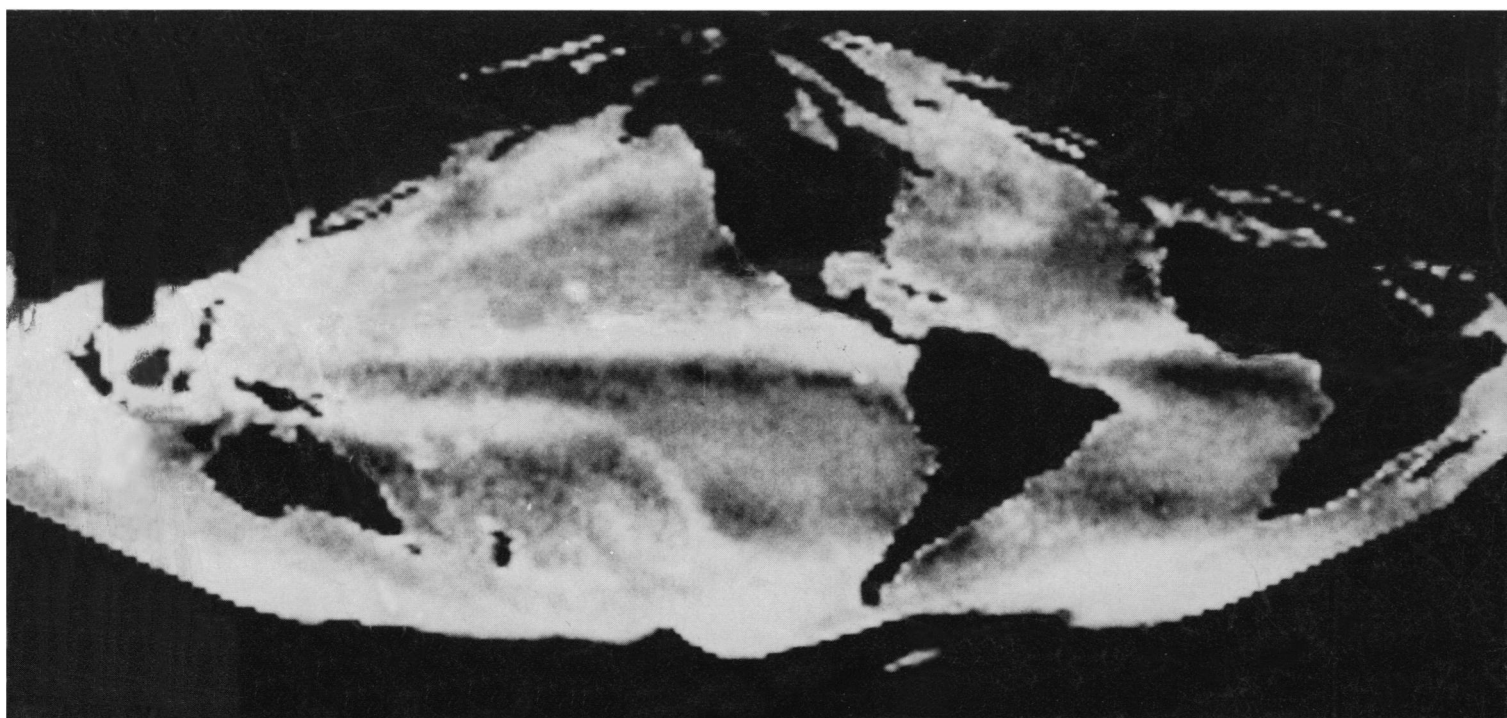
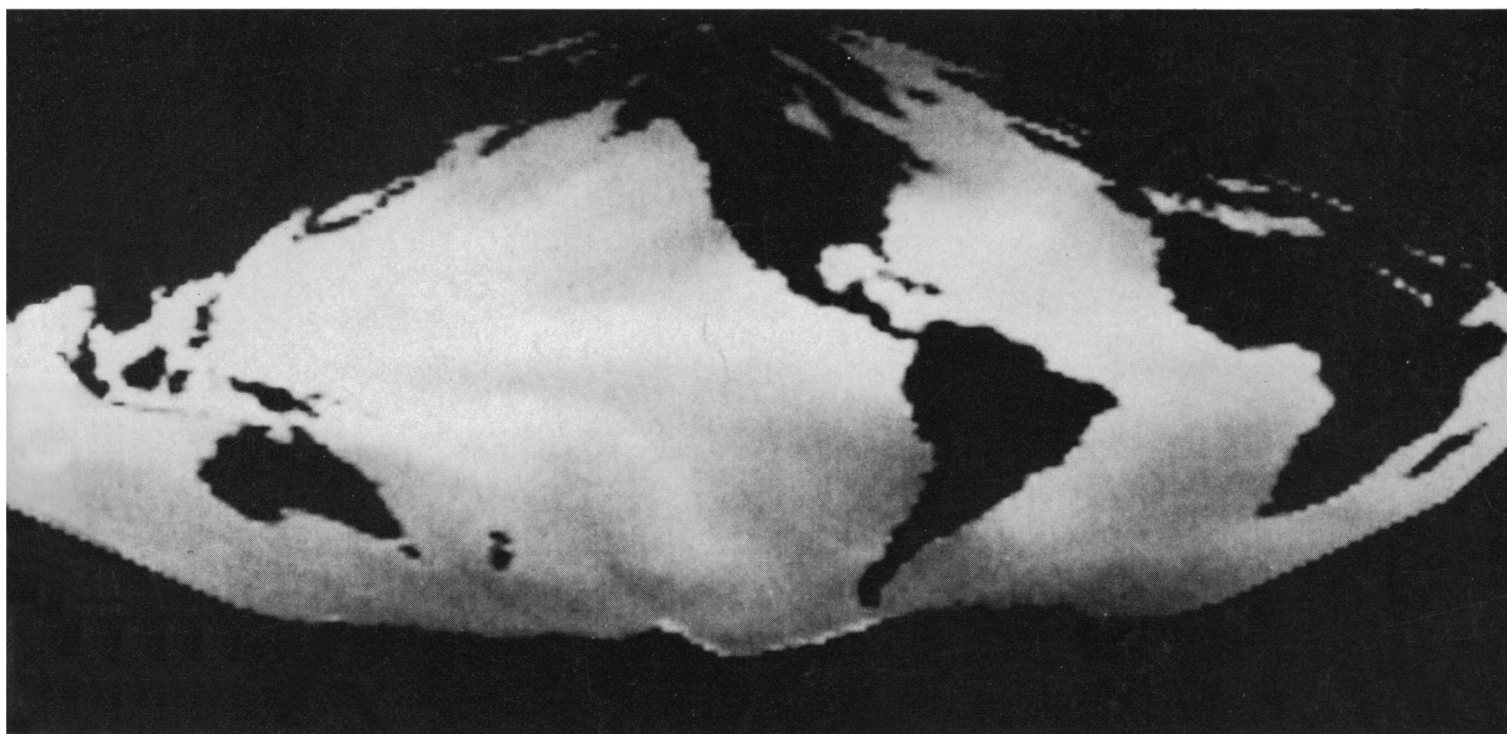


SCIENCE

2 September 1977

Volume 197, No. 4307

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE





The Chicago Connection.

With it, the phone system of tomorrow
is in Chicago today.

A while ago, we told you light-wave communications was just around the corner. Today, it's in the streets of Chicago.

For the first time, the human voice, business data and even video signals are being carried by light-waves traveling over hair-thin glass fibers. Instead of electric current traveling over copper wire.

But without that little link you see on the opposite page, lightwave communications for such a wide range of services might still be an experiment in a lab. And without Western Electric technology, the link might still be a design on a blueprint.

The link is an outgrowth of an idea from the people at Bell Labs. While they were putting the major components of the lightwave system together, they had to find a way to splice the glass fibers and get the light across the splice.

A Simple Idea

The idea they came up with was deceptively simple. A coupling device made up of tiny grooved chips, smaller than the tip of your finger, that would guide the ends of the hair-thin fibers and butt them up

in perfect alignment.

There was only one hitch. Making one chip was easy. But there was no machinery that could mass produce all the identical chips that would be needed for a lightwave system like the one in Chicago.

Making Ideas Reality

That's where Western Electric comes in. Turning ideas into technological innovations is nothing new at Western Electric.

Over the years, Western Electric has piled up an impressive list of innovations that have become manufacturing standards.

It was the first company in the world to manufacture the transistor.

It was the first to put the laser to work as a useful production tool.

And it is the company that went beyond conventional machining techniques to make the chips for Chicago's lightwave system.

Each chip is pure silicon crystal. Its internal structure (a criss-cross arrangement of intersecting planes) provides a built-in blueprint for regularly spaced grooves. And because the crystal's diagonal planes etch faster than its per-

pendicular planes, uniform grooves can be chemically cut into the chip.

By combining the science of chemistry and the art of lithography, Western Electric's Engineering Research Center developed a way to etch 12 ultra-precise, perfectly shaped, identical V-grooves on each chip. With each groove no wider than a hair and separated only by a hair's breadth from its neighbors.

And, more importantly, they were able to reproduce these chips so that each one was a perfect double of the other.

Teamwork is the Key

The telecommunications revolution beginning in Chicago is another good example of how Western Electric and Bell Labs help put new technology into practical use for the Bell telephone companies, quickly and economically.

Their close relationship is an important reason why your telephone system is the most efficient and reliable communications system in the world. And it's a basic reason why innovations in technology are a common occurrence in the Bell System.



Western Electric

2 September 1977

Volume 197, No. 4307

SCIENCE

LETTERS	Computer Security and IBM: <i>W. I. Tuchman</i> ; Imprisoned Argentine Scientist: <i>K. Adler et al.</i> ; Rail Transit and Energy Consumption: <i>C. A. Lave</i> ; Radioactive Waste Disposal: An Environmental Standard: <i>R. Pendleton</i> ; The Diesel's Advantages: <i>F. J. Hooven</i> ; New Texico? <i>W. L. Garner</i>	938
EDITORIAL	Energy and Climate	941
ARTICLES	Unconventional Viruses and the Origin and Disappearance of Kuru: <i>D. C. Gajdusek</i>	943
	How Much Are Nature's Services Worth?: <i>W. E. Westman</i>	960
NEWS AND COMMENT	Seafarer: Project Still Homeless as Milliken Says No to Navy	964
	<i>Briefing</i> : Blast-Off for Swigert, Reentry for Mosher; Odyssey of Agent Orange Ends in the Pacific	966
	National Bureau of Standards: A Fall from Grace	968
RESEARCH NEWS	Wind Energy: Large and Small Systems Competing	971
	<i>Update</i> : Drug for Treatment of Herpes Encephalitis	973
AAAS NEWS	Energy Seminars Scheduled; Technology Topic of Pacific Science Association Meeting: <i>A. H. Livermore</i> ; CSFR to Meet; Resolutions Invited for 1978 Council Meeting; French Association Meets in Brittany: <i>A. B. Lowenfels</i> ; 1976 AAAS Summary Financial Statements	974

BOARD OF DIRECTORS

WILLIAM D. MC ELROY
Retiring President, Chairman

EMILIO Q. DADDARIO
President

EDWARD E. DAVID, JR.
President-Elect

MARTIN B. CUMMINGS
RUTH M. DAVIS

RENÉE C. FOX
BERNARD GIFFORD

CHAIRMEN AND SECRETARIES OF AAAS SECTIONS

MATHEMATICS (A)
Dorothy M. Stone
Truman A. Botts

PHYSICS (B)
Norman Ramsey
Rolf M. Sinclair

CHEMISTRY (C)
Norman Hackerman
Leo Schubert

ASTRONOMY (D)
Beverly T. Lynds
Arlo U. Landolt

PSYCHOLOGY (J)
Donald B. Lindsley
Edwin P. Hollander

SOCIAL AND ECONOMIC SCIENCES (K)
Matilda W. Riley
Daniel Rich

HISTORY AND PHILOSOPHY OF SCIENCE (L)
Ernan McMullin
George Basalla

ENGINEERING (M)
Ernst Weber
Paul H. Robbins

EDUCATION (Q)
Herbert A. Smith
James T. Robinson

DENTISTRY (R)
Harold M. Fullmer
Sholom Pearlman

PHARMACEUTICAL SCIENCES (S)
Stuart Eriksen
Raymond Jang

INFORMATION, COMPUTING, AND COMMUNICATION (T)
Lawrence P. Heilprin
Joseph Becker

DIVISIONS

ALASKA DIVISION

David M. Hickok
President

Keith B. Mather
Executive Secretary

PACIFIC DIVISION

Mildred Mathias
President

Alan E. Leviton
Secretary-Treasurer

SOUTHWESTERN AND ROCKY MOUNTAIN DIVISION

Erik K. Bonde
President

Max P. Dunford
Executive Officer

SCIENCE is published weekly, except the last week in December, but with an extra issue on the third Tuesday in September, 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. Copyright © 1977 by the American Association for the Advancement of Science. 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

BOOK REVIEWS	Creation by Natural Law, reviewed by R. C. Tobey; The Visible Scientists, G. Basalla; Gene Activity in Early Development, H. Woodland; Books Received	977
REPORTS	The Oldest Macroborers: Lower Cambrian of Labrador: N. P. James, D. R. Kobluk, S. G. Pemberton	980
	Triassic-Jurassic Tetrapod Extinctions: Are They Real?: P. E. Olsen and P. M. Galton	983
	Lunar Surface Chemistry: A New Imaging Technique: C. G. Andre et al.	986
	Nucleon Stability: A Geochemical Test Independent of Decay Mode: J. C. Evans, Jr., and R. I. Steinberg	989
	Microwave Spectroscopic Imagery of the Earth: D. H. Staelin et al.	991
	Glucocorticoid in Inflammatory Proliferative Skin Disease Reduces Arachidonic and Hydroxyeicosatetraenoic Acids: S. Hammarström et al.	994
	Thyroid Hormone Action: The Mitochondrial Pathway: K. Sterling et al.	996
	Induction of Suppressor T Cells in Systemic Lupus Erythematosus by Thymosin and Cultured Thymic Epithelium: S. Horowitz et al.	999
	Defective Phagocytosis of Isolated Rod Outer Segments by RCS Rat Retinal Pigment Epithelium in Culture: R. B. Edwards and R. B. Szamier	1001
	Conformations of Prostaglandin F _{2α} and Recognition of Prostaglandins by Their Receptors: D. A. Langs, M. Erman, G. T. DeTitta	1003
	Age-Related Changes in the Hepatic Endoplasmic Reticulum: A Quantitative Analysis: D. L. Schmucker, J. S. Mooney, A. L. Jones	1005
	Combustion of Several 2,4,5-Trichlorophenoxy Compounds: Formation of 2,3,7,8-Tetrachlorodibenzo-p-dioxin: R. H. Stehl and L. L. Lamparski	1008
	Phase Separation of a Protein-Water Mixture in Cold Cataract in the Young Rat Lens: T. Tanaka, C. Ishimoto, L. T. Chylack, Jr.	1010
	Immunological Resolution of a Diploid-Tetraploid Species Complex of Tree Frogs: L. Maxson, E. Pepper, R. D. Maxson	1012
	Diet and Uptake of Aldomet by the Brain: Competition with Natural Large Neutral Amino Acids: D. C. Markovitz and J. D. Fernstrom	1014

MIKE MC CORMACK
FREDERICK MOSTELLER

CHAUNCEY STARR
CHEN NING YANG

WILLIAM T. GOLDEN
Treasurer

WILLIAM D. CAREY
Executive Officer

GEOLOGY AND GEOGRAPHY (E)
Howard R. Gould
Ramon E. Bisque

MEDICAL SCIENCES (N)
Robert W. Berliner
Richard J. Johns

STATISTICS (U)
John W. Pratt
Ezra Glaser

BIOLOGICAL SCIENCES (G)
Mary E. Clark
Jane C. Kallenbach

AGRICULTURE (O)
John P. Mahistede
J. Lawrence Apple

ATMOSPHERIC AND HYDROSPHERIC
SCIENCES (W)
Robert G. Fleagle
Stanley A. Changnon, Jr.

ANTHROPOLOGY (H)
Raymond H. Thompson
Philleo Nash

INDUSTRIAL SCIENCE (P)
Joseph H. Engel
Robert L. Stern

GENERAL (X)
Mary Louise Robbins
Joseph F. Coates

COVER

Average of water vapor (top) and atmospheric liquid water (bottom) estimates over ocean obtained from passive microwave spectrum observations of the Nimbus 6 satellite near 1-centimeter wavelength on 15 through 29 August 1975. Drier air masses are darker. See page 991. [Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge, Massachusetts]

The American Association for the Advancement of Science was founded in 1848 and incorporated in 1874. Its objects are to further the work of scientists, to facilitate cooperation among them, to improve the effectiveness of science in the promotion of human welfare, and to increase public understanding and appreciation of the importance and promise of the methods of science in human progress.

World's First Electronic Digital Stopwatch Plus Calculator.

Available Exclusively From Lectro-Media Ltd.

4-Way Timing:

Casio's amazing ST-1, the world's most powerful stopwatch gives you the flexibility to time every sport 100 hours with .005% accuracy.

Standard: Times single events. Successive presses of Start/Stop (S/S) button record times for successive trials. **Total** key displays cumulative time for all trials. **Comp** mode can then be used to calculate average time.

Net or Time Out: Ideal for ballgames with timeouts. Press S/S to commence timeout. First counter freezes cumulative game time. Press **Total** key to show second counter with elapsed time since timeout started. Press S/S again to restart game and unfreeze gametime counter.

Lap-1: *Split/Cumulative* mode times athlete at each lap. S/S freezes display for recording total elapsed time. Press S/S again to unlatch display.

Lap-2: *Taylor/Interval* mode records athlete's time for each lap. S/S button freezes display with latest laptime while resetting clock for next lap. Press again to unlatch display and watch current lap. **Total** key displays cumulative time to last lap. For auto races, S/S gives time between successive cars, while **Total** key gives time behind leader.

Plus Calculator:

The ST-1's smart little calculator has full memory, square root, percentages and discount calculations. **TM** key allows conversion of a stopwatch data in hr-min-sec to fractional hours or minutes and back again. Calculate directly with time data to add employee time logs. Ideal for time and motion studies

Warranty: The ST-1 is fully warranted for one year by Casio Inc., the world's leader in innovative electronics. In addition, Lectro-Media Ltd. will replace any defective unit for a period of 30 days from receipt. **7-Day Free Trial:** Try the ST-1 for 7 days to assure yourself that it is the most versatile stopwatch on the market. If not fully convinced, return the ST-1 for full refund.

\$50

Runner wins 20-km marathon in 1 hour 35 min, 8.7 sec.



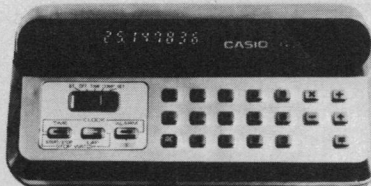
Shown Actual Size (calculator cover removed).

And For The Executive Desk

Casio's CQ-2 Electronic Appointment Secretary

The new desk-top version of the popular CQ-1 travel pocket secretary, now has a larger, brighter digitron display for office use. The CQ-2 maintains all of the incredible features of the CQ-1:

Its a **DIGITAL ALARM CLOCK** storing 4 appointment times, a **STOPWATCH** with timeout and lap times and a **CALCULATOR** with time/date abilities.



Need 1/100 sec timing? Lectro-Media carries a full line of **CRONUS** stopwatches including model **2D** with simultaneous display of both split and interval times.



Philadelphia's Computer Store

LECTRO-MEDIA LTD.

P.O. BOX 1770
PHILA., PA. 19105
(215) 925-9090

Showrooms: **NewMarket**
America's Oldest Market
Front & Pine

CREDIT CARD ORDERS

Call Toll-Free:

800-523-2906

Pa. & Canada: Call (215) 925-9090

Please send me:

____ Casio ST-1 Stopwatch/Calculator @ \$50

SCI

____ AC Adapter for Scoretable use @ \$5

____ Casio CQ-2 Calculator/Stopwatch/Alarm @ \$65 includes AC Adapter & Carrying Case

____ Casio CQ-1 ... Ideal for travel @ \$50 includes AC Adapter & Carrying Case

____ Cronus 2D Dual Display Stopwatch @ \$150 includes Batteries & Lanyard

Name: _____ Street Address: _____

City: _____ ST: _____ Zip: _____

Shipping: \$3 for 1st unit, \$1 for ea. add'l. Pa Res: add 6% sales tax. Air: CA, OR, HI, WA, AK, Houston, Dallas: add \$1. No CODs. Street Addresses only.

MC, BAC/VISA, AMEX & DC accepted: Include signature & expiration date. Please enclose money order, cashiers check or check.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Science serves its readers as a forum for the presentation and discussion of important issues related to the advancement of science, including the presentation of minority or conflicting points of view, rather than by publishing only material on which a consensus has been reached. Accordingly, all articles published in *Science*—including editorials, news and comment, and book reviews—are signed and reflect the individual views of the authors and not official points of view adopted by the AAAS or the institutions with which the authors are affiliated.

Editorial Board

1977: WARD GOODENOUGH, CLIFFORD GROBSTEIN, H. S. GUTOWSKY, N. BRUCE HANNAY, DONALD KENNEDY, NEAL E. MILLER, RAYMOND H. THOMPSON

1978: RICHARD E. BALZHISER, JAMES F. CROW, HANS LANDSBERG, EDWARD NEY, FRANK W. PUTNAM, MAXINE SINGER, PAUL E. WAGGONER, F. KARL WILLENBROCK

Publisher

WILLIAM D. CAREY

Editor

PHILIP H. ABELSON

Editorial Staff

Managing Editor ROBERT V. ORMES *Business Manager* HANS NUSSBAUM

Assistant Managing Editor JOHN E. RINGLE *Production Editor* ELLEN E. MURPHY

News and Comment: BARBARA J. CULLITON, *Editor*; LUTHER J. CARTER, CONSTANCE HOLDEN, DEBORAH SHAPLEY, NICHOLAS WADE, JOHN WALSH. *Editorial Assistant*, SCHERRAINE MACK

Research News: ALLEN L. HAMMOND, *Editor*; GINA BARI KOLATA, JEAN L. MARX, THOMAS H. MAUGH II, WILLIAM D. METZ, ARTHUR L. ROBINSON. *Editorial Assistant*, FANNIE GROOM

Associate Editors: ELEANORE BUTZ, MARY DORFMAN, SYLVIA EBERHART, JUDITH GOTTLIEB

Assistant Editors: CAITILIN GORDON, RUTH KULSTAD, LOIS SCHMITT

Book Reviews: KATHERINE LIVINGSTON, *Editor*; LINDA HEISERMAN, JANET KEGG

Letters: CHRISTINE KARLIK

Copy Editors: ISABELLA BOULDIN, OLIVER HEATWOLE

Production: NANCY HARTNAGEL, JOHN BAKER; YA LI SWIGART, ELEANOR WARNER; JEAN ROCKWOOD, LEAH RYAN, SHARON RYAN

Covers, Reprints, and Permissions: GRAYCE FINGER, *Editor*; CORRINE HARRIS, MARGARET LLOYD

Guide to Scientific Instruments: RICHARD SOMMER

Assistant to the Editors: RICHARD SEMIKLOSE

Membership Recruitment: GWENDOLYN HUDDLE

Member and Subscription Records: ANN RAGLAND

EDITORIAL CORRESPONDENCE: 1515 Massachusetts Ave., NW, Washington, D.C. 20005. Area code 202. General Editorial Office, 467-4350; Book Reviews, 467-4367; Guide to Scientific Instruments, 467-4480; News and Comment, 467-4430; Reprints and Permissions, 467-4483; Research News, 467-4321; Cable: *Advances*, Washington. For "Instructions for Contributors," write the editorial office or see page xi, *Science*, 26 March 1976.

BUSINESS CORRESPONDENCE: Area Code 202. Business Office, 467-4411; Circulation, 467-4417.

Advertising Representatives

Director: EARL J. SCHERAGO

Production Manager: MARGARET STERLING

Advertising Sales Manager: RICHARD L. CHARLES

Sales: NEW YORK, N.Y. 10036: Herbert L. Burklund, 11 W. 42 St. (212-PE-6-1858); SCOTCH PLAINS, N.J. 07076: C. Richard Callis, 12 Unami Lane (201-889-4873); CHICAGO, ILL. 60611: Jack Ryan, Room 2107, 919 N. Michigan Ave. (312-DE-7-4973); BEVERLY HILLS, CALIF. 90211: Winn Nance, 111 N. La Cienega Blvd. (213-657-2772); DORSET, VT. 05251: Fred W. Dieffenbach, Kent Hill Rd. (802-867-5581)

ADVERTISING CORRESPONDENCE: Room 1740, 11 W. 42 St., New York, N.Y. 10036. Phone: 212-PE-6-1858.

Energy and Climate

Whenever the weather in a region departs from norms for a few weeks or more, anxious queries arise. Is the world's climate changing? When leading meteorologists are questioned they usually equivocate. At one time considerable optimism was voiced that new insights would be gained soon from modeling calculations. In the past decade much time on some of the most powerful computers has been devoted to such calculations. But success has been elusive. The best performance on weather seems to be in short-range prediction—that is, the next day or two. Even then surprises occur. In predicting weather, meteorologists can take as a point of departure current conditions, but in attempting to estimate climatic change there is little guidance. Some cyclical patterns related to the 11-year sunspot activity have been noted, and a 2- to 3-year cycle also seems to persist.

Meteorologists still hold out global modeling as the best hope for achieving climate prediction. However, optimism has been replaced by a sober realization that the problem is enormously complex. In a recent report* Verner E. Suomi listed 27 variables that must be monitored to obtain data needed for studies of climate dynamics. These include total solar flux, cloudiness, surface albedo, sea and surface temperature, thickness of polar ice sheets, water vapor, CO₂, and tropospheric aerosols. Human activity has been changing at least three of the variables—albedo, aerosols, and CO₂. The report emphasizes potential effects of increasing and long-term use of fossil fuels.

One fact about CO₂ that is known with certainty is that the concentration in the atmosphere is increasing. Charles Keeling has been conducting precise measurements of atmospheric CO₂ since 1957. In two decades the concentration at the south pole has increased from 314 to 331 parts per million. It is estimated that since the beginning of the industrial revolution the change has been about 13 percent. Roger Revelle has analyzed cogent factors. Part of the increase is due to deforestation. About half of the CO₂ that has been produced remains in the atmosphere, and the rest has been absorbed in the ocean or removed by increased photosynthesis.

What are the likely future trends? For the remainder of this century the clearing of land will continue and the use of fossil fuel will increase. As a result, by the year 2000 the CO₂ concentration will exceed preindustrial levels by about 25 percent. Ultimately, other forms of energy such as solar may come to play a more substantial role. However, humanity's appetite for energy use seems insatiable.

What will be the climatic consequences of increased CO₂? S. Manabe and R. T. Wetherald have calculated that a doubling of CO₂ would lead to an average global increase in temperature of 2.5°C. Their model was necessarily oversimplified, but it seems plausible on the basis of a greenhouse effect. However, a few scientists can be found who privately suggest that because of complex feedback phenomena the net effect of increased CO₂ might be global cooling.

The most likely trend appears to be warming, with effects considerably greater in the polar regions than at mid-latitudes. In the polar regions CO₂ can have a relatively large greenhouse effect. Changes in global circulation would also contribute to the increase.

Humanity is in the process of conducting a great global experiment. If unpleasant effects are encountered they cannot be quickly reversed. Although a comprehensive understanding of what is going on may be difficult to attain, prudence requires at least a determined and sustained effort.

Congress is considering bills aimed at improving climate monitoring, augmenting climate research, improving services related to the climate, and identifying the domestic and international impacts of changes in the climate. Such legislation should be enacted.—PHILIP H. ABELSON

**Energy and Climate* (prepublication version, National Research Council, Washington, D.C., July 1977).

IMPORTANT DETAILS ARE YOURS



This stereo microscope was designed to serve college needs in viewing biological specimens, insects, ores, minerals and crystals, and the industrial market for scanning industrial parts and electronic components.

Many find it to be a great value in family hobbies such as stamp and coin collecting, identification of antique silver marks, jewelry manufacturing, gem and rock polishing, watch repairing and horticulture.

62090-002

62090-002 STEREO MICROSCOPE, 15X AND 45X

Features sharp definition, wide field image, long working distance 79 to 129 mm and magnification of 15X and 45X.

Equipped with 15X coated, paired, widefield eyepieces; eyepiece tubes adjustable for interpupillary distance; and revolving nosepiece with paired 1X and 3X coated, achromatic objectives. Roomy stage, 220 X 155 mm, contains reversible black and white contrast plate, 94 mm diameter. In fitted styrene shipping case.

\$271.00 each, delivered

Yes, I'd like to order a CENCO Stereo Microscope at \$343.00. My check or company purchase order is attached.

Central Scientific Company, Inc.
Attn: Dept. 99 SCI
2600 So. Kostner Ave.
Chicago, ILL. 60623

Name

Address

City

State Zip

Deadline for Nominations: 15 September 1977

AAAS-Newcomb Cleveland Prize: Contest Year Is Nearly Over

The deadline for nominations of papers for the AAAS-Newcomb Cleveland Prize is fast approaching. Readers are invited to nominate papers published in the Reports section of *Science* from 3 September 1976 to 26 August 1977. The prize of \$5000 and a bronze medal is now given annually to the author of an outstanding paper that is a first-time publication of the author's own research.

Nominations must be typed and the following information provided: the title of the paper, issue in which it was published, author's name, and a brief statement of justification for nomination. Nominations should be submitted to AAAS-Newcomb Cleveland

Prize, AAAS, 1515 Massachusetts Avenue, NW, Washington, D.C. 20005. Final selection will rest with a panel of distinguished scientists appointed by the Board of Directors.

The award will be presented at a session of the annual meeting at which the winner will be invited to present a scientific paper reviewing the field related to the prizewinning research. The review paper will subsequently be published in *Science*. In cases of multiple authorship, the prize will be divided equally between or among the authors; the senior author will be invited to speak at the annual meeting.

Reports

The Oldest Macroborers: Lower Cambrian of Labrador

Abstract. *We have discovered numerous borings of Trypanites penetrating skeletons and syndimentary cemented limestones in archaeocyathid reefs of the Forteau formation in southern Labrador. These are, to date, the oldest known macroborings. The discovery of these structures extends the record of large endolithic organisms 100 million years from the Lower Ordovician to the Lower Cambrian. This immediately postdates the appearance of metazoans with hard parts and confirms that endoliths have played a role in reef formation since the early Cambrian.*

The Forteau formation is a sequence of shales, limestones, and minor sandstones about 120 m thick that outcrops, mainly in shoreline section, in southern Labrador and in western Newfoundland (Fig. 1) (1). These Cambrian sediments are the upper part of a sandstone (Bradore formation) to shale to limestone (Forteau formation) sequence that unconformably overlies Precambrian granites and granite gneisses of Grenville age. The middle part of the Forteau formation contains a series of archaeocyathid reefs, specifically a lower patch-reef complex and an upper reef-mound/oolite-shoal complex (2).

The lower, 20-m-thick patch-reef complex is best developed in Labrador and grades eastward into black, potassium-

rich shales. The complex consists of individual patch reefs or groups of patch reefs and associated calcarenites separated by subtidal, calcarenite-shale rhythmites. Reefs (Fig. 2A), which may attain a stratigraphic thickness of 20 m,

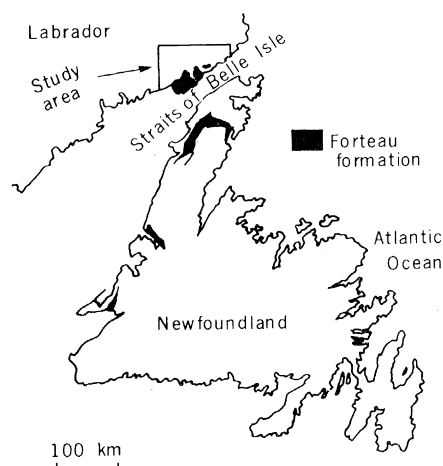


Fig. 1. Map of Newfoundland and southern Labrador, showing the distribution of Forteau formation outcrop, and the study area on the north shore of the Straits of Belle Isle.

are made up of numerous overlapping small mounds. Each mound is a jumble of sticklike and vaselike archaeocyathids along with coelobitic algae and foraminifers (?) set in a matrix of red lime mudstone which was deposited as internal sediment. The tops of shelter cavities are commonly roofed with syndimentary cement.

The upper, 15-m-thick archaeocyathid-mound/oolite-shoal complex, a series of irregularly distributed mounds, surrounded by, or intercalated with, oolitic lime grainstones, can be traced some 75 km eastward from Labrador across the Great Northern Peninsula of Newfoundland. Each mound comprises upright robust to delicate archaeocyathids, in a matrix of skeletal lime grainstone to calcareous siltstone.

On the basis of trilobites the Forteau formation is assigned a late Lower Cambrian age, mainly in the *Bonnia-Olenellus* zone (3). This is confirmed by the archaeocyathid fauna, particularly the forms *Archaeocyathus* and *Cambrocyathus* which are characteristic of the uppermost Lower Cambrian Lena or Elanka stage as defined on the Siberian Platform (4).

The shape of the individual mounds that make up the archaeocyathid reefs is not wholly constructive, but also appears to be partly a function of erosion. In cross section skeletal lime sands are seen to directly overlie truncated archaeocyathid skeletons and argillaceous lime mud, clearly indicating that the mound surface was hard and subsequently eroded before deposition of the overlying skeletal sand. Where outcrop permits, the overlying lime sands can be stripped away, or erosion has removed overlying mounds to reveal a mound surface composed of many upright and top-