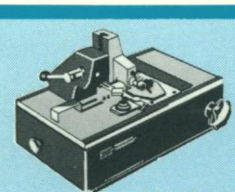
SCIENCE

27 November 1970

Vol. 170, No. 3961

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



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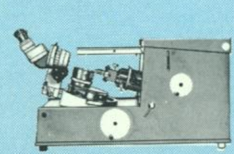
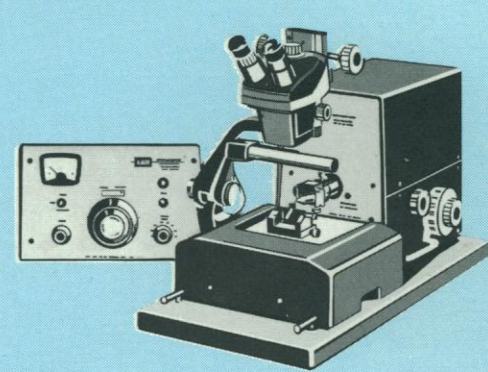


Pyramitome



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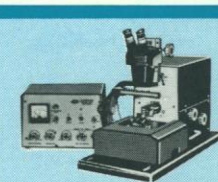
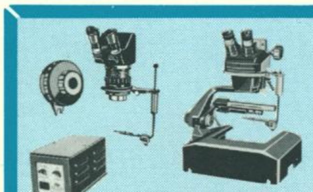


Ultrotome I



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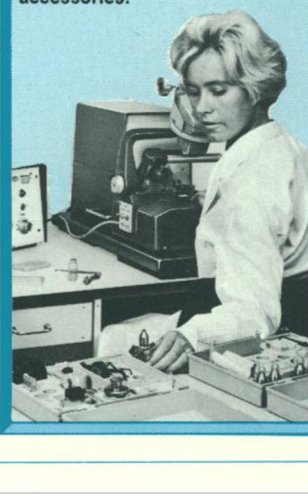
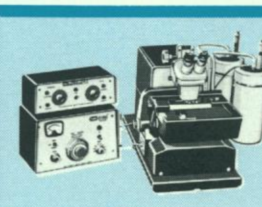


Micrograph of section prepared with CryoKit

Ultrostable



CryoKit for Ultrotomes

Suggested Reading on the Environment

Estuaries

The development of coastal areas has been very rapid in recent years, but knowledge of estuarine environments has not kept pace with the necessity to resolve problems arising from their intensive use. This is the first comprehensive collection of scientific papers covering the comparatively new field of estuarine research.

This volume contains 71 articles on physical and biological factors, geomorphology, sediments and sedimentation, microbiota, ecology, evolution, fisheries, human influences and pollution.

Edited by George H. Lauff. 1967. 2nd printing, 1968. 776 pages. Illustrated. Bibliography. Indexes.

Agriculture and the Quality of Our Environment

This symposium is basically concerned with the problem of how environmental quality affects agriculture, and how agriculture affects the quality of the environment. It identifies the part which science must play in solving environmental pollution problems.

Edited by N. C. Brady. 1967. 476 pages. Bibliography. Author and subject indexes.

Air Conservation

This is a report of deliberations of the Air Conservation Commission of the AAAS over a 2-year period. It pulls together into a single reference a wealth of information presented by authorities in the fields of conservation, pollution control, pollutants and their effects, law, economics, meteorology, public health, public opinion and government.

The *Bulletin* of the American Meteorological Society calls this work "the most thoughtful, realistic and penetrating analysis of air pollution as a factor in the societies of today and tomorrow now available. It is a *must* for the serious student and professional, and can be highly recommended to the interested citizen."

Report of the AAAS Air Conservation Commission; James P. Dixon, Chairman. 1965. 2nd printing, 1968. 348 pages. Illustrated. Bibliography. Index.

Oceanography

A collection of 30 papers presented at the first International Oceanographic Congress by world-renowned authorities. An interdisciplinary reference that deals with some of mankind's most profound questions . . . the origin and history of living things, for example, and the history of our galaxy as recorded in marine sediments.

Edited by Mary Sears. 1961. 5th printing, 1969. 665 pages. 146 illustrations. Bibliography. Subject index. Author index.

Mail to AAAS, Dept. HN, 1515 Massachusetts Ave., NW, Washington, D.C. 20005
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SCIENCE

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COVER

Electrical stimulation to the chick retina can disturb the balance of excitatory and inhibitory systems within the receptive fields of individual retinal ganglion cells, making the units fire more readily and to a wide range of visual inputs. See page 992. [F. A. Miles, University of Sussex]

Some things are changing for the better.

A practical way to automate a GC lab . . . one step at a time

Although gas chromatographs (GC's) are designed and built for around-the-clock operation, the majority of them are used only a few hours each day . . . and never on Sunday. There are always good reasons for such under-utilization of expensive equipment. In this case, it's a matter of manpower: some one has to be present to inject a new sample into the GC; and every time an analysis is completed, some one has to spend about a half-hour translating the analog data of the recorded chromatogram into a meaningful quantitative analysis. Since most GC laboratories operate on a 40-hour week, it simply has not made good economic sense to add a second and third shift simply to realize a fuller utilization of the GC's.

But that's no longer the only solution. Some new instruments have recently appeared on the scene that allow you to triple the analytical output of your GC lab without increasing your staff or number of GC's. And you can do it a step at a time, as your budget allows, each step fully compatible with the next one.

First there's the 7670A Automatic Sampler. It measures and injects samples into your GC, completely unattended. The impact of the 7670A on the productivity of your lab can be dramatic: a single chromatographer can prepare samples and load them into the 7670A thirty six at a time, keeping the GC productive around the clock, even over weekends. Assuming a half-hour cycle per sample, he can produce well over 200 analytical runs a week, easily three times his best output with manual injections. If you're wondering about the reliability of the 7670A, don't. We have repeatedly performed 24,000 continuous automatic injection cycles with it in our laboratories—the equivalent of more than two years of unattended operation—without a failure. As an unexpected bonus, you'll also improve the quality of your laboratory's output because the 7670A's machine-reproducibility is consistently more precise than a skilled technician. Cost is $2850.

Then there's the 3370A Integrator. It automatically quantitates the GC analysis, prints an area count for each peak on the chromatogram and a total area count for the analysis, if desired. This cuts the chromatographer's computational load by about 10 minutes per sample (the time that it takes him to make area measurements manually). Apply this to a 7670A-equipped GC capable of producing 200 analyses a week, and you eliminate more than 30 hours of computation time . . . enough to pay for the 3370A, which costs $4950, in about four months. And you'll enjoy a further marked improvement in the precision of your GC analyses.

Next step in this modular approach to automation is the 3360A GC Data Processing System, an on-line data handling system whose HP 2114B Computer is fully programmed for GC. It processes data simultaneously from up to eight GC's equipped with 3370A integrators and automatically prepares a typewritten report of each analysis, including the name, retention time and % concentration of each component. The 3360A thus completely eliminates manual computation, cutting an additional 20 minutes per sample from the chromatographer's load (the time that it takes him to compute component concentrations manually and prepare a final report). To understand the potential impact of the 3360A on your GC lab, two additional facts must be kept in mind: the cost of the 3360A to a laboratory that has eight GC's already equipped with 3370A integrators is not $100,000 or $50,000, but less than $20,000 installed; and the 3360A is theoretically capable of processing more than 6000 analyses per month. Even if we assume that it will be used for as few as 1000 samples monthly, the 3360A will eliminate more than 300 hours of computation time from your manpower budget, enough to pay for the entire cost of the system in little more than 6 months.

Finally, for laboratories whose sample load does not exceed 500 per month, there's an even more economical way to automate data handling. By adding a hardware-plus-software option to your 3370A Integrator, you can automatically produce a computer-compatible punched paper tape record of integration data. You then feed the punched paper tape off-line to any of the principal time-share computers, using the BASIC language program provided, and automatically receive a complete report of the analysis, as with the 3360A. This cuts some 17 minutes of computation time per sample (in addition to the 10-minute reduction from the 3370A proper) . . . or a savings of some $1400 monthly based on a 500-sample load. Considering all costs—the $1550 cost for the 3370A option and the variable costs of the time-share computer lease—payout takes less than six months.

If you care to study in more detail the economics of HP's step-by-step automation for your GC lab, write for the Fall 1970 issue of *Analytical Advances,* a 32-page study of the subject.

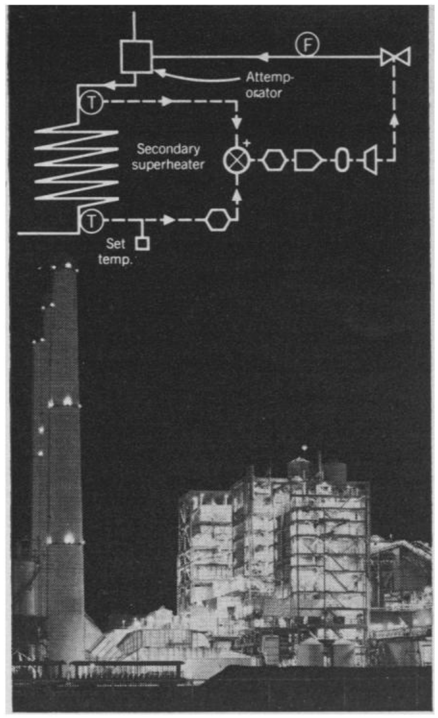
New tool for on-line control system analysis

(Note: To our Scientist Readers: The subject of the following article is a new instrument for continuous signal analysis that is useful in medical research, acoustics, radio astronomy and many other scientific measurements as well as in the process control application described.)

Very recently at a large power station in England, a system analysis of an attemperator (temperature control) loop was completed on-line, without disturbing plant output in any way. As the control characteristic of the loop was displayed on a screen during the experiment, adjustments were made to optimize control system response and the results were displayed immediately.

The job of the control system engineer—to predict how the system will react to a given input pulse—has not always been so easy. If he tested the system with a large enough impulse to produce a measurable response, plant output was changed in a way that could not be tolerated.

Some progress was made when control system analysts discovered the power of cross-correlation. With this mathematical technique, a test noise signal is applied to system input at such a low level that system output is not changed beyond normal background disturbances. Yet by cross-correlating



the test noise with system output over a relatively short period, the engineer is able to extract the impulse response of the system; background disturbances do not interfere because they are uncorrelated with the test noise. At first, cross-correlation did not help because it could only be accomplished after the fact, through off-line digital computation. What made the difference in the English experiment was the availability of two new HP instruments: a Model 3721A on-line correlator that's about as easy to use as an oscilloscope, and a Model 3722A precision noise generator that synthesizes repeatable pseudo-random noise, ideally suited to system analysis.

Correlation is fundamentally an averaging technique that is a powerful tool in recovering all kinds of periodic signals that are buried in noise, and in establishing a relationship between apparently unrelated signals. With the 3721A, the technique is easily applied *on-line* for continuous signal analysis in many kinds of scientific measurements. It might be useful in your work too. The Correlator costs $8325 and the Noise Generator $2650. On request, we'll be glad to send you a packet of information on these two instruments and a 96-page booklet on Discrete Signal Analysis.

Acquire and reduce scientific measurements automatically . . . without a computer

If you're a typical scientist, you spend a lot of time on the bench making measurements . . . and you don't object to that at all. What you do mind is the ever-increasing amount of time that you must spend at the desk making the calculations that turn raw measurements into useful information. Some scientists still rely on slide rule and adding machine for this work; some have acquired a 9100 Computing Calculator and, in one economical stroke, cut their computational load by half or more.

If you're in the second group, we'd like to tell you of a new way to liberate even more of your time for scientific investigation, by letting your data gathering instruments communicate directly with a data processing system. You might think that this will necessarily involve you in the cost and complexity of a computer.

Not so. With the new HP 2570 Coupler/Controller, you can now tie many measuring instruments to the 9100 and get reduced data directly . . . from more than 40 HP digital instruments including voltmeters, frequency and time counters, nuclear scalers, quartz thermometers and GC integrators.

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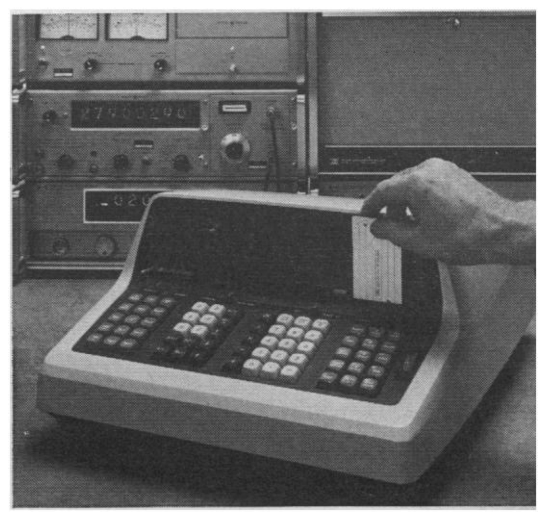

of your experiment, formatted as you like it and prepared automatically on a typewritten sheet, punched paper tape or even on the calculator's X-Y plotter.

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school systems to make them a more appropriate learning environment than to make youngsters more tractable by drugging them "en masse"? This is only one of many examples which illustrate how drugs often appear to be used as alternatives to constructive changes in the patterns of social arrangements.

Finally, if Brand is indeed correct in claiming that the chemical solution to human problems represents the "growing tide of events," should we then abandon our efforts to dissuade young people from the use of stimulant and addictive drugs and accept their assumption that drugs can be used to achieve the same effects as human relatedness and experience?

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LEON J. EPSTEIN
DONALD C. RANSOM
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ARNOLD BERNSTEIN
Department of Psychology, Queens College, City University of New York

Why People Formed States

The circumscription theory concerning the origin of the state as propounded by Carneiro ("A theory of the origin of the state," 21 Aug., p. 733) poses some fundamental problems as to the causes attendant upon the rise of the nation-state which have long mystified political scientists. Carneiro has cleared away some of the rubble of earlier classical theories which have long been the bane of fruitful inquiry in political philosophy. But his theory does give rise to several questions.

How does he distinguish between a community and a state? The primitive communities which he says were pressed by the density of their populations into a "state" as a result of environmental circumscription had many of the prerogatives he uses to define his concept of "state": power to control the time and energy of the inhabitants for collective purposes (taxes), enforcing rules of behavior, and sending men off to combat—and this power they had *before* being "circumscripted."

It is not clear if a group of people became a state when they were settled in a specified area. Were the minions of Genghis Khan a "'state"? Under Carneiro's definition the rulers of the Golden Horde exacted services and goods from their followers. Women were especially controlled, and they made up half the population.

Then again, how does Carneiro's theory handle the ongoing evolution of political organization? The concept "state" is but one point on the political continuum and its uses are extremely limited when one wants to determine the relationship of inputs and outputs within a political process, the understanding of which is much more useful in grasping political phenomena than is the worn-out and often meaningless concept of "state."

It would appear that Carneiro is struggling with the old chimera faced by the classical political theorists, namely, what is the nature of the state. Admittedly, Carneiro does not claim his theory to be all-encompassing . . . but I think he is still caught in a battle of concepts whose origins are value-laden rather than empirically substantiated.

PAUL DOLAN
Department of Political Science, University of Delaware, Newark 19711

Carneiro has failed to mention what was probably the most important single factor in the formation of mankind's earliest states—transportation. He rightly rejects "voluntaristic" theories, and various other theories with primary emphasis on the invention of agriculture. He also gives due credit to the role of coercion. What he overlooks is that coercion must necessarily be transported. In most places the formation of the state, regardless of environmental or social incentive, had to await the invention of such tools as the wheel or the ship, or the domestication of horses, oxen, and elephants, for the transport of the means of coercion and the profits thereof. The only important exceptions would appear to be geological circumstances in which states could (or were forced) to successfully evolve for primarily defensive reasons. The earliest central Mexican states probably remained essentially unchanged (despite several interim conquests) until the arrival of Cortez who imported horses and wheels in his ships.

It is interesting to speculate if states would have evolved in the eastern woodlands of North America if the human population there had invented the wheel, or had a pre-Columbian horse population been available for transport. What part did domestication of the llama, or the invention of coastal shipping, play in the evolution of the earliest Andean states? Shipping, rather than social circumscription, was certainly a critical precondition in Polynesia, and probably in some of the earliest Mediterranean states as well.

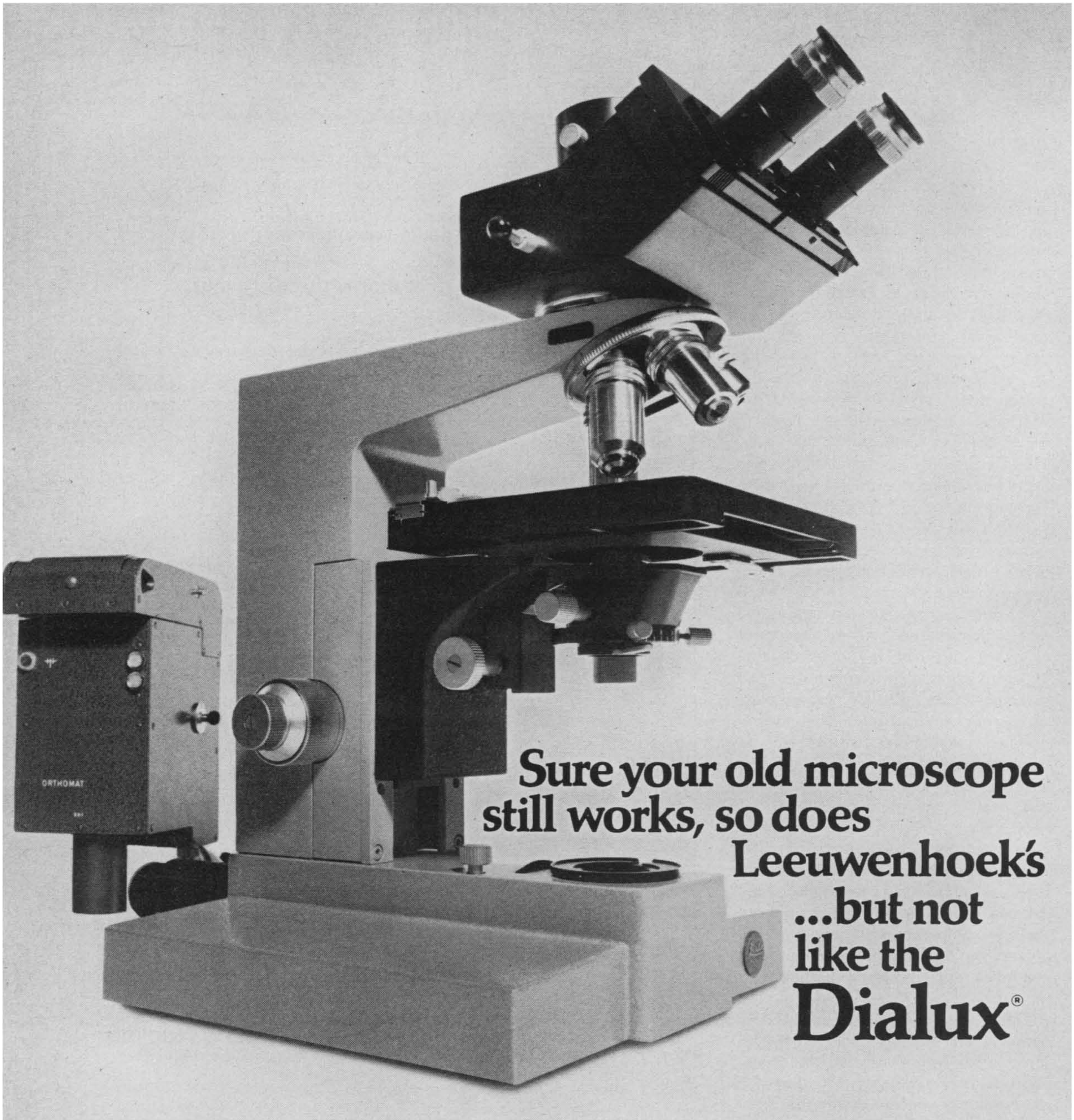
CHARLES DEB. HASELTINE
3045 Idlewild Drive, Reno, Nevada

I do not see how Haseltine can maintain that nonhuman transport was an indispensable factor in the rise of the state. The several states that arose aboriginally in Mesoamerica relied on human transport, as Haseltine admits. And if these states developed without mechanical transport, why couldn't others have done so? In fact, they did. As examples one can cite the numerous native states of tropical Africa. Mechanical transport undoubtedly facilitated the rise and growth of states. However, though a useful *adjunct* to state formation, it certainly was not a prerequisite.

Dolan asks how I distinguish a community from a state. As I use the term in my article, a community is an autonomous village. A state arises when many such communities are aggregated into a political unit having the power to tax, to draft men, and to decree laws. Dolan believes that communities had these powers before they became parts of a larger political unit. If his definition of a community is the same as mine, then he is mistaken. If he will examine the vast ethnographic literature dealing with autonomous agricultural villages—the type of community with which my reconstruction of political evolution begins—he will find that they lack taxation, conscription, and decreed laws. The power to carry out these functions arises only with supracommunity aggregation resulting from continued and successful participation in war.

Dolan also asks how my theory handles "the ongoing evolution of political organization" beyond the attainment of minimal states. My theory is not essentially concerned with this problem. I have tried to explain how the state arose in the first place. How it continued to evolve once it had emerged is a rather different problem. Certainly warfare and conquest still played a large role in this later evolution, but there was more to it than that. However, it is a separate issue which my theory is not obliged to explain.

ROBERT L. CARNEIRO
Department of Anthropology, American Museum of Natural History, New York 10024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still works, so does
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27 November 1970, Volume 170, Number 3961 SCIENCE

Lessons of the Intellectual Biography of Science

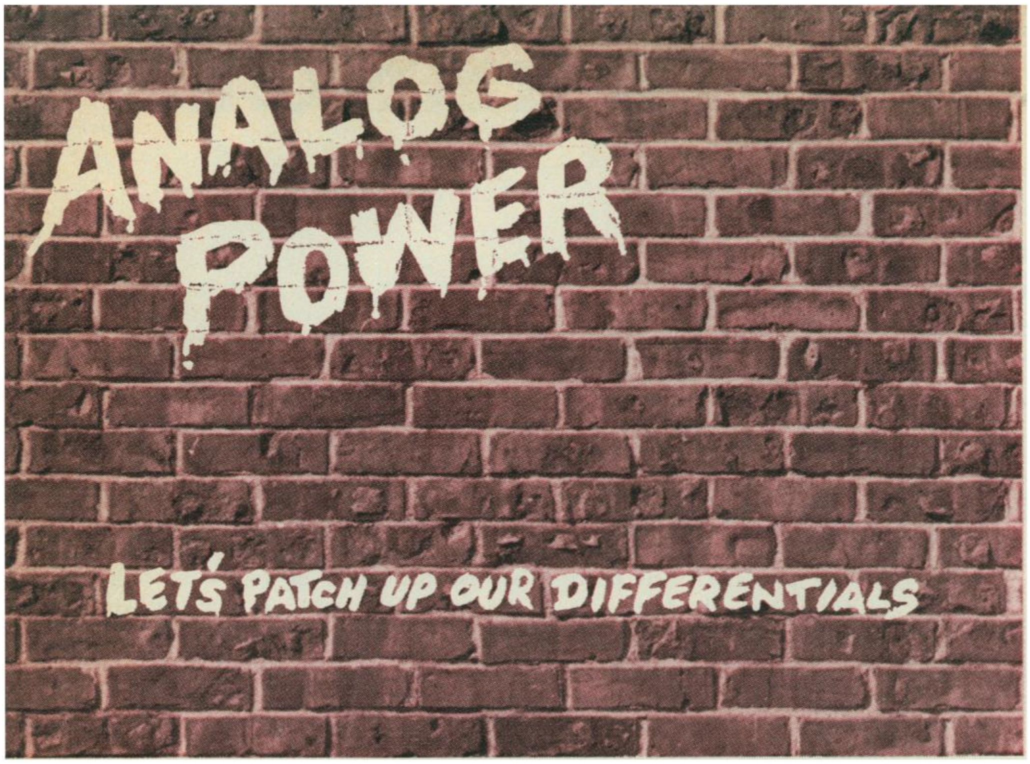
One of those never-ending battles seems to be going somewhat worse these days: all who love the sciences must be dismayed to see an upswing today in largely uninformed attacks that all but drown out the appropriate, corrective criticisms that we shall always need. If this process is allowed to continue unchallenged, one may indeed wonder for how long even the more striking and beneficent advances of science can command a fair and interested hearing beyond the circle of fellow specialists.

In such a situation, it is doubly urgent to celebrate what is worth celebrating. That was one of the motivations for devoting the current fall issue of *Dædalus*, the journal published by the American Academy of Arts and Sciences, to intellectual biographies of some of the men and some of the conceptions that have transformed science during the last few decades. The authors were asked to address themselves to the journal's nearly 60,000 general readers, as informally as they liked, about their own careers or the careers of the current chief ideas in their fields.

As editor of the project, I found in the essays not only information but a number of lessons—none more intriguing than the confirmation of common properties shared by scientific fields despite the obvious differences between them. It was not surprising that even 400 pages could not do justice to the splendid variety of scientific types and concerns, although the areas sampled range from psychoanalysis and sociology to genetics, molecular biology, chemistry, physics, and engineering. Despite this diversity, one is struck by the reappearance of the same themes, which keep coming up in not very different guises: the efficacy of quantification in the treatment of phenomena; the conscious or unconscious search for symmetries; the use of the concept of an evolutionary development as a fundamental tool of thought (as much in psychological and sociological research as in genetics and astrophysics); the contrary pulls of reductionism and holism. There is surely something like a scientific imagination shared by all scientists, which forms one of the bonds among them and which makes possible the interdisciplinary approach that characterizes almost all the developments here described.

Another of the bonds among scientists may be forged by sharing a style of life that starts with their early experiences as students. The personal development of such diverse scientists as Erik Erikson, Talcott Parsons, Francis Crick, Linus Pauling, and R. R. Wilson, among others here presented, shows that a set of ingenious social devices exists to seek out special scientific talent and to bring the acolyte quickly to the most fruitful frontiers of research. In the process the young scientist usually has both the opportunity of training and companionship with a team and also, in the best cases, the opportunity of developing even his most idiosyncratic and iconoclastic ideas.

Such case studies should be helpful antidotes to the current threats of demoralization that, paradoxically, come at a time when the immense dynamism of science has brought it to its highest plateau of achievement. Given sufficient backing, and given bright students who are eager to take part in the intellectual struggle, we can confidently expect the next decades to bring a flowering of scientific progress for which the successes of the past may turn out to have been simply a preparation.
—GERALD HOLTON, *Department of Physics, Harvard University, Cambridge, Massachusetts 02138*



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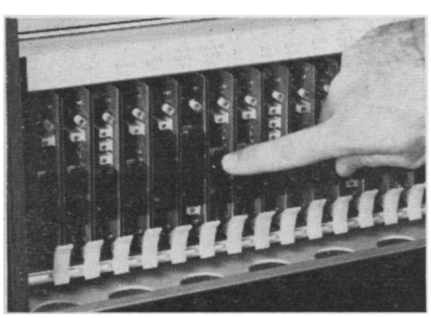

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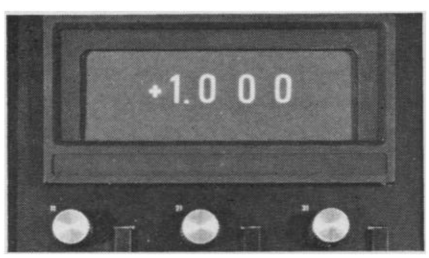

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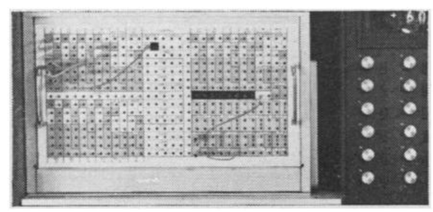

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