

What this country needs is a good \$12,000 college education.

We've got it, but we're only charging \$4,000.

\$4,000 is an average 4-year college tuition bill, exclusive of living and other expenses. A bargain for the student.

\$12,000 is the average of what it actually costs the college to educate him—and to build the new facilities and the faculty needed to educate millions more like him in the years ahead. A burden for the college. And it might become a crisis.

Because the \$8,000 deficit must be made up by gifts and grants. More help is needed from more businesses, and from individuals like you, people who believe that the future of this country lies in the potential of its young.

What this country needs are fewer bargains like this.

Give to the college of your choice.



Advertising contributed for the public good.

films OF THE WEEK

Listing is for readers' information of new 16mm and 8mm films on science, engineering, medicine and agriculture for professional, student and general audiences. For further information on purchase, rental or free loan, write to distributor.

APOLLO 11. 16mm, color, sound, 28 min. Illustrates in selected photography and the words of participants the historical highlights of the Apollo 11 mission to the moon. Traces the mission from assembly of the spacecraft to the return of the astronauts with their lunar samples to the Lunar Receiving Laboratory. Principal emphasis is, however, man on the moon. Audience: general. Free loan from NASA field installations, or information from NASA Headquarters, Audio-Visual Branch, Code FAM, Washington, D.C. 20546.

CHEMICAL CHANGE: COMBINATION AND SEPARATION. Super 8mm only, color, silent. Seven cartridge films for Technicolor projector on "What Happens When Iron and Sulfur Are Heated?", "How Can You Change Potassium Permanganate?", "Where Did the Blue Go?", "Can Washing Soda Be Changed to Table Salt?", "Can Water Change Some Materials?", "Can Electrical Energy Cause Chemical Change?", and "Can Light Energy Change Some Materials?". Audience: intermediate grades, junior high. Purchase \$126 from Rand McNally & Co., P.O. Box 7600, Chicago, Ill. 60680.

THE NATURE OF SEA WATER. 16mm, color, sound, 28½ min. Explains the physical and chemical properties of sea water, and shows how their understanding is the basis of oceanography. Audience: general. Free loan from Public Affairs Officers in all Naval Districts.

OCEANOGRAPHY—THE STUDY OF OCEANS. 16mm, color, sound, 15 min. Presents a view of the many scientists who are now involved in studying what may be our last frontier—the oceans. These are: The meteorologist who studies the effects oceans may have on our weather; the physicist who studies ocean waves, tides and currents; the chemist who studies the mineral wealth found in the oceans; the biologist who studies ways of utilizing the vast animal and plant life found in the ocean; and the geologist who studies the ocean floor for clues as to how the earth was formed. Audience: intermediate, junior and senior high. Purchase \$150 from Journal Films, 909 Diversey Parkway, Chicago, Ill. 60614.

PACED TO LIVE. 16mm, color, sound, 18 min. Points up the danger and tragedy which can happen when rail-crossing signals are ignored, and underscores the hazard of disregarding the signs which have been installed to guide and direct our everyday movements with particular emphasis given to highway or railway crossings. Audience: general. Free loan from Motion Picture Bureau, Department of Public Relations, Union Pacific Railroad, 1416 Dodge St., Omaha, Neb. 68102.

SOCIAL DEVELOPMENT IN PAPUA AND NEW GUINEA. 16mm, b&w, sound, 19 min. A report on the role of education in the development of this fertile island territory. Audience: general. Purchase \$45 or rental \$2.25 from Films Officer, Australian News and Information Bureau, 636 Fifth Ave., New York, N.Y. 10020, or Western States, Press and Information Officer, Australian Consulate-General, 350 Post St., San Francisco, Calif. 94108.

LETTERS

to the editor

Perplexing googols

In his letter (SN: 8/23, p. 144) Walter Benjamin, apparently unconsciously, answered his own query on scientists' use of "googol." Numerical expression is more accurate than ordinary phrases or sentences. Benjamin's numerical expression of a googol (1×10^{100}) is correct; his phrase, "ten to the tenth to the tenth," is not. The latter is ten raised to the googolth power, i.e., a googolplex. A googol is ten to the tenth to the second power.

Walter C. Stanley
Gaithersburg, Md.

Volume three of "The World of Mathematics" by James R. Newman, contains an article by Kasner and Newman on page 1996. According to Newman, the number of electrons in Einstein's universe is only 10^{79} ; far less than a googol (10^{100}).

In addition, Kasner invented the googolplex, which is equal to 10^{googol} or $10^{10^{100}}$!

Moe Rubenzahl
Neversink, N.Y.

I was interested in learning who cooked up that large number, the "googol," and see that Edward Kasner, an American mathematician, did it. But Benjamin made a sizable mistake in saying what the googol is equal to.

Ten to the tenth power is 1 with 10 zeros after it, or 10 billion. So ten to the tenth to the tenth power is then ten to the ten billionth power, or 1 with ten billion zeros after it. Allowing an eighth of an inch for each digit or zero in this large number means it will be nearly 20,000 miles long, written longhand. A 1 with 100 zeros after it is only about a foot long.

SCIENCE NEWS

Copyright © 1969 by Science Service, Inc., 1719 N Street, N.W., Washington, D.C. 20036 Reproduction of any portion of SCIENCE NEWS is strictly prohibited.

Subscription rate: 1 yr., \$7.50; 2 yrs., \$13.50; 3 yrs., \$19.50. Special trial offer: 39 weeks, \$3.97. Single copy, 25 cents. \$1.00 per year for foreign postage. Change of address: Three weeks' notice is required. Please state exactly how magazine is addressed. Include zip codes.

Printed in U.S.A. Second class postage paid at Washington, D.C. Established as Science News Letter® in mimeograph form March 13, 1922. Title registered as trademark U.S. and Canadian Patent Offices. Indexed in Reader's Guide to Periodical Literature, Abridged Guide and the Engineering Index. Member of Audit Bureau of Circulation. UNSOLICITED MANUSCRIPTS will not be returned unless accompanied by a stamped, self-addressed envelope.

Published every Saturday by SCIENCE SERVICE, Inc., 1719 N St., N.W., Washington, D.C. 20036. North 7-2255. Cable Address: SCIENSERV.

ADVERTISING STAFF

Director: EARL J. SCHERAGO
Advertising Sales Manager: RICHARD L. CHARLES
Address all advertising to Scherago Associates, 11 West 42nd St., New York, N.Y. 10036.

Sales: New York, N.Y. 10036: Robert S. Bugbee, 11 W. 42 St. (212-PE-6-1858); Scotch Plains, N.J. 07076: C. Richard Callis, 12 Unami Lane (201-889-4873); Medford, Mass. 02052: Richard M. Ezequiel, 4 Rolling Lane (617-444-1439); Chicago, Ill. 60611: Herbert L. Burklund, Room 2107, 919 N. Michigan Ave. (312-DE-7-4973); Beverly Hills, Calif. 90211: Winn Nance, 111 N. La Cienega Blvd. (213-657-2772).