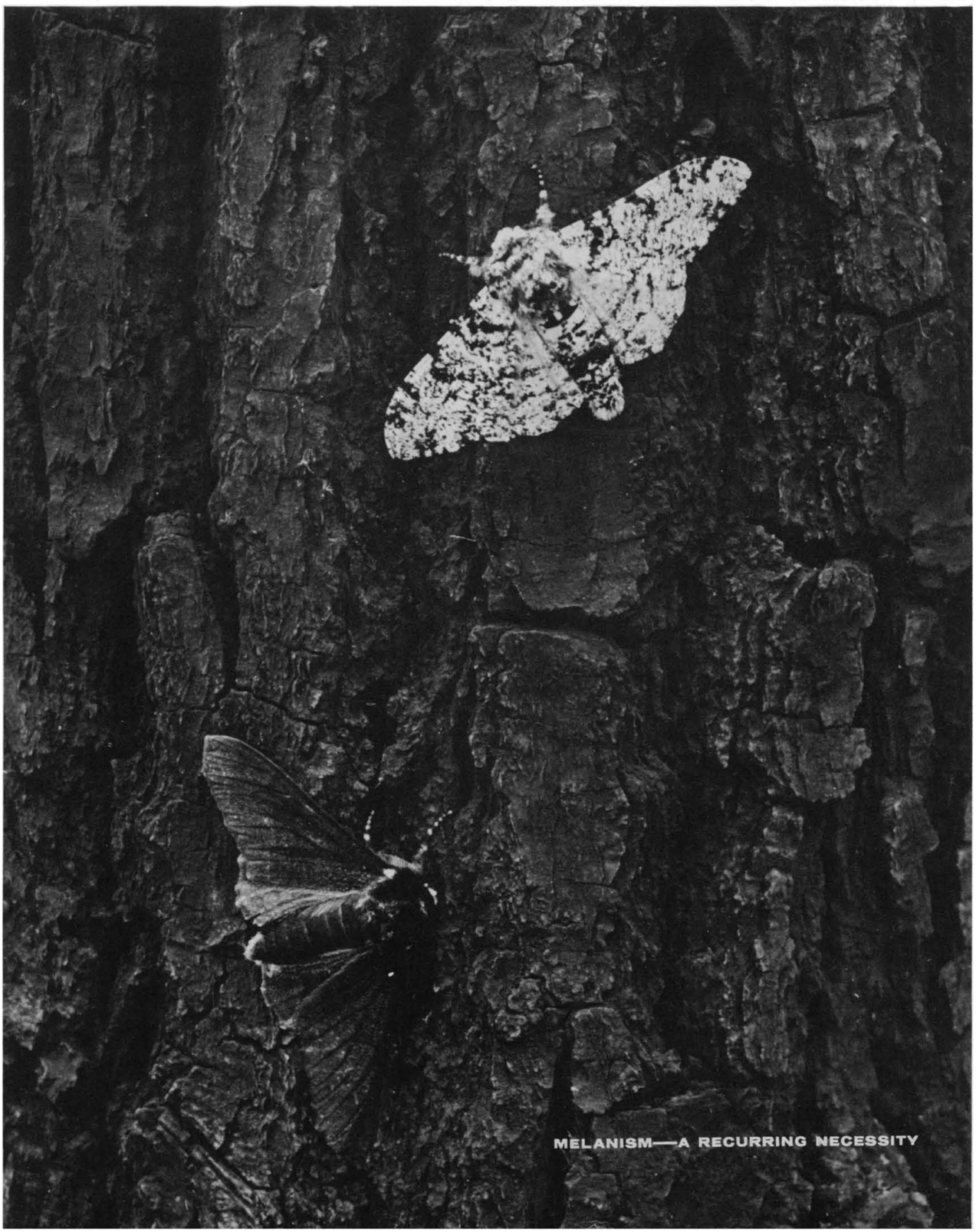
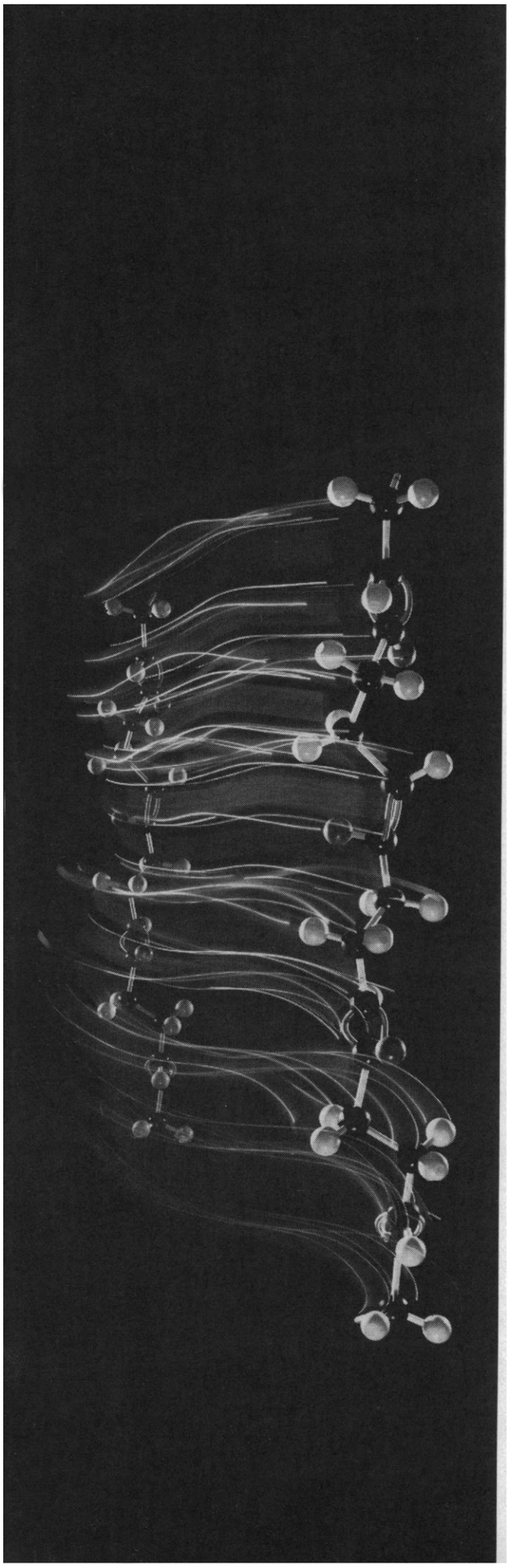
SCIENCE

4 June 1965
Vol. 148, No. 3675

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



MELANISM—A RECURRING NECESSITY



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The molecules in a solid may be tumbling, rotating, or jumping. Or just quietly vibrating. What they do can affect the characteristics of bulk matter. This is not news . . . but the way we can relate specific motions to physical properties *is*.

Physicists at GM Research are using Nuclear Magnetic Resonance (NMR) to study molecular motion as temperature or composition is changed. This new branch of spectroscopy uses magnetic nuclei to probe many phenomena on a molecular scale. From it, for example, our NMR physicists are developing new knowledge of electron densities, molecular configurations, and the basic nature of that strange squishy state of matter—the plastic crystal.

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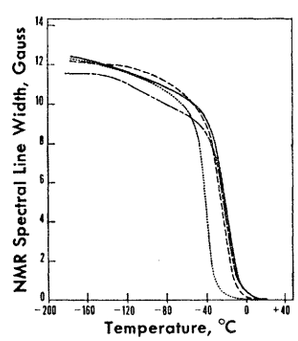
The motions of the nuclei tell the tale . . . and help General Motors find a better way.

General Motors Research Laboratories

Warren, Michigan



Effects of plasticizers on NMR spectrum of neoprene. The best plasticizer produces spectral line narrowing (due to increased molecular motion) at lowest temperature. —From a recently published GMR paper.

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All definitions are worded to maximize rapid understanding. Pronunciation is clearly indicated. Anatomical terms are now organized so that you will find the full definition under the first word you check or the first term to which you are referred. The latest *Nomina Anatomica* term carries the main entry. Consistent NA terminology is a hallmark of this edition.

Hundreds of drug names have been added. Common drugs are entered under generic and proprietary names, with brief statements on structure, action and use in the generic listing. Entries in microbiology, hematology, and dermatology have been particularly reworked for accuracy and timeliness.

Several hundreds of new illustrations have been added; many existing ones have been redrawn. The addition of many electron photomicrographs is notable. Valuable tables list chemical elements, stains and staining methods, weights and measures, etc. A concise section on "how to use the dictionary" clearly explains entry arrangements, alphabetization, etymology, pronunciation, etc. A new, more durable paper has been utilized for this edition. The highly legible type face has been retained, along with flexible binding and thumb-indexing.

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ELIZABETH W. REED, Ph.D., and SHELDON C. REED, Ph.D. Both at Dight Institute for Human Genetics, University of Minnesota, Minneapolis, 719 pages, 7¼" x 10¼", with 290 figures. $16.50. *New—Published in April!*

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Sherif, Sherif and Nebergall's

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Any social scientist or researcher interested in a better understanding of attitudes and communication in today's complex world will find this to be a fascinating book. The authors, well-known social psychologists, trace in detail the psychological processes of the individual in his acceptance or rejection of persons, groups, ideas, and events. This volume clearly sets forth and emphasizes the differentiation of attitudes into discernable classifications of acceptance, rejection, and the vital area of noncommitment. Studies conducted on *desegregation, ethnic groups, reapportionment of state legislatures, farm policy, labor-management issues, Prohibition, prices of consumer goods,* and *the 1960 Presidential campaign provide* rich psychological material on how groups and individuals come by the opinions they hold.

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4 June 1965
Vol. 148, No. 3675

SCIENCE

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AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

COVER

Melanism in insects inhabiting industrial environments is one of the most striking evolutionary changes occurring today. Extensive investigations of *Biston* (*Amphidasys*) *betularia* (peppered moth) reveal that its black form, *carbonaria*, may constitute up to 98 percent of industrial populations. The black form has a 30-percent chance of survival over f. *typica* on blackened tree trunks. A mechanism may exist in the gene complex, and may insure dominance of the black form at each mutation. See page 1290. [H. B. D. Kettlewell, University of Oxford]

IBM announces three new programming support packages for scientists and engineers who will use SYSTEM/360

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With the individual subroutines or with combinations of them, you can carry out functions like the following:

In statistics:

- analysis of variance (factorial design)
- correlation analysis
- multiple linear regression
- polynomial regression
- canonical correlation
- factor analysis (principal components, varimax)
- discriminant analysis (many groups)
- time series analysis
- data screening and analysis
- non-parametric tests
- random number generation (uniform, normal)

In matrix manipulation:

- inversion
- eigenvalues and eigenvectors (real symmetric case)
- simultaneous linear algebraic equations
- transposition
- matrix arithmetic (addition, product, etc.)
- partitioning
- tabulation and sorting of rows or columns
- elementary operations on rows or columns

In other mathematical areas:

- integration of given or tabulated functions (Runga-Kutta)
- integration of up to six first order differential equations (Runga-Kutta)
- Fourier analysis of given or tabulated functions
- Bessel and modified Bessel function evaluation
- gamma function evaluation
- Legendre polynominal evaluation
- elliptic, exponential, sine, cosine, Fresnel integrals
- finding real roots of a given function
- finding real and complex roots of real polynomial equations
- polynomial arithmetic (addition, division, etc.)
- polynomial evaluation, integration, differentiation

These new subroutines will help in every area of industry and science.

Correlation analysis, multiple regression, factor analysis, and data screening and analysis are standard tools for research in medicine, biology, psychology and like fields.

In colleges and universities, faculty members and students will get better use of their computation center with a minimum of programming time.

In the process industries, these new subroutines will speed up analysis of operating data, quality control, design of petroleum and chemical units, simulation of units, plants and processes, and laboratory analysis.

In the aerospace industry, the programs will help in system design and analysis, data reduction and analysis, data acquisition and control, and system simulation and evaluation.

Whatever industry you're in, your job becomes a little easier.

...Mathematical Programming System/360 gives you powerful mathematical optimization capabilities

This new system combines the best features of current IBM linear programming systems with significant new capabilities including MARVEL, a new language processor for matrix generation, solution analysis, management reporting and file maintenance. Modular design makes it easy to incorporate new optimization techniques, as they are developed, hence the name Mathematical Programming System/360.

- Maximum problem size of 4,095 rows.
- The system utilizes the Revised Simplex (product form of inverse) Method with bounded variables and range constraints.
- A highly efficient inversion technique using a triangularization method permits inversion to be made frequently, thus increasing the speed of succeeding iterations and maintaining a high degree of accuracy.
- Multiple pricing method, adjusted for problem size and amount of available storage, reduces the amount of file processing and increases solution speed.
- A "cycle" facility which reduces solution time for problems containing many more columns than rows.
- Dynamic storage allocation provides for maximum use of available storage.
- The control language includes conditional control statements which permit alternate solution strategies to be implemented depending upon the conditions which arise during solution.
- Interrupt facilities provide the means for preplanning alternate strategies in the event of off-normal conditions.

• Simultaneous parametric programming on both the right-hand side and the objective function may be used.

• A single language (MARVEL) is used to specify the file processing functions needed for mathematical programming applications.

• Specialized matrix generators and report writers can be written in the MARVEL language.

• Modular design makes it easy to add, modify, replace or delete functions as new requirements develop.

The MARVEL language allows you to prepare printed reports in final form with easily written programs which may perform mathematical operations, reordering, selection and analysis while the report is being prepared. The flexible input and output facilities coupled with the capacity to communicate directly with the mathematical programming procedures provide the user with a powerful management report writing system.

The MARVEL language also contains a complete set of operations to produce, select, and maintain data files associated with mathematical programming problems. By using the selection and maintenance features of the MARVEL language, the user can produce new data files (matrix generation) from one or more data sources. These new data files may: consist of data to be input to user programs; be filed as partially processed data; or, define a new mathematical programming problem.

While unknown only 20 years ago, linear programming techniques are now being used to cut costs in applications like aluminum alloy blending, gasoline blending, ice cream mixing, meat packing, electric arc furnace steel making, blast furnace burdening, production planning and a whole range of marketing problems.

...Project Management System/360

This advanced, modular program provides critical path scheduling, PERT, and PERT/COST capabilities. Its building block design under monitor control insures flexibility for incorporating additional functions and adaptability to special customer requirements, so that both customers and IBM can add such functions at a later date.

Project Management System/360 will consist of a set of modules, each designed to perform an application function and to operate efficiently with particular equipment components and features. Since each module will be operationally independent of the other modules, it is practical to efficiently support a wide range of processor, input/output devices and storage capacities. Modular design not only has the advantage of ease of modification and maintainability, but also provides exceptional ability to respond to individual needs. Thus the Project Management System/360 can be readily tailored to your specific requirements without expensive reprogramming.

Projects of all types in construction, special products manufacture, large-scale R&D, etc., have been growing increasingly complex. Effective management requires up-to-date knowledge of job status and financial performance. Even more important, management needs to determine the probable schedule and cost impact of contemplated changes in plan. Project Management System/360 provides the scientific management tools needed for making better delivery promises, for spotting out-of-line conditions, for meeting schedules, for controlling costs.

Project Management System/360 will help plan and control the use of valuable resources: men, machines, money and material.

Some of the major applications for this network oriented system include:

In manufacturing and distribution: network techniques have been used to schedule construction operations, the use of mining equipment, crude petroleum manufacturing, natural gas operations, construction repair and maintenance, pulp mill operations, paper and paperboard manufacturing, book preparation and printing, blast furnace maintenance and meat packing operations.

In construction and engineering: network techniques to plan, estimate, schedule manpower and materials, control, and coordinate sub-contractors.

In service industries: network techniques to schedule freight forwarding operations, terminal and service facilities, power plant operations, bank clearinghouse operations, dividend check distribution, insurance report preparation, judicial functions, urban development.

In Federal agencies: PERT and PERT/COST are used for internal management control as well as for contractor control.

In research and development: network techniques to schedule aerospace research and development projects, test production of biological products, experimentation with drugs, university and college curricula and facilities usage, library operations and farm planting.

Just three more reasons for choosing SYSTEM/360 *for science & engineering.*

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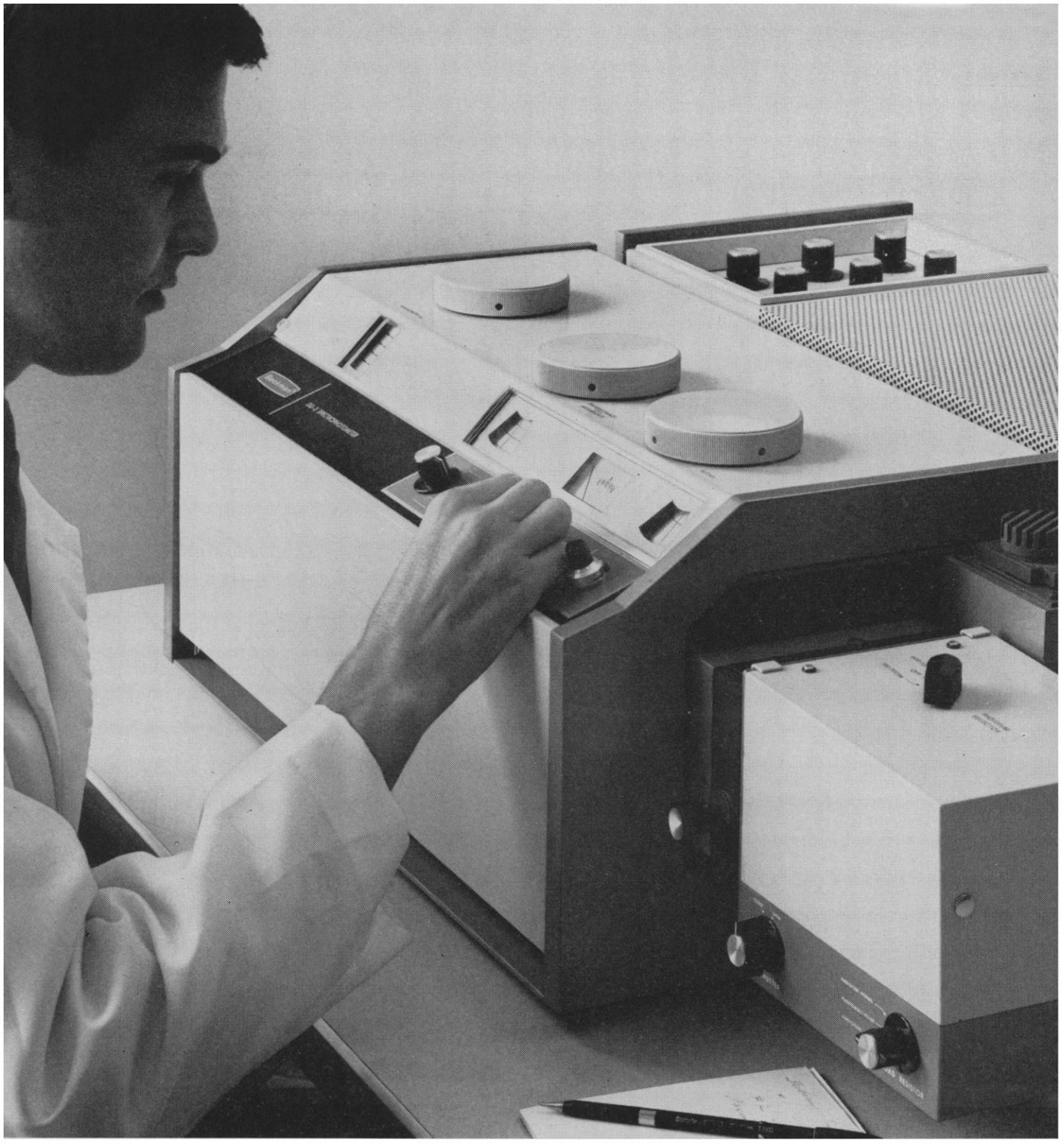

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of legal redress were not utilized. And, while the actions of the demonstrators were shocking, even more shocking was the inept handling of the situation by the university administration.

Although many of the statements in the Langer report can be challenged, certain of those in part II are most misleading. To say that "it is only Berkeley that has placed the university as a whole in a position of leadership in American higher education" does a disservice to the other campuses of the University of California. The majority of students and faculty are located on other campuses, and the implication is that these are inferior to the Berkeley campus. Yet the entry requirements are as stringent at the other campuses as they are at Berkeley. The quality of scientific research is not inferior at these campuses. And certainly neither the teaching nor administration is inferior. The university's great position in higher education is attained in a large measure through its multi-campus concept. Each campus can point to something it offers academically that Berkeley does not. When put together, these make the University of California great. All are an integral part of a single educational system.

The actions of the administration, faculty, and students at the other campuses with respect to this controversy have been admirable and certainly acceptable by community standards. Neither students' rights, education, nor research have been compromised on these campuses. The "tradeoff between . . . student 'beatniks' and . . . academic distinction," to use Langer's phrase, does not seem to be necessary at these campuses. Langer says that many Californians want a "respectable" rather than a great university. I do not know how many; I do know that the majority of Californians would agree on and strive to maintain what we have had in the past: a state university both great and respectable.

RONALD L. KATHREN
14744 Washington Avenue, San Leandro, California 94578

The Basic Priorities

The articles on the Berkeley "student revolt" constituted excellent coverage of that unhappy situation. Although *Science*'s articles touched on the basic problems involved, most of the editorials and news stories I've seen missed the mark by a wide margin.

The American public (including many scientists and educators) evinces an appalling lack of understanding of (i) the aims of education, (ii) the current pressures on students, and (iii) the nature of university administration. Education should encourage all possible freedom of thought, speech, and action that will contribute to the intellectual, moral, and physical growth of the learner. At Berkeley this dictum was forgotten or overlooked by all four groups involved—students, faculty, administrators, and regents. Owing to several factors—such as enormous enrollment increases and plant expansion, emphasis on faculty and graduate research, disregard for undergraduate teaching and guidance, inept administrative and board decisions—pressures on students blew the safety valve.

One solution to the dilemma is for all of us to recognize that each of the four campus-related groups has a specific or primary role. When these roles are reversed, or otherwise mixed up, serious dislocations occur. At the risk of oversimplifying, scholars of higher education have suggested the following basic priorities: Students are on campus to study; faculty members are there to teach; administrators should manage, negotiate, and facilitate; trustees and regents should establish the governing policies. The American public is composed of these four academically related groups, plus hundreds of other interested groups such as parents, alumni, donors, and legislators. Each person in each group can make a significant contribution to the alleviation of such pressures as caused the "revolt" at Berkeley. The first step should be in understanding the dimensions of the three numbered points above. The second step should be the acceptance of a position on these points. The third step should be a willingness to express this position by suggesting appropriate action. Really constructive criticism is in short supply!

This nation is great at least partly because of the education provided its citizens. It should be the responsibility of every citizen to take the steps necessary to insure that our schools, colleges, and universities will continue, if not improve, their important function of educating for freedom, democracy, and justice.

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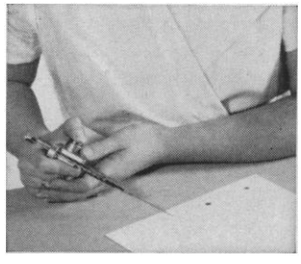
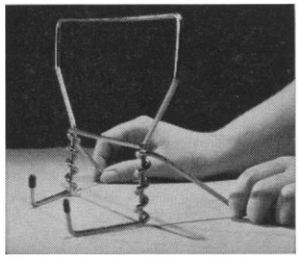
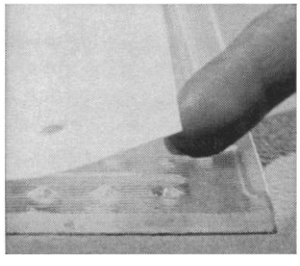
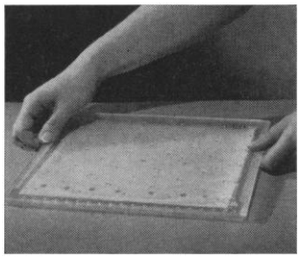
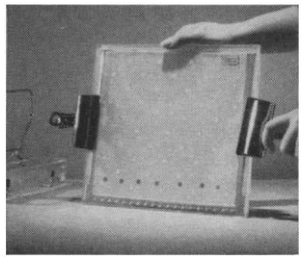
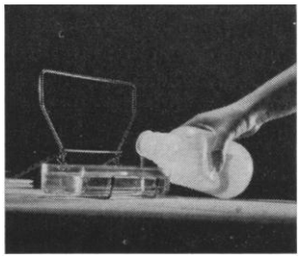
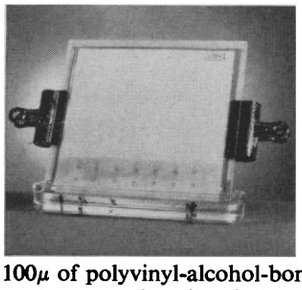
The chemist's lot eases further

Just before 5 on the afternoon of March 1, 1965 a strong movement toward the ballroom of the Penn-Sheraton was under way. These people must have done their homework by giving careful advance scrutiny to the program of the great Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy. Within the hour, what we had done to thin-layer chromatography was animating conversation in lines waiting for tables in restaurants all over the Golden Triangle.

What we had done was to break the news that EASTMAN CHROMAGRAM Sheet had arrived to take the mess out of TLC by providing silica gel properly coated on a snippable base of poly(ethylene terephthalate). What we had failed to do was to provide a minimal-volume, fast equilibrating chamber in which to develop the stuff. This we are about to put on the market as EASTMAN CHROMAGRAM Developing Apparatus. To minimize delay, place order *now*, along with your order for the sheet. Upon delivery, proceed as follows:

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Some products we are more pleased to sell than other products. The pitifully perishable character and steep price per cubic centimeter of liquid KODAK Nuclear Track Emulsions make a wicked combination. Too bad they have turned out so essential to the conduct of fundamental research in the life sciences. Originally, some decades ago, we thought the physicists were going to be the principal customers for photographic materials designed to pick up tracks of ionizing particles, but we were wrong. Turned out that bubble chambers of liquid hydrogen and spark chambers are much, much better for particle physics. Sheer joy it is for us to furnish the film on which these bubble tracks and sparks are imaged by lenses.

But biological scientists, who have a bit less need than high-energy physicists to cluster together in huge establishments with huge budgets and huge, highly specialized purchasing departments, are invited to speak right up on their own for their requirements in autoradiographic emulsions to Eastman Kodak Company, Special Applications, Rochester, N. Y. 14650. We even have a new pamphlet for them.

Lens people

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If you know enough to deny that resolving power tells the whole story about lens performance, you may qualify to participate in some really stimulating discussion. Today it is possible to talk modulation transfer functions until either the cows come home or the bucketfuls of digits boil down to a one-bit question: is Lens A better than Lens B?

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4 June 1965, Volume 148, Number 3675

SCIENCE

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Science in the State Department

The Department of State's program of sending scientific attachés to major foreign capitals was started early in the 1950's. Promising but on trial at first, faltering and almost dead a few years later, the program has now gained in size, in acceptance, and in responsibility. Scientific officers represent the U.S. in some 15 foreign capitals. To back them up, the Department of State's Office of International Scientific Affairs has grown to include a professional staff of approximately 20. The office here and the attachés abroad serve as bridges between American and foreign scientists; in more than purely scientific ways they exemplify and further a friendly spirit of international cooperation; and they advise the Department of State and our ambassadors on matters in which science and technology are involved. If the amount of work they are called upon to do is a valid measure of acceptance, the program has established its position and usefulness.

How effective a scientific officer can be in a particular situation depends in part upon the ambassador and the other foreign-service officers with whom he works and upon their interest in and knowledge of how to use the services of their scientific colleagues. The Foreign Service Institute of the State Department recently made a contribution to better utilization by conducting a 4-week science seminar that was supported by the Ford Foundation and that gave a number of foreign-affairs practitioners an intensive course on the role of science and technology in foreign relations. A description of the course, by L. F. Audrieth and H. I. Chinn, and the keynote address to the seminar, by James R. Killian, both appear in the May issue of the *Bulletin of the Atomic Scientists.*

The seminar appears to have been productive. And the recent announcement that the name of the office had been expanded to "International Scientific and Technological Affairs" and that the director would have rank and authority equivalent to an Assistant Secretary of State may enhance the prestige of the program. But these changes are not adequate substitutes for filling the top position, which has been vacant since Ragnar Rollefson, the last director, returned to the University of Wisconsin in September. The lack of a scientific director is weakening the State Department's relationships with the community of scientists and engineers and curtailing the ability of the staff to provide the best possible assistance in evaluating the scientific and technological problems that are involved in a widening array of foreign-policy decisions—for example, those dealing with international laboratories, resource development, such cooperative ventures as the study of the Indian Ocean, the technological problems of arms control and monitoring systems, application of science and technology for the benefit of developing nations, or joint arrangements for communication systems, weather reporting, or other technical matters.

Of course the State Department has had other problems to worry about in the past 9 months. Nevertheless, the post of director should be filled without further delay. Still around are a number of people who can remember the situation that arose a decade ago when the top position was allowed to remain vacant; science attachés abroad completed their tours of duty and were not replaced, and the program came almost to a halt. By inaction at that time the Department of State deprived itself of one of its own assets in the conduct of foreign relations. We hope it is not starting on that course again.—DAEL WOLFLE

Photographs A through G: Preparing organic intermediate for use in a corrosion inhibitor, using S&S No. 589 Green Ribbon.

Photograph H: Quantitative analysis, showing ignition of Fe_2O_3 precipitate using S&S No. 589 White Ribbon.

Photographs I through M: Vacuum filtration under dust-free conditions of analytical precipitate in the Alodine process using S&S No. 589 Black Ribbon.

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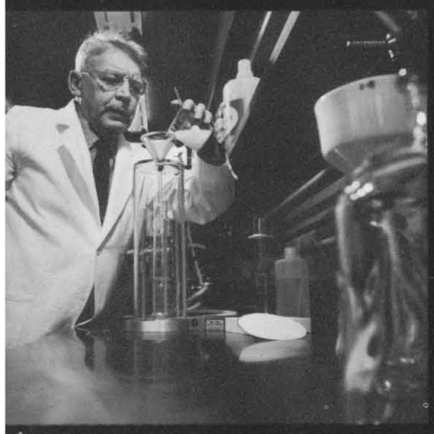

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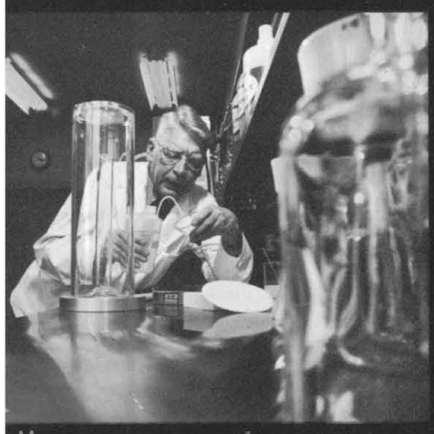

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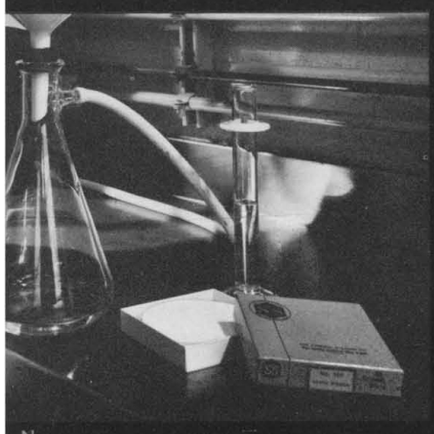

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Report from

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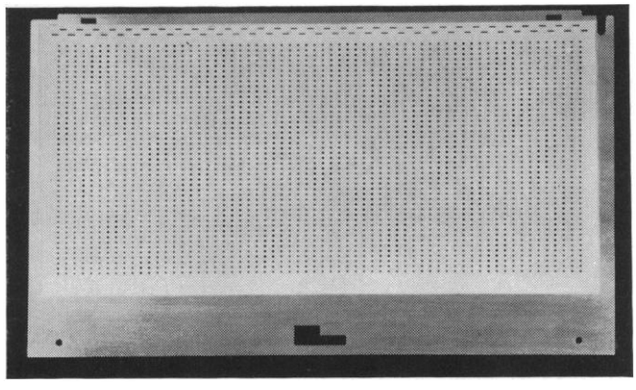
B. G. Hemmendinger examines one of the digital circuit packages used in the central control unit of the new Electronic Switching System developed at Bell Laboratories. In these circuits, logic functions such as AND, OR, and AND-OR are built up with various combinations of a basic AND-NOT gate. About 27,000 transistors and 90,000 diodes are used in two duplicated central control units for one electronic central office.

Stored-program control— flexibility for telephone switching systems

Modern systems that switch your telephone calls use complex control equipment to operate the switches that make telephone connections. Such "common control" equipment is time-shared by many telephone lines. In electromechanical systems, common control apparatus consists of hardware—an array of hundreds of relays wired together to do the switching jobs of a particular telephone exchange.



Memory card, 6½ by 10½ inches, used for storing the ESS control program. Useful information (64 forty-four-bit words) is carried by the card in the form of magnetized spots ("zero") and unmagnetized spots ("one"). The random-access memory stores the control program and other data on 2048 such cards (131,072 words). The control instructions themselves require a minimum of 100,000 words.

By contrast, common control in the new Electronic Switching System (ESS) developed at Bell Laboratories is exercised by a multitude of general-purpose digital circuits whose actions are directed by "software"—programmed sequences of instructions stored in memory. The operation of ESS, including the specific telephone services provided, can thus be changed merely by changing the magnetization pattern of memory cards like that shown at left, with little or no hardware rearrangement or rewiring.

More specifically, ESS common control consists of an electronic data processor with a large memory. The memory contains instructions for processing all of the different kinds of calls handled by a central office. Guided by this stored program, the data processor receives and interprets dialed digits, sends signals to appropriate switches, and at the same time detects and diagnoses circuit malfunctions.

With this flexible common control, combining hardware and software, ESS can efficiently provide the various telephone services available today as well as any new services needed for the future.

Bell Telephone Laboratories

Research and Development Unit of the Bell System