SCIENCE

1 September 1972

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AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

We want to be useful...

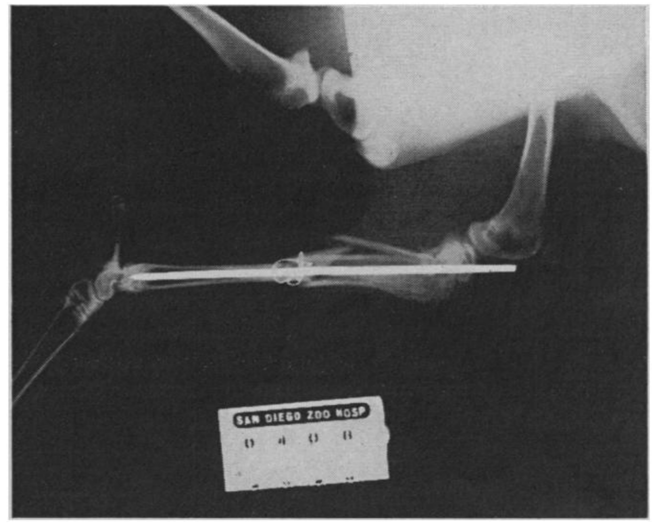
ADVERTISEMENT

Atlas of the southern sky. Pole to −20° declination. Will be distributed as about 1200 sheets of 40 x 40cm film, each covering 5°.5 x 5°.5 in blue (400 to 500 nm essentially) and red (centered app. on Hα), both to at least 21st magnitude. Project now commencing on first large (one-meter aperture) Schmidt telescope in Southern Hemisphere at new European Southern Observatory (ESO), 600 km north of Santiago, Chile. ESO is supported by Belgium, Denmark, France, Federal Republic of Germany, the Netherlands, and Sweden. Price will depend on number of customers. In U.S., somewhere around price of a standard automobile. Should prove similarly comparable in value for those attaching as much importance to identifying radio galaxies, x-ray sources, quasars as to visiting zoos, shopping, transporting kids to baton-twirling lessons.

Additional details: This is the initial phase of a project in which the Science Research Council of the United Kingdom is an equal partner with ESO. SRC is building a Schmidt telescope to begin operation in Australia one year hence with a Limiting Magnitude Survey of all objects south of −30°. "Limiting" is understood to mean what can be obtained on Kodak Spectroscopic Plates, Type IIIa-J, with any improvements in manufacture or treatment that Kodak photographic science may contribute up to the time photography starts. Thus ESO and SRC will enlarge upon and extend to the whole photographable universe the great Sky Atlas for north of −27° declination issued from Palomar Mountain in 1954. It will have the advantages of finer-grained emulsions than we made then. Each accepted glass negative from the telescopes will be contact-printed to several master positives, also glass-based for geometrical fidelity over the coming centuries. From one of these, at CERN in Geneva, on film with far better dimensional stability than the paper prints of 1954, will be contact-printed what the customers of the project get, in a form that their measuring and scanning engines accept.

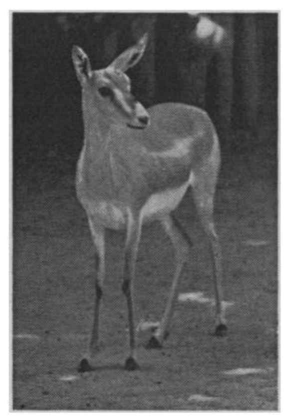
Prospective customers may obtain further information from Dr. Richard West, ESO Sky Atlas Laboratory, ESO TP-Division, c/o CERN, CH 1211 Geneva 23, Switzerland. Considering the immense technological fallout that we practical business types have enjoyed over the past 60 years from meeting the extravagant demands of astronomers, Kodak feels obligated to contribute this advertising space to their needs.

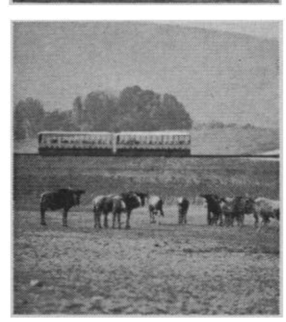
Interspecific relations



Six-inch pin and all, the subject of this radiograph is now as graceful as a gazelle and in fact is a gazelle, *Gazella subgutturosa.*

As an individual she is lucky the fracture did not occur in her natural habitat, Asian desert and high country shared nowadays with hunters who do not depend on their own or equine legs for speed. As a species the Persian gazelle can scarcely afford loss of even an individual, being perilously near extinction. But riders of the "safari train" through the San Diego zoological society's new Wild Animal Park can shoot all the gazelles they see, using cameras instead of rifles.





Now, as a side effect of giving this breed of hunters their due, a point seems to have been reached where radiological examination can help save the Persian gazelle and other species vanishing from their natural habitats.

As for species that long ago accepted commensality with man, we note that a growing volume of Kodak x-ray materials is going into the service of veterinary medicine.

Kodak

For the stars, for the gazelles

1 September 1972

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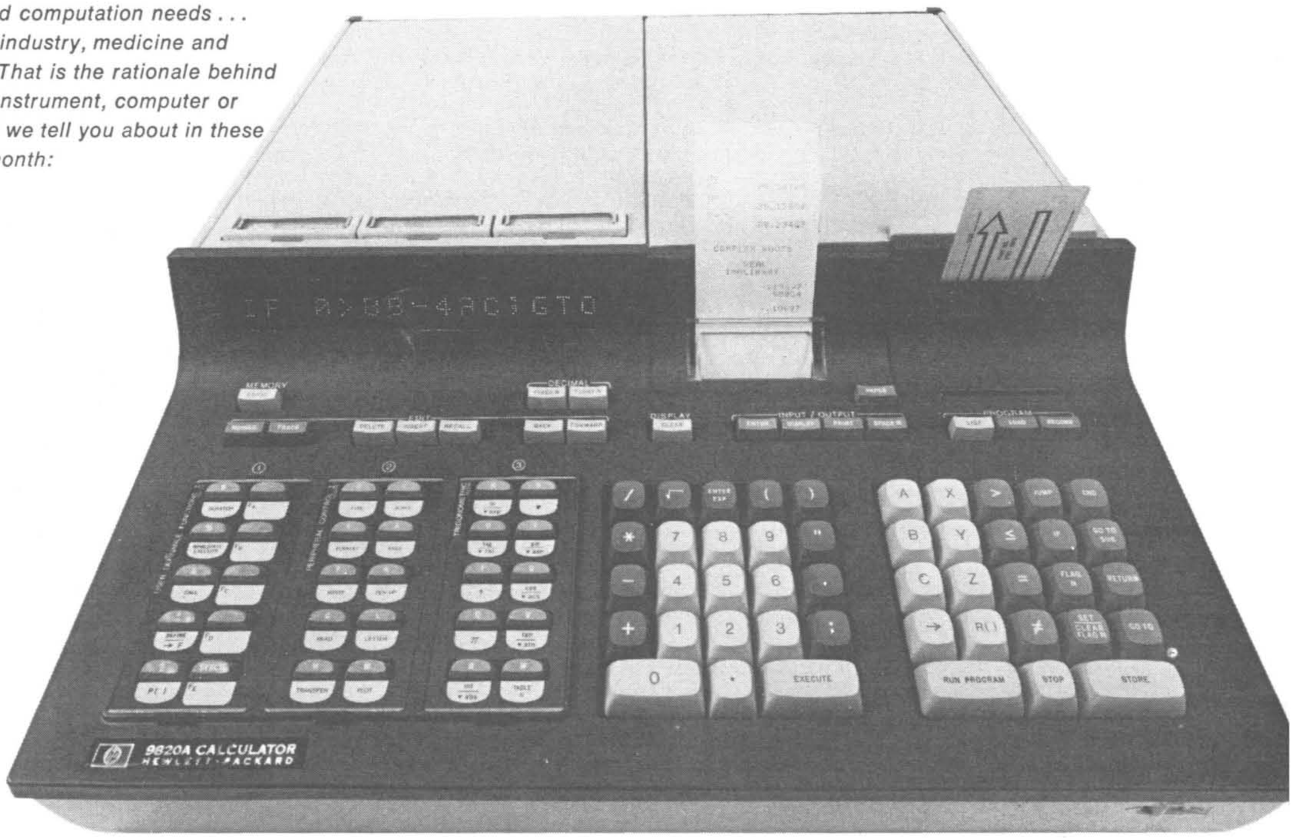
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

COVER

Rat drinking from a stainless steel spout in a chronic ethanol polydipsia situation. Overindulgence of ethanol was induced by continuous exposure to an intermittent feeding schedule. General health and body weight were maintained while physical dependence developed. Withdrawal of the ethanol resulted in convulsions. See page 811. [Richard Bryant, Rutgers University, New Brunswick, New Jersey]

Some things are changing for the better.

Many people know us as an instrument manufacturer: we make more than 2,000 products for measurement, test and analysis. Others know us as a computer company: more than 10,000 own our programmable calculators and computers. We prefer to think that our business is to serve measurement, analysis and computation needs . . . in science, industry, medicine and education. That is the rationale behind every new instrument, computer or system that we tell you about in these ads. This month:



Powerful new programmable calculator converses in simple algebraic language.

Hardly a month goes by that doesn't signal the introduction of a new calculator with more power, more memory, more output flexibility. But are things really changing for the better when the improvements so complicate the use of a calculator that one must practically become a computer programmer before he can harness its power?

This is precisely where HP's new Model 20 makes its most significant contribution. It is easier to use, by far, than any other calculator. Its language is the most simple: algebra, the kind you learned in high school. Not does it 'understand' algebra, it also 'speaks' it, using the same numbers, letters and symbols that you do.

You enter an equation just as you write it on paper including implied multiplication and nested parentheses. The Model 20 displays your entry for verification the same way you wrote it. For example:

(-B+√(BB-4AC))/2A

It tells you what to do next (in the program mode):

ENTER A

Then you enter the values on the keyboard (for A, B and C in this example) and press a key to execute. The calculator immediately displays and prints the solution to ten significant digits, along with its English label if you desire:

REAL ROOTS

If you make a mistake, the Model 20 tells you so and identifies precisely what the error is . . . lets you correct it without redoing the entire line, let alone the entire program . . . and automatically adjusts program storage to occupy the least possible memory.

In addition to its conversational ability, the Model 20 changes things for the better not only through more power and more memory but through a hardworking line of Series 9800 Peripherals: X-Y Plotter, Typewriter and Card Reader, to name a few. Model 20 costs $5,475.

This man is obviously not in bed. Yet the ECG telemetry system he is wearing enables nurses at a central monitoring station to keep close watch on his heart action.

Freedom with protection for the post-coronary patient.

Once the coronary patient is released from the intensive care unit, his recovery can often be aided by freedom to move about and mild exercise . . . provided his ECG can be continuously monitored.

With the new HP ECG Telemetry System, the post-coronary patient can be ambulatory. Wherever he goes, his heart action is transmitted to a receiver at the nursing station where it can be continuously observed. The transmitter is small enough to be carried comfortably in a bathrobe pocket, has a strong enough signal to reach the nursing station from 200 feet even through several masonry walls, and is rugged enough to operate reliably even if dropped.

At the nursing station, the patient's ECG signal is monitored by a receiver that operates automatically, never requires tuning and accepts only valid signals, minimizing artifacts from patient motion. An automatic warning light alerts the nurse of such inoperative conditions as: patient out of range, dislodged electrode, low battery power. It is completely compatible with HP patient monitoring systems. Because it doesn't require new wiring, the ECG Telemetry System is easily introduced into existing facilities. Price is $1,800 for each patient unit. Write for our new illustrated brochure.

Instrumentation quality tape recording at a bargain price.

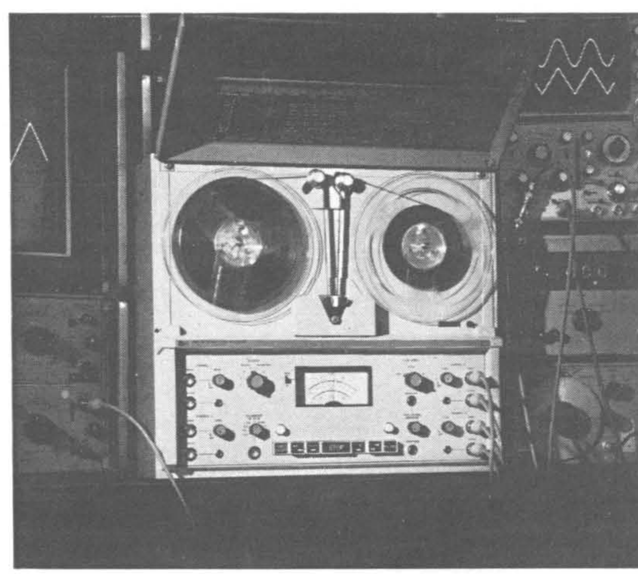
Most scientists would use portable instrumentation tape recorders for analog recording if only they performed as well as the big expensive laboratory machines. Unfortunately, their small size usually meant reduced performance.

Then came the HP 3960. Truly portable in size (50 pounds) and low in price ($4,270 for a fully-equipped four-channel instrument), the 3960 actually outperforms most laboratory machines costing five times more.

If this sounds too good to be true, listen to some of the 3960's capabilities. At 15/16 ips, its FM signal-to-noise ratio of better than 200:1 lets you play back signals that would be buried in noise (ECG's for example) on many lab machines as well as on any other portable.

The 3960 lets you mix and interchange four FM direct record/reproduce channels at will. You have a choice of three electrically-switched speeds, for a time-base expansion of 16:1 or 10:1 . . . without signal degradation. Tape drive is bidirectional so that you don't have to rewind either to continue recording or to play back.

Built-in facilities let you calibrate the 3960's FM electronics without external equipment. And an integral peak-reading meter lets you optimize record level without using a scope. Options include a 5 to 30 foot loop adaptor, an interrupting voice channel, and an inverter for 12 or 28 VDC . . . all integrally mounted.



Write for Application Note 89, a tape recording handbook useful to scientists interested in tape recording techniques for vibration and test analysis, research and clinical medicine, acoustics, oceanography and other environmentally difficult research projects.

For complete information, write Hewlett-Packard, 1507 Page Mill Road, Palo Alto, California 94304. In Europe: 1217 Meyrin-Geneva, Switzerland; Japan: YHP, 1-59-1, Yoyogi, Shibuya-Ku, Tokyo, 151.

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HEWLETT hp PACKARD

Nuclear Waste Storage

In public discussion of nuclear power and public safety, much concern is expressed about the need for storing the radioactive waste for centuries. While such long-term storage is an essential part of nuclear power development, the projected public safety issue involved is minimal, compared with other environmental problems. A completely adequate waste storage system is trivial in terms of scope and cost, although we depend upon its being there and functioning properly and would suffer hazard and expense if it were not. Because of the long radioactive lifetime of nuclear waste, we are of necessity handing on to future generations a problem that we have "wrapped up" in one form or another. There is some ambiguity about what this form should be, derived mainly from a lack of clear distinction between the concepts of "waste disposal" and "waste management." We believe that perpetual, flexible management is essential so that future generations can have the option of choosing new solutions as new conditions and new technologies appear. Such perpetual care is neither difficult nor costly, chiefly because the inherent volume of nuclear waste is so small.

Each citizen of the United States consumes about 7000 kilowatt-hours of electricity per year, on the average; this amount of power is obtained from the fissioning of about 1 gram of nuclear fuel, equal to the weight of three aspirin tablets, but with a volume less than that of one aspirin. Thus if the source of the electric power is nuclear, about 1 gram of fission products to be stored per year per person is created. The waste concentration process is carefully arranged so that valuable plutonium is removed for fuel purposes, but there the removal of certain other inert material is too much trouble. The safest way to handle the final mixture is to drip it in liquid form into a small pot, heated by electric coils, where it boils dry and then melts to form a glasslike ceramic clinker that is insoluble in water. This is done in a sealed chamber behind heavy walls and watched and controlled with telescopes. After firing and cooling is completed, the clinker, pot and all, is sealed up inside a tight can, and then in still another. It then can be safely moved in a thick-walled shipping cask to a final place. In clinker form the 1 gram of fission products and the accompanying inert material (representing about 1 man-year of electricity use) will occupy about 1/10 of an ounce, volume measure, and the total cost of processing, transport, and permanent storage will amount to about 14 cents (*1*). The heat emitted is 1/40 of a watt, or about 1/10 the energy of a penlight flashlight. In a lifetime of 70 years, each person served by nuclear power could account for a maximum nuclear waste accumulation of less than half a pint in volume. The value of the electric power consumed in his life, at 2 cents per kilowatt-hour, would be, at most, $10,000, and the cost of the nuclear waste storage would be $10 of this.

Thus, the volume to be stored is trivial, and the cost of storage is a fraction of a percent of the value of the power, but the wastes last a long time, must be kept behind thick walls, and must get rid of a certain amount of heat. Nuclear wastes accumulated for 1 year emit 10 watts of heat for each megawatt of heat emitted while in the reactor. If wastes from the same power source are continuously added to the storage vault, a steady-state heat output is reached of 550 watts per megawatt, since the older residues are decaying (*2*).

Where would we store such wastes? How can we contemplate a continuity of protection and integrity of containment that will extend over hundreds of generations? Has anyone ever made such commitments before? The answer is yes—in Egypt, and with rather remarkable success. Wooden chests and sarcophagi removed from the Egyptian pyramids are perfectly preserved and look like new after 5000 years in the desert. Metal, ceramic, and glass objects are also unchanged. Can we not do as well?

The stone of the great pyramid of Cheops, which is about 230 meters square at the base, could be arranged to form a series of smaller vaults that would house all the nuclear wastes that could be generated by the United States, at its present rate of electric power consumption, for over 5000 years. The heat dissipation of 275 megawatts is a small load for such a "dry cooling tower." During these thousands of years, some spent waste could be removed for simple burial to make room for new, so that in fact a perpetual capacity would exist for our present rate of electricity use. New pyramids would be needed as electrical loads increased, perhaps one every decade or so.

We recognize that an engineered storage facility with appropriate handling and cooling facilities would require additional volume, and might look more like the Pentagon than a pyramid. The point of this example is to give perspective to the quantities of waste to be managed, which are indeed tractable and feasible to handle. We are not seriously suggesting that pyramids in the desert are the best way to store nuclear wastes. Other places, such as salt mines, are perhaps better. But if all else fails, they would work, they could be safe and attractive, and they would not be forgotten (*3*). The key objective is to give our successors the freedom to manage the radioactive waste and to change the storage plan if they find a better one, or if surrounding conditions change.

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References and Notes

1. W. G. Belter, *Nucl. Safety* **8**, 174 (1966).
2. A. M. Weinberg and R. P. Hammond, "Global Effects of Increased Use of Energy" (paper presented at the Fourth International Conference on Peaceful Use of Atomic Energy, Geneva, 1971), table III.
3. Since the above was written, the Atomic Energy Commission has announced plans for vault storage, while continuing research on other modes.

Herbicide Study

As one accustomed to hearing scientists charge that reporters will sometimes distort reality through selective reporting, I feel obliged to report evidence that at least some journalists and some scientists share a common humanity. Vide the statement from Arthur Galston in his book review (14 Apr., p. 154) of *Harvest of Death* (*1*) that "in the meantime, the National Academy of Sciences has picked up the ball, and under a grant from the Department of Defense(!) is conducting an additional survey" [of the effects of herbicides in Vietnam].

That the financial instrument is a contract rather than a grant is not terribly important; what is more important is that the contract between the Department of Defense and the National Academy of Sciences was not made at the initiative of the department but at the behest of the Congress, specifically in the Military Procurement Act of 1970.

Two corrections are therefore in order. It is the Congress that deserves credit for "picking up the ball," and the implication should be hastily removed that the National Academy of Sciences turned to the Department of Defense to support the described study. Galston's exclamation point is herewith returned, for more appropriate use elsewhere(!).

HOWARD J. LEWIS
National Academy of Sciences–National Research Council, Washington, D.C. 20418

Reference

1. J. B. Neilands, G. H. Orians, E. W. Pfeiffer, A. Vennema, A. H. Westing, *Harvest of Death* (Free Press, New York, 1972).

I am willing to change "grant" to "contract" and "picked up the ball" to "accept the ball." In both instances, I was aware of the situation Lewis describes and do not feel that the changes are substantial.

I must, however, insist on restoring the returned exclamation point to its original location in my review. It is somewhat surprising that the Department of Defense (DOD), which was responsible for spreading massive quantities of herbicides over Vietnam without adequate knowledge concerning the consequences of such an action, should now be in the position of supporting, after the fact, a National Academy of Sciences (NAS) investigation into the extent of the partly irreversible ecological damage it has caused. At the very least, DOD sponsorship has led several able anthropologists to refuse to participate in the study. I suspect there have been other disadvantages as well.

It has been reported that previous investigating teams, including the Herbicide Assessment Commission of the AAAS, received less than complete cooperation from the military once they got to Vietnam. I presume that the NAS was able to ensure a more favorable ambience for its investigations. But whatever the concessions made by the DOD to the NAS investigating group, many scientists would have been happier with alternative financial sponsorship. Perhaps the NAS should have sensed this and acted accordingly.

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SCIENCE

Where the Action Is

In his address to the 1971 National Conference of the American Society for Public Administration, Congressman John W. Davis (D–Ga.) highlighted the confluence of three major trends in the United States: (i) a renewed interest in federalism, caused by the realization that all problems cannot be solved in Washington; (ii) a shifting of our national priorities from defense and space to domestic problems, which traditionally have been the responsibility of state and local governments; and (iii) a rapid increase in funds for applying science and technology to domestic problems, such as housing, transportation, health care, crime, and pollution.

This same theme—a need for local government involvement—was expounded by Edward E. David, Jr., in an article in *Chemical and Engineering News*: "As our domestic programs begin to focus on societal needs, they will require new forms of participation by industry, academia, and local governments if our strategic approach is to work." And in his science message to Congress, President Nixon stated:

> A consistent theme which runs throughout my program for making government more responsive to public needs is the idea that each level of government should do what it can do best. This same theme characterizes my approach to the challenge of research and development. . . . If we are to use science and technology effectively in meeting these challenges, then state and local governments should have a central role in the application process. That process is a difficult one at best; it will be even more complex and frustrating if the states and localities are not adequately involved.

How does one adequately involve state and local governments—long ignored by the scientific community—in the application of science and technology to domestic problems? Two avenues have already been opened. First, several states and larger cities have begun to incorporate science into their decision-making processes. According to recent statistics of the National Science Foundation, 49 governors have appointed personal science advisors, 23 states have created science advisory committees or commissions, 5 have established state science foundations, and 5 have appointed science advisory committees to their legislatures. Second, two recent reports have drawn a blueprint for establishing an effective federal-state science partnership.

In the preface to one of the reports, *Public Technology: A Tool for Solving National Problems*, which was issued by the Federal Council for Science and Technology, Vice President Agnew states: "[This report] will provide a useful basis in developing federal policies to foster more effective scientific and technological relationships between the federal government and state and local governments." In a companion volume published by the Council of State Governments (*Power to the States: Mobilizing Public Technology*), Russell W. Peterson, governor of Delaware, emphasizes that "one great need is for government to find ways to best harness science and technology in solving problems. . . . Each governor will find this report extremely helpful in accomplishing his prime mission—solving problems and thus increasing the quality of life for the citizens of his state." In Victor Hugo's vernacular, the hour and the idea have arrived; the President and the governors are playing the same tune.

In his closing address at the National Action Conference: Intergovernmental Science Policy (21 to 23 June 1972, Harrisburg, Pennsylvania), Congressman Davis stated: "It has been observed that the federal government can open the gates to an action partnership in domestic technology. But only the state and local governments themselves can make the decision to walk through that gate." This is the challenge of the 1970's—one that the states can ill afford to ignore.—JOHN E. MOCK, *Science Advisor to the Governor of Georgia, Box 32745, Atlanta 30332*