SCIENCE

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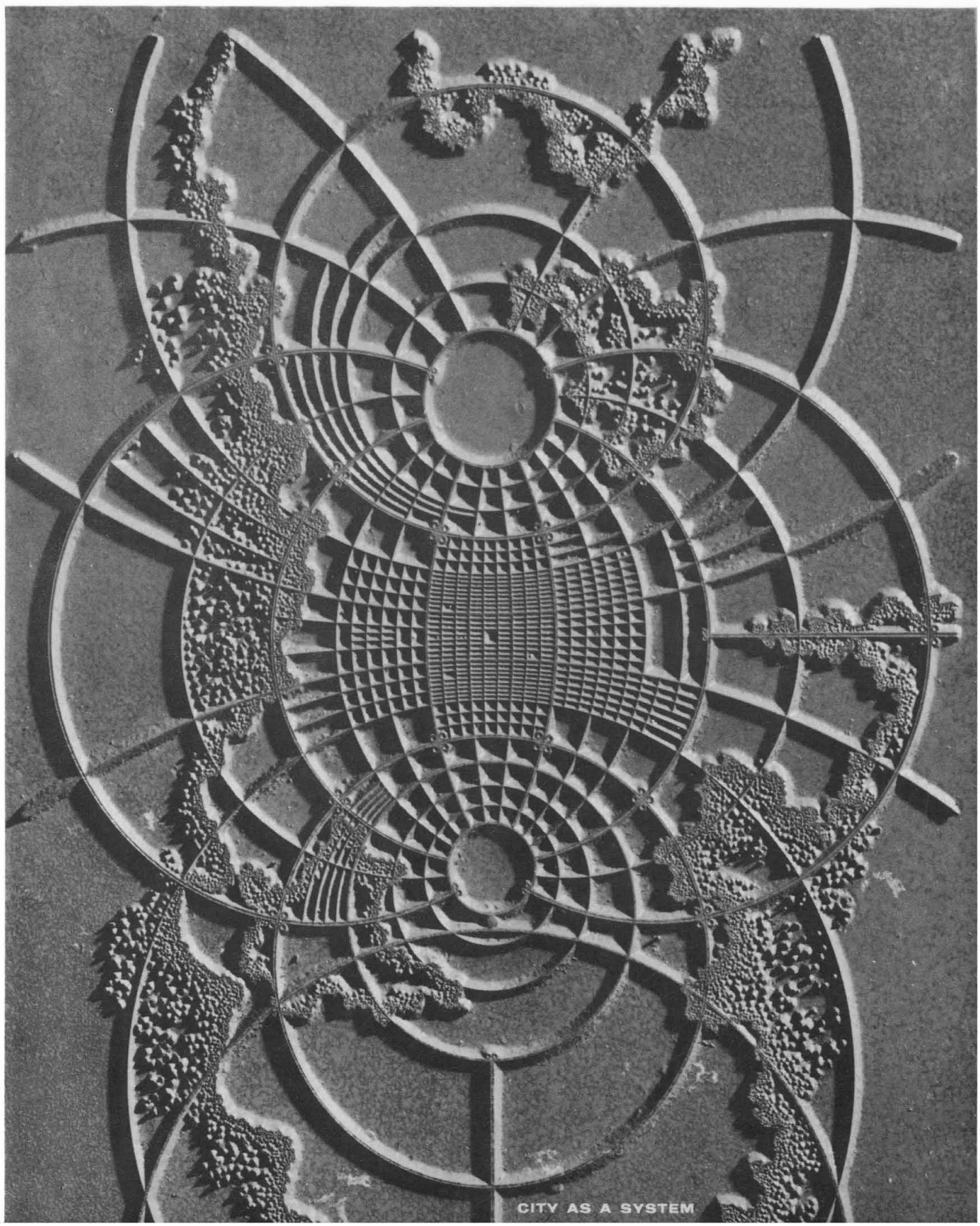
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



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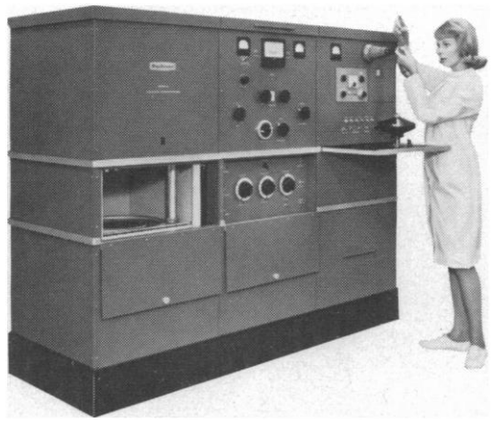
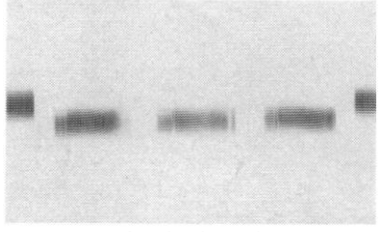


Those "shadows" of molecules moving through the analytical cell can now yield considerably more data than in the earlier days of analytical ultracentrifugation. And some of the exciting developments, both experimental and theoretical, reported in recent literature suggest that the potentialities of the technique have only begun to be explored.

Low Solute Concentrations



The six-channel centerpiece used by Yphantis reduces the time-consuming aspect of equilibrium centrifugation by permitting simultaneous study of three solvent-solute pairs.

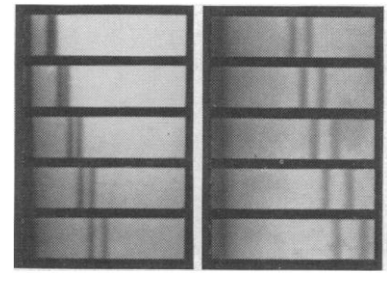
An equilibrium sedimentation technique that permits the study of unusually low initial concentrations with interference optics has been developed by Yphantis — and, in many cases, he has been able to estimate the size of the smallest macromolecular component present in disperse solutions. He employed about three times the usual centrifugal speed, so the concentration near the meniscus became virtually independent of position and could be neglected in comparison with initial concentration. Concentrations in the cell were then determined directly from the fringe patterns without the ambiguity inherent in relating fringes to absolute concentrations.

Some Theoretical Investigations

Adams and Williams have shown that the centrifugal behavior of interacting systems containing any number of macromolecular species can be calculated from the sedimentation equilibrium analysis. Nichol and Winzor have taken the sedimentation velocity approach: assuming an analogy between the behavior of polymerizing systems (as predicted by Gilbert) and rapidly reacting systems of the Type $A+B \rightleftharpoons C$, they suggest a method of evaluating equilibrium constants without assigning values to any velocity terms. Gilbert has extended his calculation for a reversibly aggregating substance to include concentration dependent sedimentation coefficients and the effects of impurity mixed with the aggregating substance.

Another Way to Use Density Gradients

Vinograd, Bruner, Kent, and Weigle have physically separated macromolecular components into discrete bands so that sedimentation coefficients and relative concentrations measured in the mixtures are free from the effects of interaction between components. In lieu of centrifuging macromolecules previously distributed through a density gradient, they layered a thin lamella of the macromolecular solution on top of a denser miscible liquid under centrifugal force. Photographed by absorption optics, the macromolecular components can be seen to separate into bands, which move at different velocities through the cell.



Band-forming centerpiece: macromolecular solution moves from circular channel to sector containing denser miscible liquid.

New developments in instrumentation, applications, and techniques are discussed regularly in "Fractions", a publication sent to owners of Beckman analytical and preparative ultracentrifuges, electrophoresis and diffusion instruments, and amino acid analyzers. If you would be interested in such news, we would be glad to send you a copy. More information about the centerpieces shown is also available. Write Beckman Instruments, Inc., Spinco Division, Stanford Industrial Park, Palo Alto, California.

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SCIENCE

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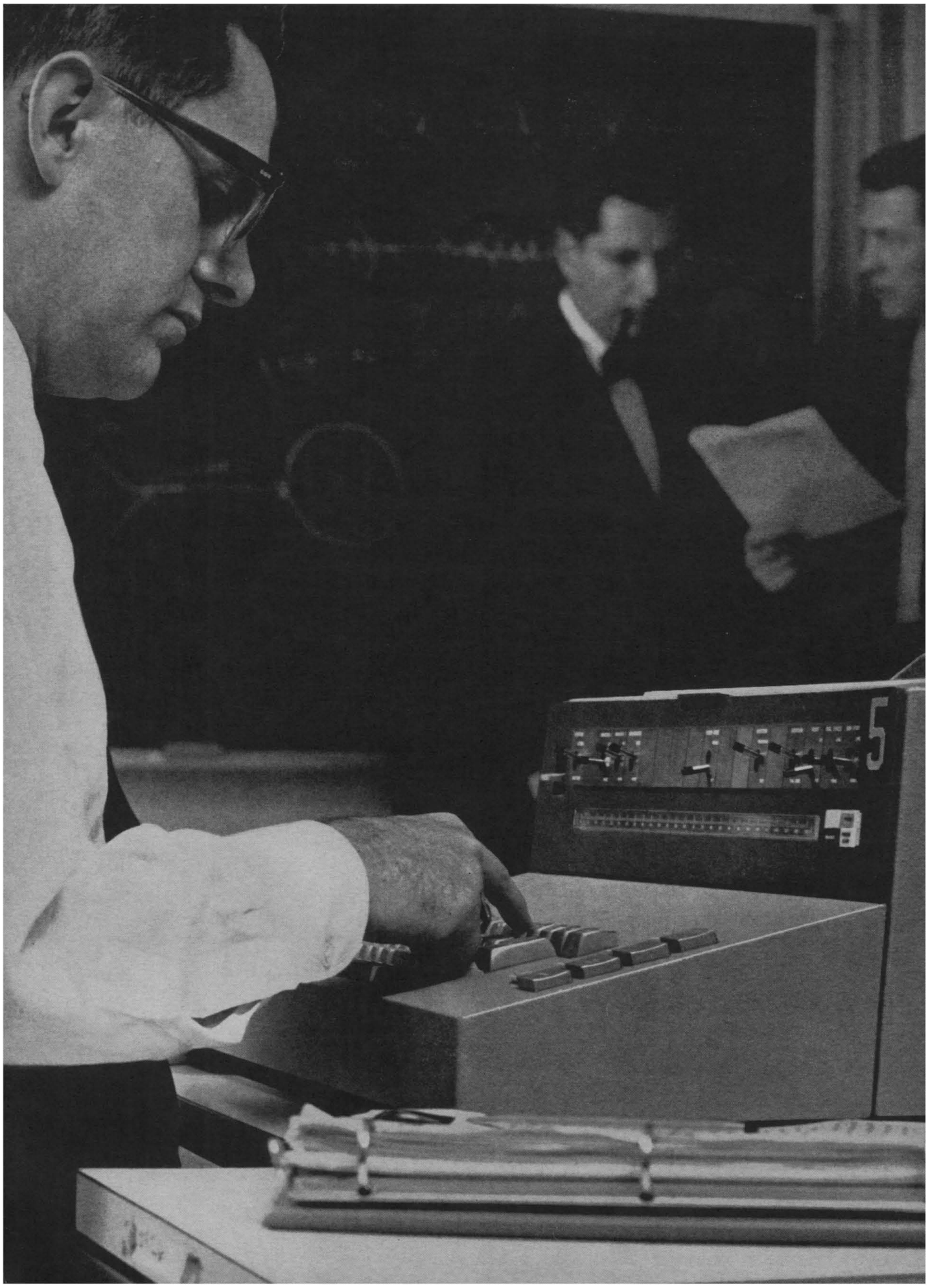
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

COVER

Proposed structural network for a new city, based upon a system of life, circulation, growth, and transformation. The network starts at the center with a simple orthogonal organization that grows outward, changing in geometry, dimensions, and use, while preserving its unity and continuity. The system can suffer topological transformation as the result of changes in time, topography, and human needs, without losing its basic structural properties. See book review of *Structure in Art and in Science*, page 527. [Eduardo Catalano]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```
                    NUMBER = 2+2
101. =              NUMBER=           4
101. -READY

                    NUMBER = 12/2
101. =              NUMBER=           6
101. -READY

                    N = SQRT(64.)
101. =              N=            8
101. -READY


101. -READY         PROGRAM(SAMPLE)
102. +READY         DIMENSION ZPLOT(52), TABLE(500)
103. +READY         X=0
104. +READY         Y=1.
105. +READY         I=1
106. +READY         READ 101, DELX,CHAR,ZPLOT
107. +READY 101    FORMAT (F7.4, 53A1)
108. +READY         PRINT 102
109. +READY 102    FORMAT (5X,1HX,7X,1HY)
110. +READY     2   TABLE (I) = X
111. +READY         TABLE (I+1) =Y
112. +READY     1   PRINT 103,X,Y
113. +READY 103    FORMAT(2X,F7.4,F8.5)
114. +READY         IF (X-1.) 5,3,3
115. +READY     5   I=I+2
116. +READY         X=X+DELX
117. +READY         DELY =X+Y+DELX
118. +READY         Y=Y+DELY
119. +READY         GOAT 2
119. +ERROR     STATEMENT NOT IN LANGUAGE
119. +READY         GO TO 2
120. +READY     3   DO 4  J= 1,I,2
121. +READY         X= TABLE(J)
122. +READY         K=1. +((TABLE(J+1)-TABLE(2))/(TABLE (I+1)-TABLE (2))*50.)
123. +READY         ZPLOT(K) = CHAR
124. +READY         PRINT 101, X, ZPLOT
125. +READY     4   ZPLOT (K)=ZPLOT (K+1)
126. +READY         STOP77
127. +READY         END
```

Portion of a typical mathematical problem solved with QUIKTRAN.

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tional and realistic political step. Many of us felt that it was the responsibility of academicians to alert the public to their lack of confidence in the soundness of the advice given to the President by their former colleagues. The foregoing reasons were far more important than any particular policy alternative in fostering the sudden growth of teach-ins and other debates. . . .

The teach-in can be looked upon as a simple revival of older democratic forums such as the town meeting. . . . The teach-ins can and in some cases did allow for a side-by-side comparison of the areas of disagreement. At least, they aired many of the complexities of the Viet Nam war which had too often been obscured by the administration policy of an "optimistic outlook." The "academic dissenters" probably have stepped into a vacuum of criticism and discussion, where foreign policy seems too complex for the individual to get hold of. In doing so they have signaled the end of a time when one or two advisers will be given carte blanche to advise the President on matters of national importance. In order to have their advice accredited, the Bundys are going to have to go back periodically to the debate platforms, to the colleges, to Congress, and to the people they serve. Bundy has referred to the academic critics as "my people." How true!

ROBERT BUCKHOUT
Department of Psychology,
Washington University,
St. Louis, Missouri

Rank Discrimination

Being a community rich in degree-holders of every kind, Princeton is likely to have Ph.D.'s, M.D.'s, D.D.'s, and so forth among its candidates for election to the school board. Under the auspices of the League of Women Voters, our recent candidates gathered before elections for public questioning. In front of each was a name plate. The title "Dr." appeared with the names of M.D.'s; the Ph.D.'s were designated "Mr." Searching for an explanation, I found that the League of Women Voters solemnly believes that being identified by the title "Dr." embarrasses a Ph.D.—especially "after hours" (a reservation that apparently does not apply to M.D.'s or D.D.S.'s seeking public office "after hours"). Pundits on etiquette were also cited as authority, although with some controversy, since apparently they differ. Inclusion of the title in one's telephone-directory listing was an additional criterion for establishing the right to it (three Ph.D.'s are so listed in Princeton, including the president of Princeton University).

Are degrees becoming obsolete? Are we headed toward the abolition of titles, or is this manifestation reserved for Ph.D.'s?

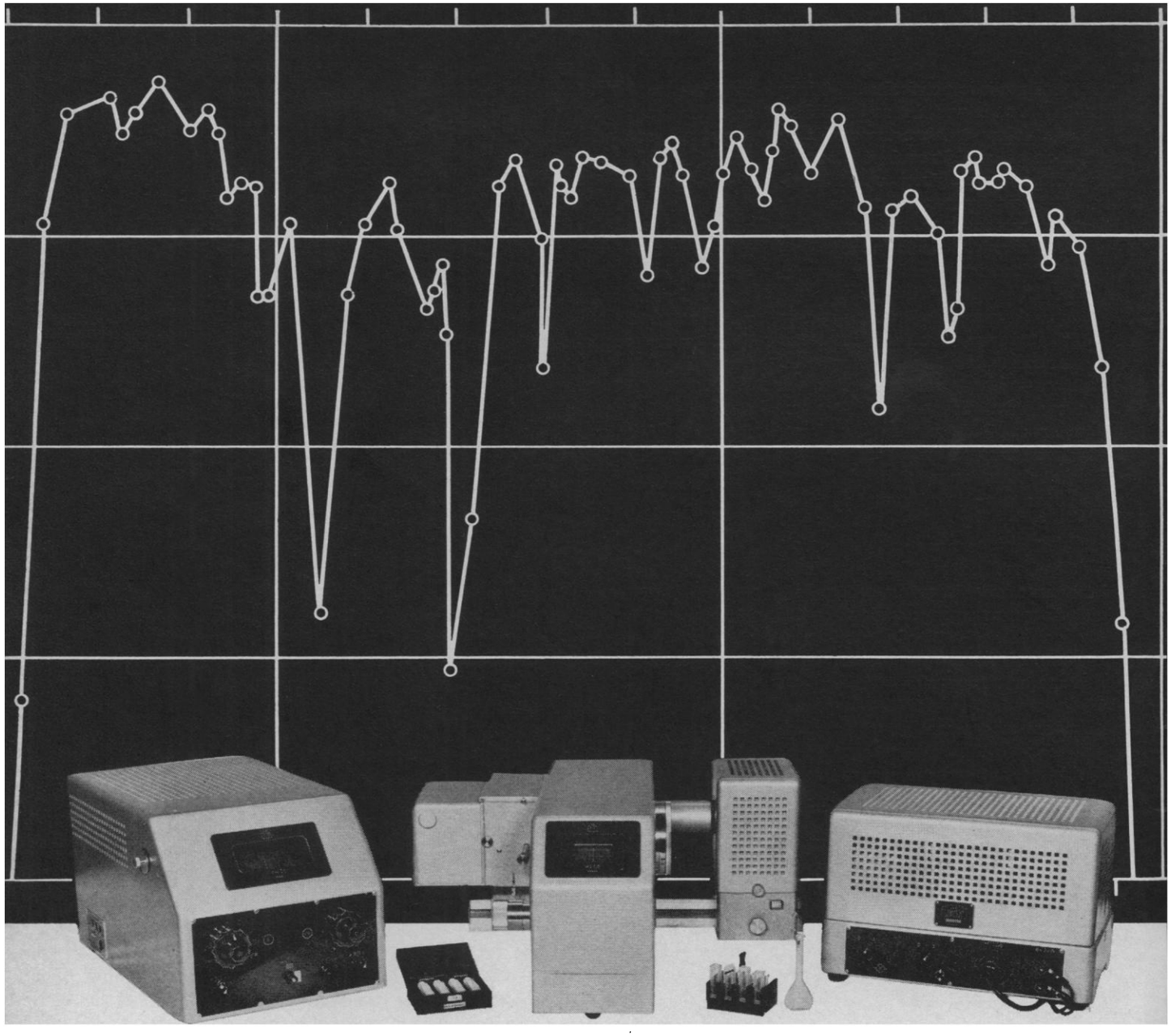
M. A. BENARDE
College of Engineering,
Rutgers University,
New Brunswick, New Jersey

Lullaby for Male Voices

Herewith a contribution to Rossi's Brave New World. [See Alice S. Rossi, "Women in science: Why so few?" 28 May, p. 1197.]

Hush, my little baby, and brush away that tear.
Your mother needs to have a scientific career.
Please don't fret and whimper, that's an affective quirk.
Mother's just out looking for more meaningful work.
Her absence is a blessing, for this negative condition
Will make your heart grow fonder and will stimulate cognition.
You'll love the child-care center, which is cunningly contrived
To cope with all the problems of the maternally deprived.
Your Ma's maternal instincts are more than merely ample—
She's providing the whole family with a shining good example.
So what if meals are tardy and the cleaning ineffectual?
Take comfort in the fact that your Mama's an intellectual.
Think of the ultracentrifuge and other apparatus
That are going to help Mother in her search for equal status,
Though real equality for her depends on one condition:
Persuading Dad to take over the task of parturition.

MARJORIE DORMAN
220 Sycamore Mills Road,
Media, Pennsylvania



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The Productive Environment for Innovation

The Department of Defense and the Arthur D. Little Company have recently conducted a stimulating historical study of the conditions that foster successful research, developments, or inventions—the key ideas that have given to major weapons their high operational capabilities. The results give useful, even if still tentative, leads to understanding the elements of the laboratory environment that are most conducive to successful innovation.

The physical scientists who worked on the study sought initially for objective characteristics of a productive laboratory which they could count and measure. They found, however, that these characteristics appeared to be far less important than were attitudes, motivation, personal relations, and the way in which the laboratory was managed.

They found, too, and with some surprise, that improved weapons come chiefly through many relatively small steps rather than a few giant ones. The transistor and the high-temperature shock tube have been called major breakthroughs, but more typical examples were the development of ablative cooling, magnetic (instead of jewel) bearings for gyros, the low-cavitation propeller, and zone-melting as a technique for purifying metals.

Typically, these and the other achievements they studied occurred only if three elements were all present: a clearly understood need; a source of relevant ideas, information, insight, and experience; and men and money to commit to the job. In a few cases a new idea appeared so promising that it was pushed through to successful development even though a specific need was not yet apparent, but the trigger that set off the burst of activity that led to a useful new development was most commonly the explicit recognition of a need. Ideas not related to a recognized need were likely to lie fallow. Necessity still seems to be the mother of invention.

In a few instances the developmental activity was funded through a contract specifically intended for that purpose. More usually, after the need and the idea were brought together, money was borrowed or taken from some other source. Retrospectively, it is easy to justify these diversions of funds. A need and a promising idea for its solution existed. Informal cost/effectiveness estimates typically showed the potential value multiplied by the probability of success to be 10 to 100 times the predicted cost. They were good gambles, so instead of waiting 6 to 12 months for a new contract, the company or university paid the expenses from its own funds, or borrowed money intended for related work or other activities, or (in a few cases) used funds that had been made available on a discretionary basis. The desirability is obvious of providing effective laboratories with funds that are under the discretionary control of the men who are directly acquainted with the need, with what seems to be a good idea, and with the probability of its successful development.

The Department of Defense is to be commended for this study, and for its planned continuation. It might have allowed the history to stay buried. It is good that it did not, for now it has some stimulating suggestions for improving its own research and development management, and some of these suggestions will be appropriate to other agencies and laboratories. We will continue to spend much on research and development; critical analysis of past accomplishments can help us to spend future money more effectively.—DAEL WOLFLE