SCIENCE

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

1 April 1977, Volume 196, No. 4285

Let's Tell It Like It Is

DEPEND ON US FOR MORE FOOD Hunger

Increased famine in the developing world in Asia, Africa and Latin America is inevitable because:

1. Food production cannot keep pace with runaway growth in population, and
2. Population growth in those areas is out of control. It cannot, and will not, be stopped in the foreseeable future, using conventional methods now being practiced or contemplated by our foreign aid establishment.

Last year, The Environmental Fund sponsored an advertisement ("The Real Crisis Behind the Food Crisis") which elaborated on the above statement. Its publication stimulated a surprising 23,000 replies (all but 13 in agreement with the analysis). Many asked, "What can we do about it?"

Indeed, how can Americans ameliorate the impending tragedy?

First, we must understand that we are being misled into believing that the United States has no problem with excessive population growth.

Second, we are being misled into thinking that many poor nations of Asia, Africa and Latin America are successfully coping with their runaway population growth.

Both assumptions are wrong.

The United States has a serious population problem; the vast majority of the hungry nations have an even more serious one.

Yet nearly all nations, the United States included, lack any sort of population stabilization program. Most do not want one.

Unless people lower the birth rate (or nature raises the death rate) the world's population will quadruple during the lifetime of many of us now reading this page.

This insupportable growth is **not** the result of an increase in the birth rate. It is the result of a precipitous drop in the death rate, with no accompanying drop in the birth rate. It takes no special foresight to see that birth rates must come down, or death rates will climb to what used to be considered "normal".

The U.S. Department of Agriculture has announced that the world can no longer rely on U.S. food aid gifts or concessional sales to fill the world food gap.

This unusually candid declaration from the USDA provoked an immediate and vigorous response from various groups, organizations and individuals. Some, recognizing the wastes of an affluent society, declared that the problem was not limited capacity, but a reluctance to distribute resources fairly. Others declared that it was a moral imperative for us to become the "breadbasket of the world", today, and that the future would take care of itself. Still others are lobbying in Washington to establish food aid as "the cornerstone of our foreign policy", i.e., charity-by-law. Even granting the consent of the taxpayers and the good intentions of the lobbyists, this course of action is a prescription for disaster.

THE ADVERSE EFFECTS OF FOOD AID

Consider what food aid does.

Each piece of land has a specific carrying capacity. That capacity can be altered by fertilizer, improved management, and superior crop varieties. But there are still definite limits to how many people a given unit of land can support. Food aid violates the carrying capacity principle by artificially allowing more people to live on the land than can live from it.

Today, in order to provide large amounts of food aid, the donor country must overcultivate its own land, farming marginal acres, destroying the topsoil, and reducing its future ability to produce. When a 10,000 ton freighter loaded to the scuppers with U.S. wheat sails forth, it carries with it 200 tons of nitrogen, 41 tons of phosphorus, and 50 tons of potassium—all lost forever from the fertility of our soils.

THE INVERTED ETHICS OF FOOD AID

Food aid also enables the donor to postpone facing the grim reality which no one wants to face, which is unless population growth is stabilized, the inescapable result of saving lives today will be an even greater number of lives lost tomorrow.

Those who ask the United States to increase its foreign aid commitment so that more food may be sent to the hungry overseas, simply misunderstand the problem: there are now too many people for the carrying capacity of the land. This year, the world's population will add 93 million people; next year, 95 million. Within eight years, 800 million people will be added to the world.

Nearly all of the 123 countries of Asia, Africa and Latin America— whether or not they have "benefited" from the U.S. foreign aid program—now have more poor, more illiterate, more hungry people than they had when this program began. Yet today, the U.S. development establishment allows recipient nations to count on food shipments from this country or to depend on the empty promise that those shipments will continue tomorrow—no matter how large populations grow.

This is a cruel deception.

By means of promises, declarations and resolutions, the United States is assuming a role it cannot play, and responsibilities it cannot carry out. This perception of the United States as a **limitless** cornucopia is a dangerous delusion to all concerned. It is dangerous to Americans because it isn't true, and, like all evasions of reality, it eventually leads to disillusionment and despair.

But it is an even more dangerous disservice to the leaders of the crowded and hungry nations. Belief in these promises enables them also to evade reality, to evade the hard decisions that must be made if their mushrooming populations are to be matched by their own resources.

WHAT AMERICA CAN DO AT HOME AND ABROAD

In order to help anyone at all—at home or abroad—Americans must learn to distinguish fact (the carrying capacity of the land) from fancy ("We can feed the world, if we really want to"). We must learn to distinguish pride in our achievements from the vanity of our ambitions. America cannot **control** the world, but perhaps we can influence policy. We can do it better and more honestly if the United States first puts its own house in order—which means facing the American population problem (our own growth rate will double our population in 47 years).

To put our own house in order, the United States should:

A. Enact a national population stabilization program
B. Encourage smaller families
C. Stop illegal immigration, which now doubles our annual growth rate
D. Balance legal immigration with emigration

All of these are necessary steps for our own benefit; in addition, they will also enable us to face our overpopulated neighbors with a clearer conscience and increased credibility.

Obviously, our most direct opportunity to deal with the population problem abroad is in the area of foreign policy, and there we should:

E. Stop any U.S. foreign aid program which encourages population growth

One way of doing this would be for the Congress to enact a Resolution along these lines:

WHEREAS we are aware, and are rightly fearful, of the ominous consequences of the growing world food/population crisis; and

WHEREAS the consequences of continued population growth will be increased human misery; and

WHEREAS increasing food production and/or availability, which lowers the death rate without influencing the birth rate, accelerates population growth; and

WHEREAS agricultural production cannot keep pace with a world population growth rate that would double our numbers every twenty-five years;

NOW THEREFORE BE IT RESOLVED that it is the sense of Congress that a moratorium be declared on all U.S. food aid and technical assistance to any country if:

1. its population growth rate is above the world average, **unless**
2. it officially acknowledges that its national birth rate must be lowered and unless it adopts stringent measures to control population growth, which measures must be judged adequate by the United States as the donor nation.

What would be the value of such a moratorium?

It might awaken the leadership of the developing countries to the urgency of their population problem. For the United States, through this Resolution, to say it cannot endorse the unrestricted use of its assistance funds, because to do so will increase the sum of human suffering, would be a total reversal of what the world has been hearing for the past quarter of a century.

Why haven't the leaders of the developing world taken the necessary steps to check their population growth rates? Why are countries with the fastest-growing populations often the least willing to acknowledge the existence of a problem?

One answer is the optimism generated by the American scientific community and development establishment. Year after year, since we initiated the foreign aid crusade, the leadership of the hungry nations has heard that the agricultural profession can solve the food problem if given enough support. It cannot.

A moratorium would not eliminate all foreign assistance. Our government should continue not only to help, but to **expand** its assistance to those few developing countries with population growth rates lower than the world average. But it should **concentrate its assistance on those countries which clearly show through active practices, a determination to decelerate their rate of population growth.** The moratorium would affect only these nations which will not do so.

Many will feel that such a moratorium is morally wrong.

Those who feel this way must weigh the morality of the moratorium against the morality of any action which contributes to overpopulation. Overpopulation today makes it impossible for half of those within the hungry nations to have the diet necessary to protect them against debilitating diseases that bring early death. Overpopulation makes whole nations dependent upon the vagaries of the weather to prevent famine in their lands. Overpopulation leads to more suffering and more deaths, to war, and to chaos.

None of this is new, **but the number of people involved is new.**

Who, then, are the moral—those who advocate steps that will decelerate population growth, or those who advocate steps that will encourage population growth?

A moratorium on assistance will not abandon the developing world of Asia, Africa and Latin America to a future without resources. We sometimes forget that the world consists of independent nations that possess convictions of their own and the ability to order their priorities on how to spend their money. Every year they spend, for instance, $28 billion on armaments. We may not think this makes much sense, but it is **their** decision.

Might not declaring a moratorium on assistance be the alarm signal that would alert the leadership of such countries to the necessity for different decisions?

For too long, we have tried to solve the food crisis without trying to solve the problem which causes it. Confusing the effect with the cause, we have been told to tighten our belts, and "asceticize" our diets, so that more food could be shipped to the world's hungry. None of the variations on this theme deal with the cause of the crisis: runaway population growth.

Whether your most urgent concern is peace, freedom, the food supply, civil liberties, the environment or social justice, it's a lost cause unless the population of the world is stabilized. We share these concerns, and all are compelling reasons why population stabilization is essential.

If you have a better solution, **tell** us. Tell us how **you** would solve the problem.

The Environmental Fund does not solicit contributions or memberships. However, we would welcome your comments and if you would like to be on our mailing list, please let us know.

Mr. Justin Blackwelder, President
THE ENVIRONMENTAL FUND, INC.
1302 18th Street, N.W.
Washington, D.C. 20036

Name _____

_____

Address _____

_____

Comments: _____

_____

_____

_____

THE ENVIRONMENTAL FUND

1302 EIGHTEENTH STREET, N. W. • WASHINGTON, D.C. 20036 • 202-293-2548

1 April 1977

Volume 196, No. 4285

SCIENCE

SCIENCE is published weekly, except the last week in December, but with an extra issue on the fourth Tuesday in November, by the American Association for the Advancement of Science, 1515 Massachusetts Ave., NW, Washington, D.C. 20005. Now combined with **The Scientific Monthly®**. Second-class postage paid at Washington, D.C., and additional entry. Member rates on request. Annual subscriptions $60; foreign postage: Canada $10; other surface $13; air-surface via Amsterdam $30. Single copies $2 (back issues $3) except **Guide to Scientific Instruments** $6. School year subscriptions: 9 months $45; 10 months $50. Provide 6 weeks' notice for change of address, giving new and old addresses and postal codes. Send a recent address label, including your 7-digit account number. **Postmaster: Send Form 3579 to *Science*, 1515 Massachusetts Avenue, NW, Washington, D.C. 20005.** ***Science*** is indexed in the **Reader's Guide to Periodical Literature.**

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

COVER

Aircraft of National Aeronautics and Space Administration, carrying a thermal scanner, passes over an experimental field at the U.S. Water Conservation Laboratory in Phoenix, Arizona. The scanner maps canopy temperatures that are used to predict grain yield on the basis of a "stress degree day" concept. See page 19. [U.S. Department of Agriculture, Agricultural Research Service; Con Keyes, Tempe, Arizona]

BAER: The Genetic Perspective

The Genetic Perspective explains the relevance and value of genetic knowledge in everyday life. Designed for the non-science major, it teaches students the essentials of genetics and evolution without overburdening them with the details found in more technically-oriented books. Topics include *genetic counseling, cancer, aging, plant breeding,* and *recombinant DNA.* And, by drawing on examples from a broad cross-cultural range (from South Sea Islanders, to Navajo Indians, to rock star Johnny Winter), the author maintains a level of relevance your students will readily appreciate.

By **Adela S. Baer,** San Diego State Univ. About 305 pp. Illustd. Ready April 1977.
Order #1471-X.

DE WITT: Biology of the Cell: An Evolutionary Approach

Avoiding a "catalog" approach to the study of cell features, this introductory text emphasizes evolutionary development. The author's narrative style skillfully incorporates reviews of basic chemistry, pH, basic biochemical information, and introductory aspects of cytology and molecular genetics wherever appropriate. His eclectic account of the evolution of living systems draws on theories of workers such as Oparin and Margulis. This book will fit well into an introductory "core" sequence, either before or after courses in organismic biology.

By **William De Witt,** Williams College. 568 pp. 287 ill. $13.95. Jan. 1977.
Order #3045-6.

DE WITT & BROWN: Biology of the Cell: Laboratory Explorations

Well-conceived, class-tested experiments in cell biology—many never before adapted for undergraduates—are the cornerstone of this laboratory manual which reflects the evolutionary approach of the senior author's text. Of special interest are a number of unique experiments relating to theories on the chemical origin of life, particularly the formation of proteinoids and coacervates. No sophisticated equipment is needed to perform the experiments, and the manual can be used to complement virtually any introductory text in cell biology.

By **William De Witt** and **Eleanor R. Brown,** both of Williams College. 205 pp. Illustd. Soft cover. $6.95. Jan. 1977. **Order #3047-2.**

VILLEE: Biology *Seventh Edition*

Emphasizing biology with a human orientation, this new 7th edition maintains Villee's reputation for stimulating high student interest. Perfect for serious introductory courses, its extensive survey of the kinds of living things follows the Whittaker five kingdom phylogenetic scheme. Botanical coverage has been revised, rewritten and better illustrated to include modern terminology and current ideas on plant evolution and phylogeny. Physiological coverage is accentuated with brief discussions of and allusions to topics of medical concern. New to this edition, you'll find: *a complete reorganization (and some simplification) of material on cellular biology and biochemistry; a new chapter on human ecology; careful up-dating of data from active research areas including eukaryotic molecular biology, membrane structure, and the immune system,* and a *refurbishing, replacement or addition of literally hundreds of figures.* A valuable **Laboratory Manual** by Clinton F. Schonberger is also available.

By **Claude A. Villee,** Harvard Univ. Medical School. 980 pp. 650 ill. About $15.95. Feb. 1977. **Order #9023-8.**

CARPENTER: Microbiology *Fourth Edition*

Completely revised and up-dated, the new 4th edition of Carpenter's **Microbiology** maintains the same student-orientation and thoroughness of coverage that have long made it popular with students and teachers alike. The chapter on systematic study of bacteria has been completely rewritten to bring it in line with the 8th edition of Bergey's Manual; the nomenclature of genera and species has been up-dated throughout the text. The chapter on bacterial metabolism has been totally restructured; and there have been further additions to an already excellent group of illustrations. With the inclusion of sections on applied microbiology and infectious diseases—featuring the best immunologic coverage of any similar text—Carpenter's new edition is the perfect microbiology text for students in any life science discipline. An accompanying **Instructor's Manual** is also available.

By **Philip L. Carpenter,** Univ. of Rhode Island. About 545 pp., 355 ill. (with 4 color plates). Just Ready. **Order #2438-3.**

ROMER & PARSONS: The Vertebrate Body *Fifth Edition*

A standard for any course in comparative anatomy, the fifth edition of this classic text has undergone a vigorous revision under the authorship of Dr. Parsons. Maintaining Dr. Romer's overall emphasis on phylogeny and paleontology, the text also incorporates significant insights from functional studies. You'll see evidence of up-dated information on virtually every page, in addition to many new illustrations. There's also been a substantial expansion of Chapter 3 *(Who's Who Among the Vertebrates)* and the shortening and modernization of Chapter 4 *(Cells and Tissues).*

By the late **Alfred Sherwood Romer,** formerly of Harvard Univ.; and **Thomas S. Parsons,** Univ. of Toronto. About 680 pp., 435 ill. Ready April 1977.
Order #7668-5.

PETERS, PALAY & WEBSTER: The Fine Structure of the Nervous System: The Neurons and Supporting Cells

For giving your students a complete, documented study of neural fine structure, there's no other text like **Peters, Palay & Webster.** This definitive work brings together all the major advances of the past 20 years including the new techniques of freeze cleavage and scanning electron microscopy. Illustrated with detailed, full-page electron micrographs and extensively referenced, the book includes individual chapters on the meninges, ependyma, choroid plexus, blood vessels, connective tissue sheaths of peripheral nerves, and much more. The authors also explain how new tracing techniques using labelled amino acids and horseradish peroxidase, in conjunction with established methods of Golgi impregnation and experimental degeneration, can refine the structural analysis of the nervous system and extend the value of electron microscopy.

By **Alan Peters,** Boston Univ. School of Medicine; **Sanford L. Palay,** MD, Harvard Medical School; and **Henry deF. Webster,** National Institute of Neurological and Communicative Disorders and Stroke. 406 pp. 117 ill. $31.00. Sept. 1976.
Order #7207-8.

WALKER: A Study of the Cat with Reference to Human Beings *Third Edition*

The new third edition of this manual features 34 new figures along with an appendix of Greek and Latin roots of anatomical terms. Extensively revised, it includes: *comparison of fetal, neonatal and adult circulation; new information on the functional significance of the carotid rete mirabile; expanded comparisons with human science;* and much more.

By **Warren F. Walker, Jr.,** Oberlin College. 216 pp., About 110 ill. (some in color). Soft cover. About $6.50. Just Ready. **Order #9093-9.**

18 March

ELECTRONICS

a special issue of SCIENCE

The progress in electronics continues to be both rapid and revolutionary in its effects on society. Costs have been reduced so much that sophisticated electronics technology is now available for use by more and more people for many entirely new purposes—uses undreamed of even 5 years ago. Yet many individuals and institutions alike are still unaware of electronics' present-day possibilities and are therefore unprepared for its future impact.

The 18 March issue of SCIENCE will explore the entire spectrum of electronics development and the impacts on the way people will live and work in the next decade. More than 35 of the country's foremost authorities will discuss the unique role of electronics as a catalyst for change and will seek to identify important, long-term trends. Several articles will focus on the nature and prospects of electronics technology itself, while others will deal with the social and political impact of electronics in education and medicine, as well as other applications ranging from national defense to electronic mail service.

Both individual and institutional members of today's technological society should be alert to the fact that we have scarcely begun to properly explore the new world of electronics.

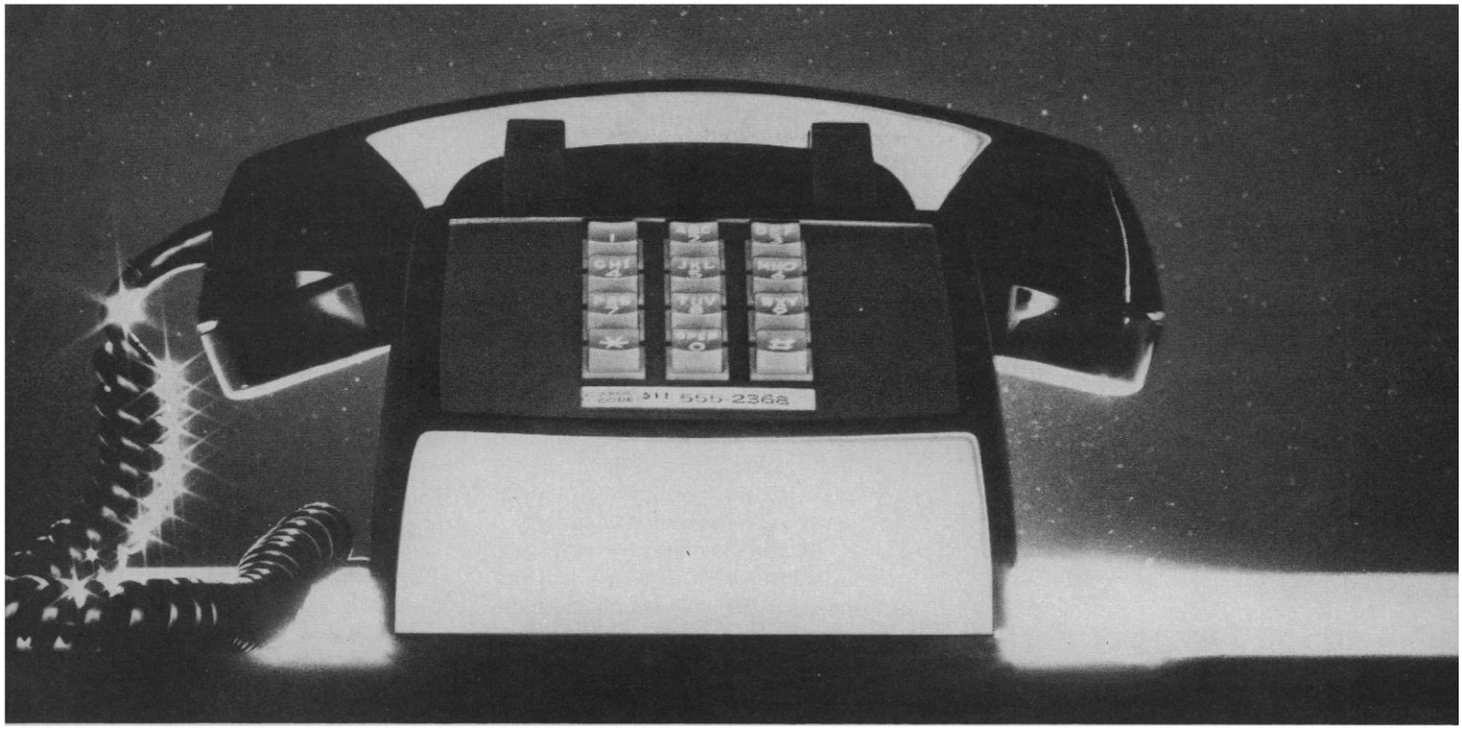
Among the distinguished contributing authors are:

- **William O. Baker,** President, Bell Laboratories
- **John R. Pierce,** California Institute of Technology
- **Robert Noyce,** Chairman, Intel Corp.
- **Herbert Simon,** Carnegie-Mellon University
- **John Linvill,** Stanford University

Additional copies of the Electronics Issue are available for $3.00 each

Send orders to: American Association for the Advancement of Science
Department—Electronics
1515 Massachusetts Avenue, NW,
Washington, D.C. 20005

(Remittance must accompany all orders under $5)



There's at least one thing you can afford that's the very best on earth.

American telephone service is the best in the world. Yet it's well within the reach of virtually every American.

This didn't happen by accident.

Both the quality and economy of your telephone service benefit greatly from technological innovations Bell Laboratories and Western Electric produce for the Bell System.

Money Well Spent...

Genuine innovation doesn't come cheap.

But the money Western Electric spends on research and development at Bell Labs produces a lot of innovation.

About 40% of what Western Electric makes today didn't exist in 1972.

That's triple the amount of innovation of industry in general.

Though such innovation costs a lot, it saves you money.

...Saves You Money.

Take long distance calling, for example. It's one of the few things that costs little more today than 25 years ago. That's because technological improvements have helped hold costs down.

For example, we have increased the capacity of coaxial cable systems from 600 simultaneous conversations in 1941 to 132,000 today.

We've increased sevenfold the capacity of our major microwave transmission system.

And our largest electronic switching system can handle four times the capacity of the previous system.

Innovations like these involve answering engineering and manufacturing questions at the forefront of technology.

Without the intimate flow of information that exists between Bell Labs and Western Electric, many of our innovations would have been much longer in coming.

Some might not have come at all.

A Complex Future.

Many future innovations will be even more complex, requiring even closer interaction.

As part of the Bell System, Western Electric and Bell Labs will continue to put technology to work for you.

So even if you can't afford the best of everything, you'll still be able to afford the best of something: The best telephone service on earth.

Bell Laboratories/Western Electric

LETTERS

Oil Spills: Effects of Petroleum on Marine Organisms

Philip H. Abelson's editorial (14 Jan., p. 137) concerning the *Argo Merchant* oil spill incident was prudent and timely. I have been involved for 3 years in work on the effects of petroleum on marine organisms. In my studies on mixed-function oxidase enzymes in relation to petroleum hydrocarbon detection and metabolism, representatives of several animal phyla have been exposed to petroleum in the laboratory. Research has included animal collections and observations near refinery outfalls, chronic sources of the hydrocarbons of low molecular weight that are believed to be the most toxic petroleum components. We have also exposed fish to petroleum for as long as 6 months and carried out some mutagen testing with fruit flies and the Ames bacterial strains. No laboratory results or observations of fauna near refinery outfalls have suggested that petroleum is a very harmful substance. A critical review of the literature also demonstrates that, in laboratory studies where toxic effects have been produced, experiments have generally been carried out with large doses of oil in stagnant water systems. A large spill in a confined area near shore will undoubtedly result in localized damage, but there was little reason last December for us to be awaiting daily a great ecological catastrophe on or near the George's Bank. Unfortunately, the flames of irrationality were kindled by a number of scientists. Now I am wondering how much garbage has been placed in my environmental conscience about pesticides and radionuclides—pollutants about which I have less familiarity.

JEREMIAH F. PAYNE
Newfoundland Biological Station, Fisheries and Marine Service, St. John's, Newfoundland A1C 1A1, Canada

Natural Gas and *Science* Paper

I prefer the nonglossy look given by the paper and ink used for two-thirds of the 11 February issue of *Science*. It is easier to read without the high reflective surface of the glossy paper. Why not continue with this paper and ink process, particularly if it results in an energy savings?

BARBARA D. HAYS
Department of Life Sciences, University of Pittsburgh, Pittsburgh, Pennsylvania 15260

Your explanation of the use of uncoated paper when the drying oven of Byrd Press ran out of gas (News and Comment, 11 Feb., p. 557) neglected to answer one obvious question: Did production of *Science* by that means cost any less? If so, I suggest that you consider making the change permanent, in the interest of saving fuel as well as cost. I found the "duller finish" more comfortable on the eyes—because of the absence of glare—and it did not appear to me that any pictures on the uncoated paper were intolerably "less sharply defined."

WALDEN P. PRATT
7048 Parfet Court, Arvada, Colorado 80004

The change in paper finish in the issue of 11 February, brought about by the fuel shortage, has a very agreeable side-effect: I can now write notes in the margins of the articles with almost any writing instrument, something I could not do on the coated paper.

Furthermore, I find the uncoated paper tends to produce much less glare than the coated paper, making it easier to read both the articles and the aforementioned annotations.

Unless there are serious considerations that make it inadvisable, I would prefer that *Science* continue to use the uncoated paper, even after the gas supplies have been restored.

JAMES M. PRICE
Department of Psychology, University of Oklahoma, Norman 73019

We have received a large number of letters about our use of natural gas and paper. Because of the natural gas shortage, portions of recent issues of *Science* have been printed on uncoated paper with a dull finish, which required little heat to dry the ink. Previously *Science* had been printed entirely on coated glossy paper, for which natural gas was used to dry the ink. The switch conserved some natural gas, but it did not save energy or money.

For the issue of 11 February, the substitution of uncoated paper for glossy paper saved about $100 worth of gas but cost us an additional $5000 for paper and $600 for postage. The uncoated paper is heavier, and we thus consumed an extra 16 tons. Obviously, the extra weight required the cutting of more trees and the use of additional energy in processing the wood to make paper.

The halftones in that issue were better than anticipated because the paper was of a higher quality than we expected to find on short notice.—EDS.

IBM Introduces
THE DEVICE COUPLER
A simple and economical way to automate your lab experiments.

Moving data automatically into and out of a computer offers significant benefits: more precise data; control of laboratory instruments and test equipment; reduction of operator error; and most important, better use of your time.

But lab automation always contained the "Yes Buts." "Yes, but it's too complicated." "Yes, but I can't afford to interrupt my experiments." "Yes, but I can't be bothered learning another language." "Yes, but it's too expensive."

The IBM 7406 eliminates the "Yes Buts." You can plug the 7406 into your experiment in *days,* not months. It's portable so it can be moved from one experiment to another whenever you need it. You can look at runs by the dozen. Even exploratory runs you never thought you'd have time to examine. With the Device Coupler, a terminal and a telephone line you can enter data directly into virtually any terminal-oriented interactive system that has the data handling capacity you need.

You don't need software or hardware specialists to make changes for you. And you keep the ability to interact with your experiment because you program directly in a high-level language of your choice.

The 7406 can enhance your experimental capabilities. For example, you could tie in your Device Coupler to your mass spectrometer; or your emission spectrometer; or run both experiments together looking at the same sample. Create the instrument setup you want with data reduction programmed the way you want it.

We'll be happy to tell you how you can use the IBM 7406 in your research. For instance, Gas Chromatography, Atomic Absorbtion, NMR, Spin Resonance, Mass Spectroscopy, Spectrophotometry, Microprobe Analysis, Calorimetry, Electron Device Studies. Just drop us the coupon or call Dr. Jack Smith at (914) 696-4575 and ask about your specific needs.

Oh yes—the best part. Configurations of the Device Coupler start as low as $3050.

IBM® INSTRUMENT SYSTEMS
1000 Westchester Avenue, White Plains, New York 10604
See us at the FASEB Show Booths L54, K54, K55.

Yes, I'd like to know more about using the IBM 7406 Device Coupler for my SM3

APPLICATION

NAME

TITLE

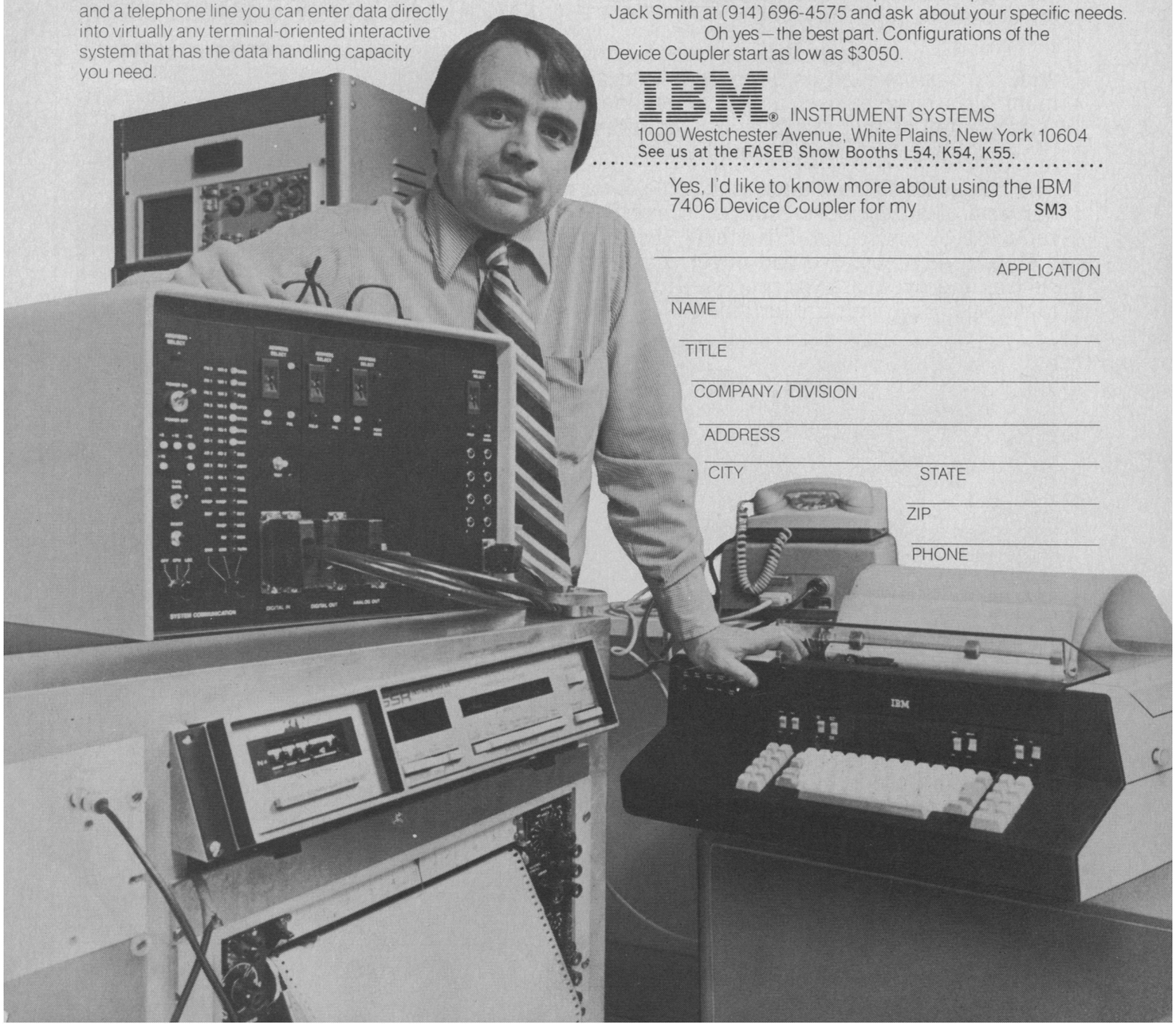
COMPANY / DIVISION

ADDRESS

CITY STATE

ZIP

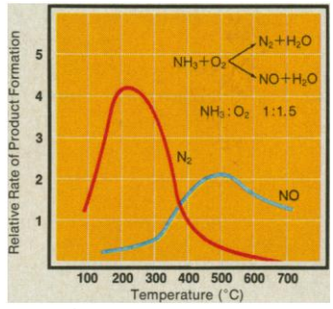
PHONE



Why does ammonia on a platinum catalyst oxidize to nitric oxide one time and nitrogen gas another? Where do reactions take place on a platinum catalyst? What can be done to make catalysts live longer in an automotive catalytic converter?

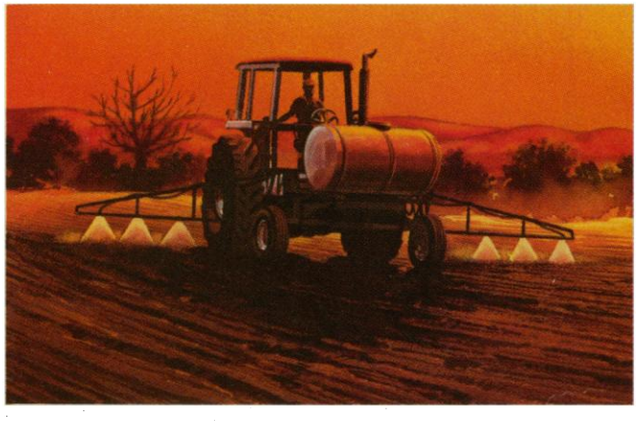
Finding answers to these and other questions has been the object of a broad program by the Research Laboratories at General Motors.

For instance, we've learned that it may be possible to select the product of oxidation of ammonia on a platinum catalyst: either nitric oxide or the desired nitrogen gas. How? By raising or lowering the temperature.



What's more, by creating terraces 12 atoms wide by 1 atom high on a single crystal platinum surface, we've been able to determine the "active site" of this reaction. It's the atom at the step from one terrace to another.

For us, this information is a stride toward our goal of an effective catalytic converter to reduce NOx emissions. For others, it may be a step in directions we had never considered, such as improved catalytic processes for making nitric acid or agricultural fertilizers.

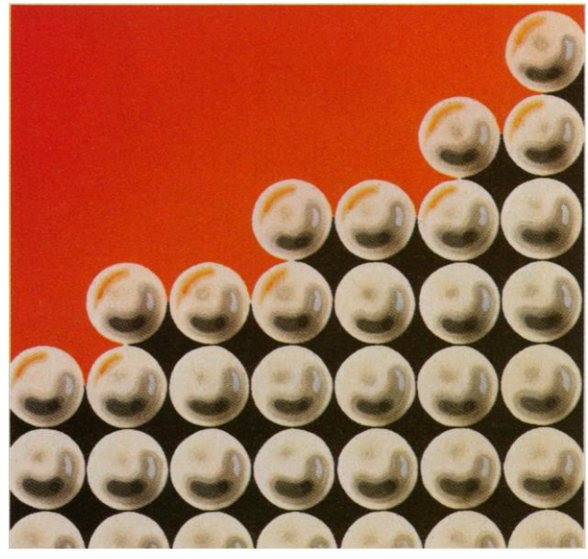


In another phase of our catalysis research, we've studied the life span of a catalyst pellet in the chemically demanding environment of automotive exhaust gas. And from that, a mathematical model has been developed that points the way to future generations of longer living catalyst pellets.

At the Laboratories, we're reacting to make catalysts even more effective in reducing automotive emissions.

Where the (re)action is.

Our discoveries about catalysts could help put food on your table.



GM

General Motors Research Laboratories
Warren, Michigan 48090

1 April 1977, Volume 196, Number 4285 **SCIENCE**

Alaskan Oil

Beginning in the summer of 1977, the North Slope of Alaska will become available to the "lower 48." During a testing period, Alyeska, the operator of the Alaska pipeline, will pump oil through at a slow rate. As the total system including pumping stations is proved reliable, the flow will increase to 1.2 million barrels (160,000 metric tons) per day by the end of 1977 and later may reach 2.0 million barrels a day. This addition to the nation's production comes at a time when other output has dropped below 8.0 million barrels a day, while imports recently peaked at 10.4 million barrels a day. Ultimately, further exploration on land and in the Beaufort sea together with exploitation of the Naval oil reserve will lead to additional supplies of petroleum and natural gas. The Prudhoe Bay field is already known to have natural gas totaling 26 trillion cubic feet (728 million cubic meters). Elsewhere on the North Slope are vast reserves of coal.

During early March, I visited three areas of the Alaska pipeline—the terminal in the south at Valdez, a construction camp in the north at Galbraith in the Brooks Range, and the production facilities at Prudhoe Bay. While considerable work remains to be done at Valdez, the temperatures there are mild and no difficulty in meeting schedules is anticipated. At Prudhoe Bay, operating staffs have taken over many of the facilities and one official said he could be ready to put oil in the pipeline in 2 weeks. Such suspense as remained concerning completion of the pipeline was centered in the vicinity of Galbraith where temperatures were often −35°C or below. Work to be completed included repair of some welds, pressure testing of the line, and installation of a natural gas line from Prudhoe Bay. A few years ago a construction camp geared to such work would have been a Spartan place populated by unkempt males. What a shock to encounter a large number of attractive women, well-groomed men, nine Xerox machines (with collators), and a computer printout listing all the tasks (most of them trivial) remaining to be done at 35,000 locations on the pipeline.

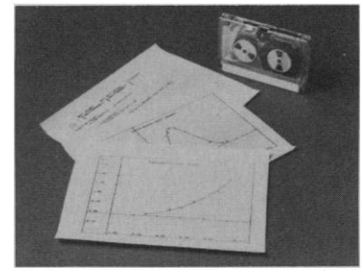
Seldom has a major project received as much attention, publicity, and monitoring as has the pipeline. Environmental controversies delayed construction for about 4 years, and the costs of meeting environmental demands have been estimated as high as $2 billion. Design and construction procedures were established with a view to limiting environmental impact and at present federal employees from nine agencies are monitoring the work closely. After the cleanup and revegetation following the end of construction, little evidence of human activity will remain except the pipeline and a road.

During the past year and a half, considerable publicity has been given to faulty or poorly documented welds. The public has the impression that once the pipeline is in use, the landscape will be deluged with oil. But thus far 640 miles (1024 kilometers) of the line have been tested with water pressures exceeding by 25 percent the ultimate operating pressures. No leaky welds have been found. On one occasion, a faulty test procedure led to extreme overpressuring of a part of the line. A section of pipe ballooned out, but the welds held. Before oil goes into the line, questionable welds will be repaired and the remaining sections will be hydrotested.

In any job as complex and unique as the pipeline, subject as it is to extreme conditions, there is always the hazard of the unexpected. However, Alyeska management engineers and inspectors have plenty of incentive to attempt to foresee and prepare for contingencies. In the event of a failure leading to shutdown of the line, the total revenue forgone by the oil companies and by Alyeska would range between $13 million and $22 million per day. Costs such as taxes and interest on construction expenditures would continue. Thus, Alyeska has little incentive to spill oil or to create any other nuisance leading to a shutdown.

But more than money is involved. Those who have participated in this great enterprise are proud people who are determined that it will be a success.—PHILIP H. ABELSON

"Your graphics saves me money. But your nonlinear software sold me."



Hardcopies of Marquardt's nonlinear least squares, Gauss-Newton nonlinear least squares, and Nelder and Mead function minimization — all demonstrate the ease of PLOT 50 Statistics Vol. 4 analysis.

Problem: Nonlinear statistics are commonplace. Nonlinear regressions software is not.
Whatever your hardware, you've had to settle for less satisfactory methods of modeling and fitting.

Solution: Tektronix' PLOT 50 Statistics Vol. 4 software and the 4051 Graphic System.
With up to 32K of local processing power, the 4051 combines computational independence with the efficiency of high-resolution Graphics. Now our new nonlinear regressions software volume provides graphics-assisted problem solving in applications as wide ranging as chromatography, physiology, logistic growth curves, kinetics and spectrophotometry.

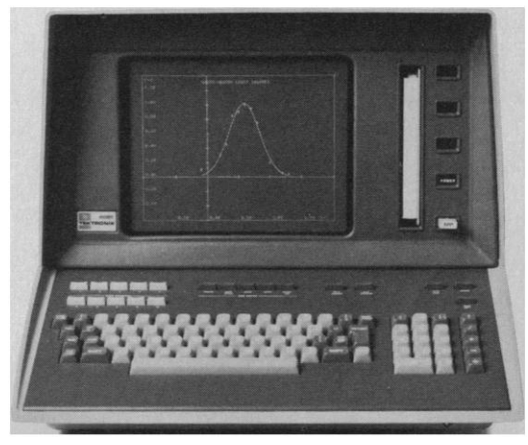
It's easily the most comprehensive nonlinear function support available. Programs include data fits to nonlinear systems of equations, exponential least squares curve fitting, one knot spline curve fitting, Fourier regression, and much more.

You can handle equations with up to four exponentials. And because guesswork is inevitable to many statistical equations, the 4051's off-line processing power lets you work at your own pace ...without paying the price in timeshare charges.

To learn more about the 4051 and its software library, talk to your Tektronix Sales Engineer.

Tektronix, Inc.
Information Display Group
P.O. Box 500
Beaverton, Oregon 97077
Tektronix Datatek NV
P.O. Box 159
Badhoevedorp, The Netherlands

4051 and Stat 4: Seeing is believing



Tektronix
COMMITTED TO EXCELLENCE