

# SCIENCE

31 July 1970

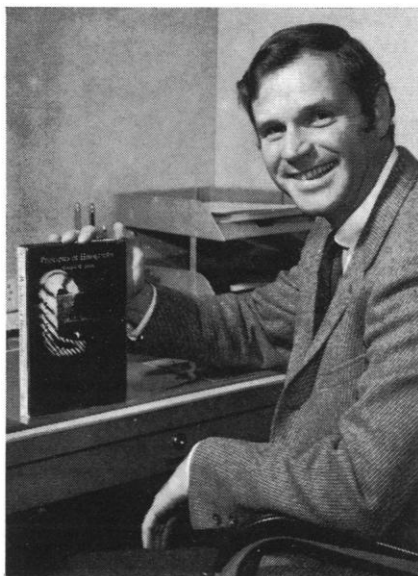
Vol. 169, No. 3944

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



We want to be useful  
...and even interesting

Kodak



### Photography and coherence

Howard M. Smith's book "Principles of Holography" has to be ordered from a bookseller, not from us. Honor done to Dr. Smith for the usefulness of his exposition does us honor also, since he is one of us. An author setting out to do a good job under that title gets beyond the scope of our own literature on how to derive fun or profit from Kodak products. Principles and practice must not be kept apart for too long, however. Products useful in the practice of holography are subject to high-speed evolution. Bruce Burdick, Eastman Kodak Company, Rochester, N.Y. 14650 is the man whose job it is to keep in touch with those concerned. Burdick's number is 716-325-2000, ext. 3440.

One is taught to look onward and upward. The possibility must be discounted that in the year 2020 nobody will want to make a hologram or remember how it was done. On the contrary, one must assume that by then the capture and storage of imagery by causing photochemically the deposit of substances in geometrical analogy to an original subject will seem closely akin to the paleolithic hunter's beautiful representations of the local fauna on the cave wall. That kind of photography may by then have resumed its close relationship with the art of painting from which it had diverged (and which has been severely shaken by the schism). For everyday utility in 2020, images would be handled by recording, modi-

fying, and regenerating actual wavefronts (rather than only radiance patterns), just as an acoustic diaphragm recreates what was in Bach's head. In our line of work it would be folly to place no bets on this.

Not being alone in this optimism, we must separate our work on the applications of coherent optics from our efforts to serve others who have ideas of their own. To the Optical Society of America earlier this year, R. L. Lamberts and C. N. Kurtz—fellow laborers of Howard Smith's in the Kodak Research Laboratories—presented a new recipe for a hologram-developing solution that is followed, not by fixing, but by a bleach. Desilvered phase holograms are known to diffract light much more efficiently than amplitude holograms, but with the brighter image degraded by a veiling flare. Lamberts and Kurtz attribute the flare to accentuation of the lower frequencies by micro-corrugations forming on the gelatin surface during drying. At the higher frequencies, displacements are too small to create a relief pattern, but the refractive index periodicity left from development action remains for all frequencies. The new recipe pits the relief effect against the index effect, instead of with it.

If interested in the latest version of the recipe, ask Mr. Burdick.

We may also be of assistance to the school of holography that places faith in amplitude and wants more silver left. If Burdick answers some of them with a suggestion about adding a little sugar to their developer, he's not being funny.

### Polar ladder

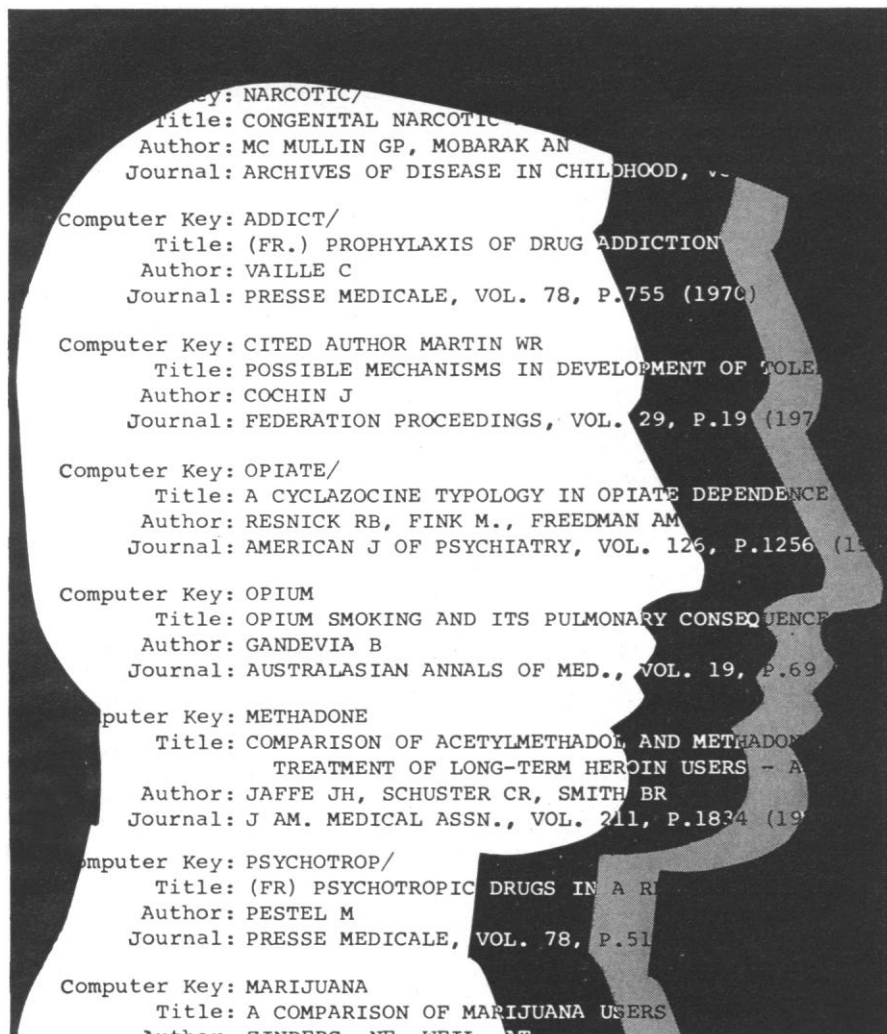
"Solid state" has graduated from a branch of physics to a point made in equipment salesmanship. Though students of the liquid state have achieved less influence, it is widely understood that some liquids are more polar than other liquids and that this determines what dissolves what how fast and makes chromatography work.

Here is a ranking by ascending polarity of 87 solvents very readily available from the lab suppliers who handle EASTMAN Organic Chemicals:

Dielectric Constant	EASTMAN Number		BP—°C
109.50	565	Formamide	211
47.90	13060	Formic Acid	101
46.70	13034	Methyl Sulfoxide	189
42.60	P328	Dimethyl Sulfate	188
42.50	13027	Glycerol	290
41.00	140	2-Furaldehyde	60/15mm
39.40	S189	Nitromethane	100
37.70	133	Ethylene Glycol	195
37.60	13023	N,N-Dimethylformamide	153
37.50	13008	Acetonitrile	82
36.10	13035	Nitrobenzene	211
35.00	264	1,3-Propanediol	98/6mm
32.80	13032	Methanol	65
32.00	1321	1,2-Propanediol	185
27.40	193	o-Nitrotoluene	220
25.20	487	Benzonitrile	191
25.00	1088	2,4-Pentanedione	133
23.00	656	m-Nitrotoluene	232
21.10	468	Acetaldehyde	20
20.70	13006	Acetone	56
20.70	13004	Acetic Anhydride	140
20.10	848	Propyl Alcohol	98
18.50	383	2-Butanone	80
18.30	972	Cyclohexanone	154
18.30	212	iso-Propyl Alcohol	82
18.00	653	Propionaldehyde	50
17.70	13029	iso-Butyl Alcohol	108
17.10	13014	Butyl Alcohol	118
17.00	P1330	3-Pentanone	96
15.40	1928	2-Pentanone	100
15.00	111	Ethyl Acetoacetate	58/7mm
14.70	1956	2-Methyl-1-Butanol	126
14.20	1915	Ethylendiamine	117
13.90	1355	3-Pentanol	116
13.30	P825	Hexyl Alcohol	154
13.10	40	Benzyl Alcohol	94/8mm
12.30	13002	Pyridine	115
11.80	P369	m-Cresol	203
10.34	871	Octyl Alcohol	195
9.93	494	o-Dichlorobenzene	180
8.50	S1227	Methyl Formate	31
8.22	6287	Trifluoroacetic Acid	72
7.77	1903	Dibromomethane	96
7.57	P2378	2-Ethoxyethyl Acetate	153
7.52	T3613	1,1,1-Trichloroethane	74
7.10	P349	Ethyl Formate	51
7.00	164	Iodomethane	41
6.89	13010	Aniline	184
6.68	520	Methyl Acetate	56
6.15	763	Acetic Acid	118
6.08	74	p-Chlorotoluene	162
6.02	13025	Ethyl Acetate	76
5.90	70	Chlorobenzene	132
5.80	P687	Piperidine	98
5.55	2449	m-Chlorotoluene	160
5.50	875	iso-Propylamine	31
5.50	746	Methyl Propionate	80
5.40	43	Bromobenzene	154
5.36	1142	m-Bromotoluene	66/16mm
5.32	13022	Dichloromethane	40
5.30	1261	Butylamine	77
5.04	1281	m-Dichlorobenzene	172
5.01	710	Butyl Acetate	123
4.81	13017	Chloroform	60
4.45	73	o-Chlorotoluene	157
4.39	45	Bromoform	150
4.34	13026	Ethyl Ether	34
4.28	47	o-Bromotoluene	58/10mm
3.40	1521	Propyl Ether	90
3.40	13038	Trichloroethylene	86
3.38	1193	iso-Propyl Ether	68
3.35	396	Propionic Acid	140
2.57	276	o-Xylene	145
2.41	719	Ethylbenzene	136
2.40	616	Triethylamine	90
2.38	13037	Toluene	110
2.37	275	m-Xylene	139
2.30	13012	Benzene	80
2.27	277	p-Xylene	138
2.24	13015	Carbon Tetrachloride	76
2.22	1043	Cyclohexene	81
2.21	2144	p-Dioxane	105
2.02	13019	Cyclohexane	80
1.94	13039	2,2,4-Trimethylpentane	98
1.89	13028	Hexane	66
1.84	P2370	2-Methylbutane	27
1.80	P1501	Pentane	33

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Vol. 169, No. 3944

# SCIENCE

<b>LETTERS</b>	Federal Graduate Aid: Crucial Changes and Cutbacks: <i>N. J. Demerath, III, E. J. Lehman, K. B. Little</i> ; One's Own Yogurt: <i>E. F. Segal</i> ; Value of Historical Perspective: <i>D. E. Atkinson</i> ; Global Energy Balance: <i>D. A. Berkowitz</i> .....	425
<b>EDITORIAL</b>	Parenthood: Right or Privilege?: <i>G. Hardin</i> .....	427
<b>ARTICLES</b>	Caldera Collapse in the Galápagos Islands, 1968: <i>T. Simkin and K. A. Howard</i> .....	429
	Hazards Implicit in Prescribing Psychoactive Drugs: <i>H. L. Lennard et al.</i> .....	438
	Technological Strategies and National Purpose: <i>R. Gilpin</i> .....	441
<b>NEWS AND COMMENT</b>	Harry C. Kelly: An Extraordinary Ambassador to Japanese Science .....	449
	Westinghouse's Environment School: Combining Business with Ecology .....	453
	CBW: Interagency Conflicts Stall Administration Action .....	454
<b>RESEARCH TOPICS</b>	Waste-Water Treatment: The Tide Is Turning .....	457
<b>BOOK REVIEWS</b>	<i>Race to Oblivion</i> , reviewed by <i>W. K. H. Panofsky</i> ; other reviews by <i>L. G. Freeman, R. D. Cadle, J. T. Edsall, E. M. Banks, W. K. Hartmann</i> ; Books Reviewed .....	460
<b>REPORTS</b>	Deuterium Content of Snow Cores from Sierra Nevada Area: <i>I. Friedman and G. I. Smith</i> .....	467
	Apollo 11: Exposure of Lower Animals to Lunar Material: <i>C. A. Benschoter et al.</i> ...	470
	Jupiter's Clouds: Structure and Composition: <i>J. S. Lewis and R. G. Prinn</i> .....	472
	Arctic Paleo-Oceanography in Late Cenozoic Time: <i>Y. Herman</i> .....	474
	Hydrogen Bonding in Hydrochloric Acid Solutions: <i>S. C. Lee and R. Kaplow</i> .....	477
	Retinal Tapetum Lucidum: A Novel Reflecting System in the Eye of Teleosts: <i>H. J. Arnott, N. J. Maciolek, J. A. C. Nicol</i> .....	478

<b>BOARD OF DIRECTORS</b>	H. BENTLEY GLASS Retiring President, Chairman	ATHELSTAN SPILHAUS President	MINA REES President-Elect	DAVID BLACKWELL RICHARD H. BOLT	LEWIS M. BRANSCOMB BARRY COMMONER
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# AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Lactate Dehydrogenase Isozymes: Further Kinetic Studies at High Enzyme Concentration: <i>T. Wuntch, R. F. Chen, E. S. Vesell</i> .....	480
Sexual Reproduction in <i>Geotrichum candidum</i> : <i>E. E. Butler and L. J. Petersen</i> .....	481
Diploid Azaguanine-Resistant Mutants of Cultured Human Fibroblasts: <i>R. J. Albertini and R. DeMars</i> .....	482
Fetal Kidney in Organ Culture: Abnormalities of Development Induced by Decreased Amounts of Potassium: <i>J. F. S. Crocker and R. L. Vernier</i> .....	485
Antigen Receptor Molecules: Inhibition by Antiserum against Kappa Light Chains: <i>J. Lesley and R. W. Dutton</i> .....	487
Vesicular and Synaptoplasmic Synthesis of Acetylcholine: <i>A. K. Ritchie and A. M. Goldberg</i> .....	489
Cyclic Adenosine Monophosphate: Potassium-Dependent Action on Vascular Smooth Muscle Membrane Potential: <i>A. V. Somlyo, G. Haeusler, A. P. Somlyo</i> ..	490
Chromosomal Aberrations Induced in Barley by LSD: <i>M. P. Singh, C. S. Kalia, H. K. Jain</i> .....	491
Quinacrine: Mechanisms of Antimalarial Action: <i>K. Van Dyke, C. Lantz, C. Szustkiewicz</i> .....	492
Immunoassay of Plasma Low-Density Lipoproteins: <i>R. S. Lees</i> .....	493
Chromosomal Abnormalities in the Human Population: Estimation of Rates Based on New Haven Newborn Study: <i>H. A. Lubs and F. H. Ruddle</i> .....	495
Contraceptives and Dysplasia: Higher Rate for Pill Choosers: <i>E. Stern, V. A. Clark, C. F. Coffelt</i> .....	497
Conditioned Vocalizations as a Technique for Determining Visual Acuity Thresholds: <i>R. J. Schusterman and R. F. Balliet</i> .....	498
<i>l</i> - $\Delta^9$ - <i>trans</i> -Tetrahydrocannabinol in Pigeons: Tolerance to the Behavioral Effects: <i>D. E. McMillan et al.</i> .....	501
Technical Comments: Many Responses per Food Reward with Free Food Present: <i>A. J. Neuringer</i> ; Control of Acidic Mine Drainage: <i>W. H. Hartford</i> .....	503
<b>MEETINGS</b> Theory and Practice of Classification in Diverse Disciplines: <i>T. J. Crovello</i> ; Coulomb Energies in Nuclei: <i>A. A. Jaffe, S. M. Shafroth, W. J. Thompson</i> .....	505

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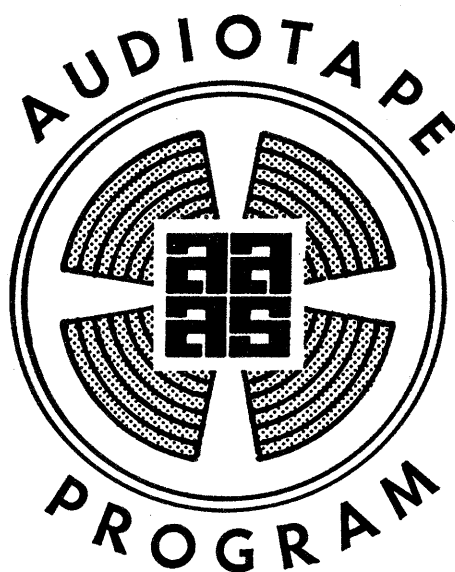
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## COVER

Cloud-wreathed summit of Fernandina volcano, Galápagos Islands, 3 weeks after the start of a massive collapse that dropped the large caldera floor 300 meters. Rockfall dust drifts out over the far rim in this air view looking west. See page 429. [Official U.S. Air Force photo by G. Pierson]

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.



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#### **Hunger and Malnutrition (1/69, Sessions, I-VII)**

Introduction and Survey (1/69, I); Surveillance of the State of Nutrition (1/69, II); Nutrition and Degenerative Diseases (1/69, III); Nutritional Problems of Special Groups within the U.S. and Related Territories (1/69, IV); Nutritional and Economic Problems of the Aged and the Sick (1/69, V); Food Habits and the Economics of Food Distribution (1/69, VI); The Changing Significance of Food (1/69, VII).

### **Malnutrition and Learning in Children within the U.S.A. (2/69)**

#### **Effects of Nutrition on Behavior: Studies in Animal and Man (3/69, Sessions I-II)**

### THE DESIGN AND NATURE OF CITIES

#### **Human Settlements and Environmental Design (4/69, Sessions I-VI)**

Historical Perspectives (4/69, I); Social Dysfunction and Environment: Some Harbingers of Catastrophe (4/69,

II); Research into Environment and Behavior (4/69, III); Living Environments for Work and Leisure (4/69, IV); Future Environments (4/69, V and VI).

**Quantitative Studies of Urban Problems (5/69, Sessions I-II)**  
Operations Research Contributions (5/69, I); Mathematical Contributions (5/69, II).

**The City as a Social System: Perspective on Urban Social Organization (6/69, Session II only)**

**The Organization of Urban Places (7/69)**

**Statistics, Governments, and the Analysis of Social Problems (8/69, Sessions I-II)**  
Urban Problems (8/69, I); Organization of Statistical Systems (8/69, II).

**Systems Models of Urban Systems (9/69)**

### FAMILY AND POPULATION PROBLEMS

**Is There an Optimum Level of Population? (10/69, Sessions I-IV)**  
Physical Factors (10/69, I); Biological Parameters (10/69, II); Social-Personal Factors (10/69, III); Panel Discussion (10/69, IV).

**The Identity and Dignity of Man: A Scientific and Theological Dialogue on Issues Emerging from Behavioral, Surgical, and Genetic Interventions (11/69, Parts I-VIII)**  
Control of Population and Regulation of Behavior (11/69, I); Problems of Population Control (11/69, II); Regulation of Behavior (11/69, III); Extension of Life through Organ Replacement (11/69, IV); Problems with Organ Replacement (11/69, V); Improvement of Quality of Life through Genetic Manipulation (11/69, VI); Problems with Genetic Manipulation (11/69, VII); Summary of Conference (11/69, VIII).

### THE EARTH, THE SOLAR SYSTEM, AND THE COSMOS

**Whither Lunar and Planetary Exploration in the 1970's? (12/69, Sessions I-III)**  
The Planets (12/69, I); The Moon (12/69, II); Panel Discussion (12/69, III).

**Space Astronomy (13/69, Sessions I-II)**  
X-ray and Gamma Ray Astronomy (13/69, I); Ultraviolet, Infrared, and Radio Astronomy (13/69, II).

**Recent Development in the Field of Pulsars (14/69)**

**Unidentified Flying Objects (15/69, Sessions I-III)**  
UFO's and the Public (15/69, I); UFO Reports (15/69, II); Retrospective and Future Studies of Unidentified Flying Objects (15/69, III).

**Current Problems of Cosmology (16/69)**

**The Space Program for the Next Decade (17/69)**

**Deep Sea Drilling Project (JOIDES) Science and Resources (18/69, Sessions I-II)**

**Climate and Man (19/69, Sessions I-II)**  
Natural Climate Changes (19/69, I); Man's Effect on Climate (19/69, II).

### HEALTH, DISEASE, AND BEHAVIOR

**TEKTITE: A Behavioral Study in a Hostile Environment (20/69)**

**Youth: Ego Ideals and the Impact of Culture (21/69)**

**The International Study of the Eskimos (22/69, Sessions I-II)**

**Physiological Effects of Audible Sound (Extra-Auditory) (23/69, Sessions I-V)**  
Introduction. Experimental Studies: Cardiovascular; Sleep (23/69, I); Experimental Studies: Reproductive; Biochemistry and Pharmacology of the Central Nervous System (23/69, II); Experimental Studies: Neurological (23/69, III); Experimental Studies: Endocrine and Metabolic; Assessment of Sonic Boom Effects (23/69, IV); Panel Discussion (23/69, V).

**Biology and Sociology of Violence (24/69, Sessions I-II)**  
Biology of Violence (24/69, I); Sociology of Violence (24/69, II).

### SOCIAL AND POLITICAL INTERACTION

**Technology Assessment and Human Possibilities (25/69, Sessions I-III)**  
State of the Art of Technology Assessment (25/69, I); Responsibilities and Opportunities for Science and Engineering (25/69, II); Implementation of Technology Assessment (25/69, III).

**Approaches to Policy Sciences (26/69, Sessions I-II)**

**Science and Public Policy Workshop: Technology Assessment (27/69)**

**The Political Attitudes of Scientists (28/69)**

**Science and Society: A New Intergovernmental Approach to Domestic Problems (29/69, Sessions I-II)**

**Arms Control and Disarmament (30/69, Sessions I-II)**

**Academic Research and the Military (31/69, Sessions I and II)**  
Current Status of Military Support of Academic Research (31/69, I); Where Do We Go from Here? (31/69, II).

**Chemical and Biological Warfare (32/69)**

**Behavioral and Social Sciences: Outlook and Needs (34/69)**

## ETHICS, MORALS, PHILOSOPHY, AND HISTORY

### **Science and the Future of Man (35/69, Sessions I-III)**

Science and the Problems of Society (35/69, I); The Scientist and Society (35/69, II); Outcome of Our Concern, Crises of Man and His Environment (35/69, III).

### **Mathematical Logic (36/69)**

### **Comparative History and Sociology of Science (37/69)**

### **The Sorry State of Science—A Student Critique (38/69, Sessions I-II)**

The Misuse of Science and Technology (38/69, I); The Technologist in His New Habitat (38/69, II).

## LIFE AND THE LIVING EARTH

### **Photosynthetic Organisms: Origin and Evolution on Early Earth (39/69)**

### **Physics and the Explanation of Life (40/69)**

## AFFAIRS OF TECHNOLOGY, ECONOMICS, AND BUSINESS

### **Power Generation and Environmental Change: Reconciling Man's Desire for Power with the Needs of His Environment (41/69, Sessions I-II)**

### **Rational Use of Water (42/69)**

### **Computers in Mathematics and Science (43/69)**

## EDUCATION, LEARNING, AND COMMUNICATIONS

### **Brain and Language (44/69)**

### **Innovation (45/69)**

### **Undergraduate Studies in Environmental Science (46/69, Sessions I-II)**

### **Expanding Horizons in Medical Education (47/69, Sessions I-II)**

The Challenges Facing Medical Education (47/69, I); The Response of Medical Education (47/69, II).

### **Ecology and the Undergraduate Curriculum (48/69)**

### **Preservice Science Education of Elementary School Teachers (49/69)**

### **School Science—Past and Future (50/69, Sessions I-II)**

Curriculum Innovation: Lessons from Past Experience (50/69, I); School Sciences: Needs and Resources (50/69, II).

### **Education of the Infant and Young Child: Empirical Data and Theoretical Issues (51/69, Sessions I-II)**

### **Basic Research Related to Education (52/69)**

### **SATCOM Report, Its Implications and Impact (53/69)**

### **Science and Music (A Concert/Symposium) (55/69)**

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## Parenthood: Right or Privilege?

Birth control is not population control. Individual goals, not community needs, motivate individual actions. In every nation women want more children than the community needs.

How can we reduce reproduction? Persuasion must be tried first. Tomorrow's mothers must be educated to seek careers other than multiple motherhood. Community nurseries are needed to free women for careers outside the home. Mild coercion may soon be accepted—for example, tax rewards for reproductive nonproliferation.

But in the long run a purely voluntary system selects for its own failure: noncooperators outbreed cooperators. So what restraints shall we employ? A policeman under every bed? Jail sentences? Compulsory abortion? Infanticide? . . . Memories of Nazi Germany rise and obscure our vision.

We need not titillate our minds with such horrors, for we already have at hand an acceptable technology: sterilization. The taboo on this subject is fast dissolving, thanks to Arthur Godfrey and Paul Ehrlich, who have confessed their sterilizations in public. Fear (mostly unjustified) about the safety of the "pill" has motivated multitudes to follow in their footsteps.

It should be easy to limit a woman's reproduction by sterilizing her at the birth of her  $n$ th child. Is this a shocking idea? If so, try this "thought-experiment": let  $n = 20$ . Since this is not shocking, let  $n$  diminish until population control is achievable. The Women's Liberation Movement may not like it, but control must be exerted through females. Divorce and remarriage play havoc with assigning responsibility to couples or to men. Biology makes women responsible.

Many who want no third child would fight resolutely for the freedom to have that which they do not want. But what is freedom? Hegel said that "Freedom is the recognition of necessity." People need to recognize that population control is needed to protect the quality of life for our children.

The "right" to breed implies *ownership* of children. This concept is no longer tenable. Society pays an ever larger share of the cost of raising and educating children. The idea of ownership is surely affected by the thrust of the saying that "He who pays the piper calls the tune." On a biological level the idea of ownership of children has not been defensible for almost a century, not since August Weismann drew his celebrated diagram of the relationship of germ plasm to somatoplasm.

Biologically, all that I give "my" child is a set of chromosomes. Are they *my* chromosomes? Hardly. Sequestered in the germinal area long before *my* birth, "my" gonadal chromosomes have lived a life of their own, beyond *my* control. Mutation has altered them. In reproduction, "my" germ plasm is assembled in a new combination and mixed with another assortment with a similar history. "My" child's germ plasm is not *mine*; it is really only part of the community's store. I was merely the temporary custodian of part of it.

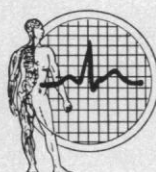
If parenthood is a right, population control is impossible. If parenthood is only a privilege, and if parents see themselves as trustees of the germ plasm and guardians of the rights of future generations, then there is hope for mankind.

—GARRETT HARDIN, *University of California, Santa Barbara*

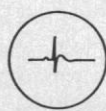


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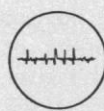
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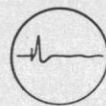
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