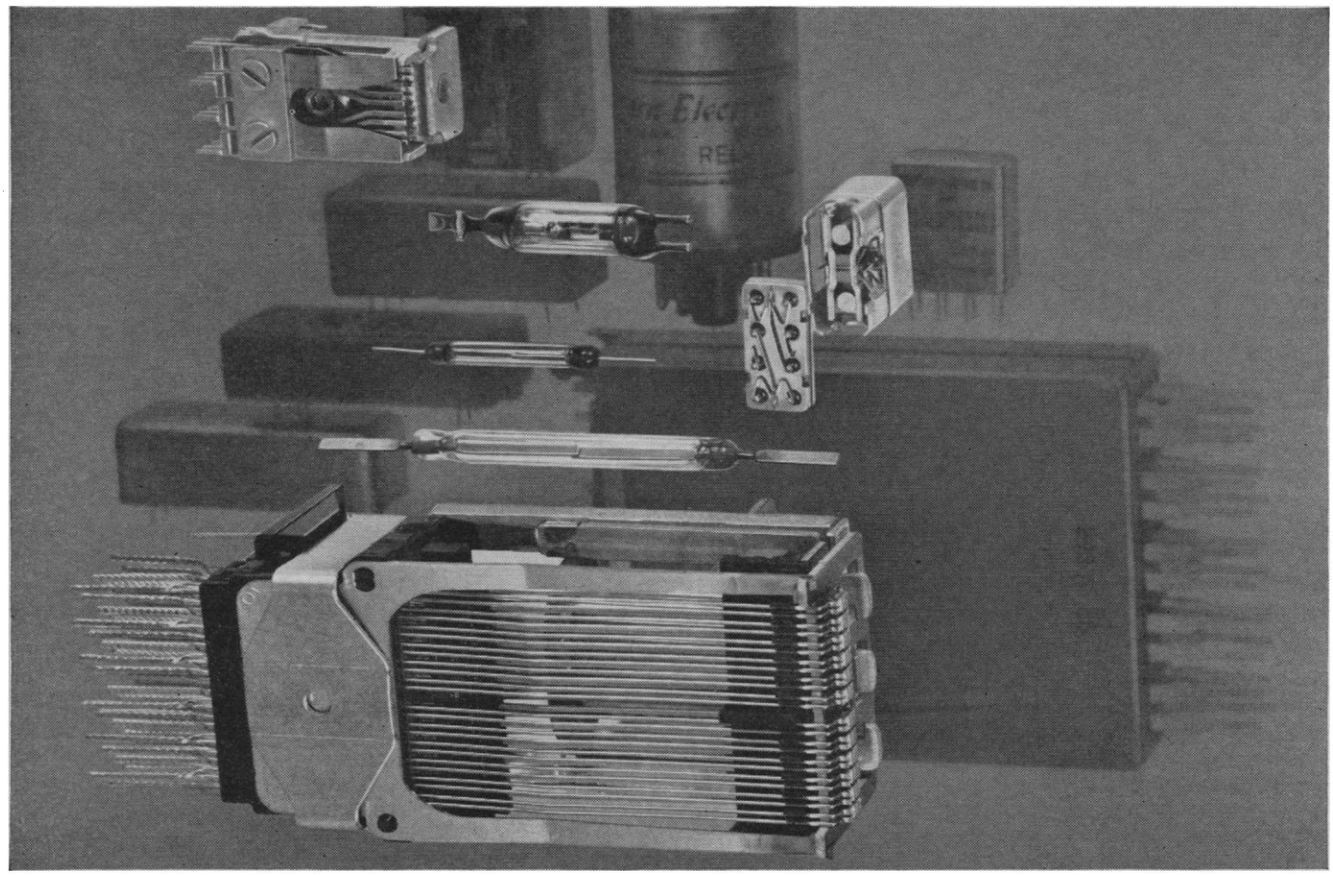
# A relay for every communications need

The average modern telephone office uses 50,000 or more relays, and an average telephone call involves 1000 relay operations and 7000 electrical contacts. Furthermore, a telephone relay is typically expected to operate with not more than one failure in 5 million operations—the equivalent of 40 years of service life.

The jobs assigned to relays range from simple switch closures to the computer-like functions of counting, machine memory, and number and code translation. These call for a variety of relay types, many of them tailored for use in electronic switching systems, data systems, and submarine cable amplifiers.

Therefore, Bell Telephone Laboratories maintains a continuing program of designing and developing reliable and economical relays to meet the ever-expanding needs of modern communications.

**Bell Telephone Laboratories**
Research and Development Unit of the Bell System



**Some electromechanical relays developed at Bell Telephone Laboratories:**

**The large unit at the bottom foreground is the wire-spring relay, the switching "workhorse" of the Bell System. It takes many forms, with many contact arrangements and such special features as magnetic latching.**

**Upper left is a rugged miniature relay. It can be mounted directly on a printed-circuit board or in a socket. In this type, each pair of precious-metal contacts is closed by its own pretensioned springs. Thus, contact force remains constant for millions of operations and is essentially unaffected by wear.**

**Right center are two subassemblies of a "crystal can" relay, especially designed to withstand extreme environments. It went into space in the TELSTAR® I and II satellites and will be in the ocean in submarine cable amplifiers. This relay's moving masses are balanced and are therefore virtually immune to vibration and shock. And, because the coil is sealed and because the moving parts contain no organic materials, it is highly resistant to internal deterioration.**

**The three units at the center are glass-sealed reed contacts; they are unaffected by the external atmosphere. The topmost of the three, a mercury-wetted reed, is chatter-proof; its contacts stay closed without "bouncing." This is accomplished by feeding liquid mercury—sealed within the glass envelope—to the contacts by capillary action. A fast-acting device, it has the highest current-carrying capacity of any communications-type switch element. Also, it has the longest life, often up to 1 billion operations.**

**The two remaining units are sealed dry reeds. They can make contact in less than 1/1000 second. Relays containing such dry-reed contacts and associated operating coils may have one or many contacts in an apparatus unit. Ferreed switches, for example, used in the Bell Laboratories-developed Electronic Switching System, have as many as 256 contacts in one unit. A dry-reed type relay also replaces five larger relays in a translator, which control a ten-digit indicator tube.**

**Typical enclosures are seen in background. All units are shown about 4/5 actual size.**