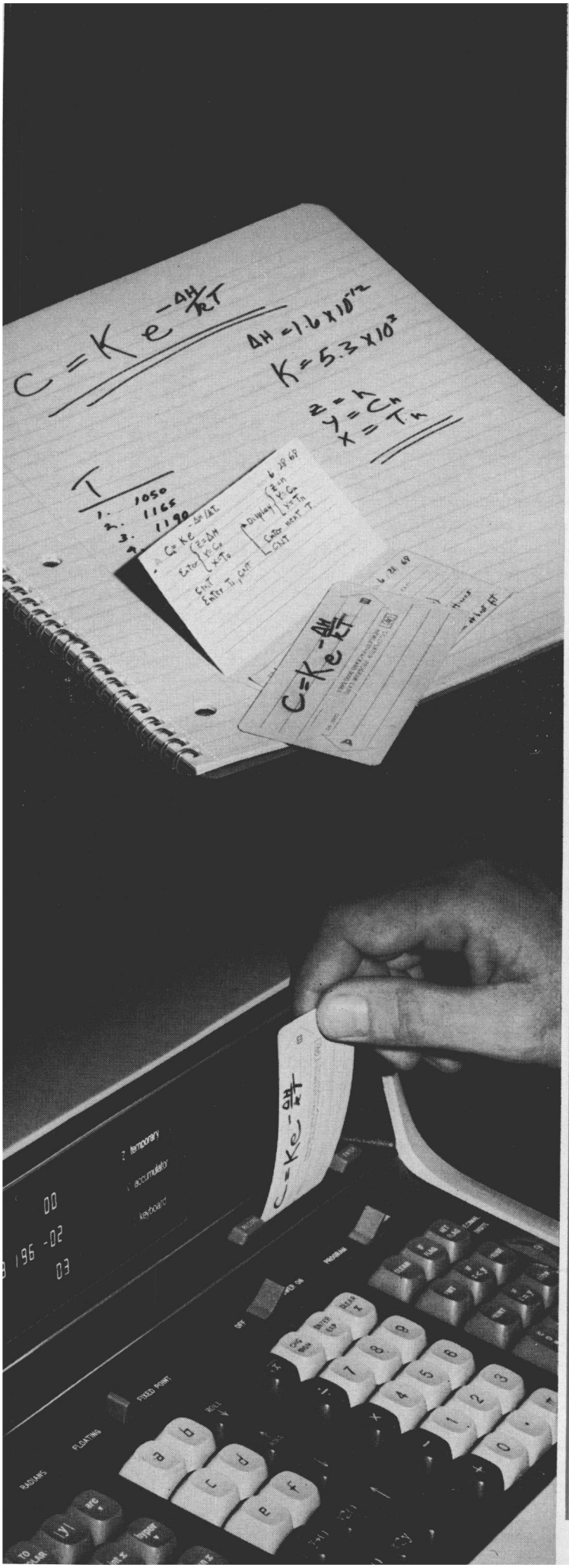

Restoring the Balance Between Analysis and Computation

Time was when the scientist enjoyed sitting at his desk to manipulate the raw analytical data that he had accumulated while standing at the bench. Somehow complex computations with classical formulae created a pleasant interlude between creative sessions at the bench.

During the post-war period, this somewhat romantic attitude has gradually disappeared. Backed by a seemingly endless parade of new automatic instruments for analysis, the scientist has become such a prodigious producer of analytical data that the balance between his analytical and computational loads has been destroyed. One of the top technical management problems of the day is to release the scientist from the time-consuming drudgery of massive computations and return him to creative work.

Obvious solutions are not always satisfactory. The typical electronic desk calculator is simply not up to the job: many of the commonest mathematical routines of science and engineering are beyond its scope. On the other hand, the computer is often too imposing for the problem immediately at hand, too inconvenient of access or too expensive to justify, and always relatively difficult to program and use.

What is needed is a machine that combines the accessibility of the calculator and the capacity and speed of the computer. Such is the H-P 9100A computing calculator. It not only resembles but even surpasses the computer in its ability to handle very large (10^{99}) and very small (10^{-98}) numbers at the same time. In practical terms, for example, the 9100A allows the scientist to use Avogadro's number (6×10^{23}) and Planck's constant (6.6×10^{-27}) in the same computation without risk of overflowing its capacity, and without requiring the scientist to keep orders of magnitude in his head.

The 9100A also shares with the large computer the ability to solve complicated computations in fractions of a second. This stems from its ability to store as many as 196 program instructions, some of which may be decisions based on conditional branching and looping commands. But the 9100A is far easier to use than any computer because of two unique characteristics which bring it within easy reach even of the scientist who has no knowledge of computer programming techniques. First, all programming is carried out in English or common math symbols, not in special computer language. Second, even the most complex program can be stored on wallet-size magnetic cards and entered into the 9100A simply by inserting the card in a slot (as in the photo at left) and pushing a button.

As a result the 9100A can, for example, determine the straight line that best fits a set of experimentally obtained X-Y points in seconds. The scientist need only insert the appropriate program card and enter the data points on the keyboard. The 9100A then carries out the entire 'least squares fit' computation and displays the slope (m), intercept (b), and correlation coefficient (r). It will even plot the line itself when equipped with the forthcoming H-P X-Y plotter.

Yet the 9100A is no bigger and costs no more than a calculator. More important, it is as easy to use since all machine operations are in English or common math symbols. This includes single-key operation for log, exponential, trig and hyperbolic functions, and for coordinate conversions from polar to rectangular and vice-versa.

If you want to know how the 9100A can restore the balance between analysis and computation in your lab, get a copy of our new 22-page brochure. Write Hewlett-Packard, 1501 Page Mill Road, Palo Alto, California 94304. In Europe: 54 Route des Acacias, Geneva.

HEWLETT hp PACKARD

ANALYTICAL INSTRUMENTS

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pp 399-409 not hd.

Structure of an Organism

I would like to question the validity of what I take to be Michael Polanyi's main argument in his article "Life's irreducible structure" (21 June, p. 1308). In his own words, it is this:

> 1) [An organism's] structure serves as a boundary condition harnessing the physical-chemical processes by which its organs perform their functions.
>
> 2) If the structure of living things is a set of boundary conditions, this structure is extraneous to the laws of physics and chemistry which the organism is harnessing.
>
> 3) Thus the morphology of living things transcends the laws of physics and chemistry.

Even without further elucidation of Polanyi's conception of an organism's structure as a boundary condition harnessing physical-chemical processes, it is easy to see that this argument is invalid. For, granting the premises, the most that follows is that the morphology of an organism "transcends" *those* physical-chemical processes which it harnesses. It does not follow that it "transcends" *all* physical-chemical processes. But the latter conclusion is surely what is needed if one is to go on to claim that "both machines and living mechanisms are irreducible to the laws of physics and chemistry."

Probing deeper we see that we may not even have to accept the weaker conclusion, for the second premise of the argument is questionable. Polanyi supports this premise with the following analogy:

> In Galileo's experiments on balls rolling down a slope, the angle of the slope was not derived from the laws of mechanics, but was chosen by Galileo. . . . this choice of slopes was extraneous to the laws of mechanics . . .

To take a different, but similar, example, consider the solar system. The positions and momenta of the components at a given time, t, serve as boundary conditions for determining the state of the system at all other times according to the laws of mechanics. Now it is an obvious truth that the boundary conditions at t do not follow from the laws of mechanics alone. But to describe this truth by saying that the structure of the solar system transcends the laws of mechanics is at best misleading, for clearly the boundary conditions at t do follow from the laws of mechanics provided only that we supply some other boundary conditions; for example, the state of the system at t'. Or, to carry the example somewhat further, it is at least logically possible that the solar system should have been formed from hydrogen atoms by the action of gravitation alone. Thus, while it may be of some interest to think of the universe as a hierarchy of systems, each providing boundary conditions for "lower" systems, it has not been shown that any but physical-chemical laws are needed throughout the hierarchy. It has not even been shown that the *same* laws may not be operative throughout. . . .

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UFO Story: Is Propriety the Issue?

In letters recently published here (30 Aug. and 27 Sept.), Condon and Branscomb question the propriety of *Science* reporting on the administrative difficulties surrounding the UFO study that Condon is conducting for the Air Force. Since they raise the question of propriety, I think it is desirable for *Science* readers to be informed of the following concerning the celestial Bay of Pigs that Condon is running in Boulder.

Not long after the publication of a *Look* article attacking Condon for his management of the project, Condon offered to help *Science* prepare a story about the project. It was his hope, he explained, that an article in *Science* would present the situation in a way that would counteract the effects of the *Look* article. As it turned out, independent of the *Look* article or Condon's invitation, the news department was planning a story anyway. Condon assured us of his complete cooperation and did not raise any question of propriety.

When the *Look* article, though critical, failed to evoke any significant public interest, Condon concluded that it would be inappropriate for *Science* to touch the matter, withdrew his offer of cooperation, and proceeded to enunciate high-sounding principles in support of his new-found belief that *Science* should not touch the subject until after publication of his report. When reminded that he had sought to initiate an article and had assured *Science* of his cooperation, Condon flatly refused to discuss the matter further.

Since Condon does not set the editorial policy of this journal, we pro-

ceeded to investigate the situation and prepared an article on the basis of the information that could be obtained. When there was reason to believe that relevant information was lacking, it was so indicated in the article. (For such lacks, it might be added, Condon can only blame himself.)

As for the propriety of an article in *Science* prior to the issuance of the Condon report (which we await with great interest), it is difficult to know where to begin. But when public funds and matters of public concern are involved, where is it prescribed that nothing may be said until the public is presented with a *fait accompli*?

As for Branscomb's anguished assertion that "the tragedy is that *Science* apparently fails to perceive that public acceptance of the rationality of science is at stake"; if it is at stake, it should be noted that *Science* merely presented a report on the interesting events in Boulder, it didn't create those events.

D. S. GREENBERG

Science

Since Condon (Letters, 30 Aug.) characterizes *Science*'s article on his UFO project as gossip, perhaps he could be persuaded to answer two questions:

1) Is the memo printed at the end of the article "Colorado UFO fiasco" by Curtis Fuller beginning on page 30 of the magazine *Fate* (September 1968) an accurate transcription or copy of a memo written by Robert J. Low concerning the UFO project at the University of Colorado?

2) Is Low the author of this project's report, or otherwise associated with it in some capacity in the past or now?

J. B. HATCHER

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Conservation: Guideline for the Courts

Kesteven's excellent article, "A policy for conservationists" (24 May, p. 857), is a timely assist to the group of conservation-minded congressmen who have sponsored legislation for a National Conservation Bill of Rights. The resolution to amend the Constitution of the United States by setting forth a statement of national policy concerning the environment and natural resources was introduced in the House on 12 June. Congressman Richard L. Ottinger of New York sponsored the resolution

along with Congressmen Kupferman, Saylor, Dent, Scheuer, Button, Cleveland, Farbstein, Walker, Edwards (Calif.), Eilberg, and Podell.

The purpose of the amendment is to define the rights of citizens of this country with respect to the condition of our general environment and to the use and conservation of natural resources. "The right of the people to clean air, pure water, freedom from excessive and unnecessary noise, and the natural, scenic, historic, and esthetic qualities of their environment shall not be abridged." The resolution calls for periodic inventories and evaluation of "natural, scenic, esthetic and historic" resources and restrictions on actions that would adversely affect resource values on public lands. A constitutional statement of the nation's will in respect to resources and environment is essential to provide a legal basis for resolving conservation issues. As it now stands, litigation to protect the public from actions damaging to its environment has been only marginally successful. The courts find insufficient basis in existing statutes to give favorable opinions on behalf of the public in conservation matters, and, since these concerns are relatively new, there is practically no protection in common law. The constitutional amendment would set a guideline which the courts could follow.

The Conservation Bill of Rights, now in the Judiciary Committee, faces a long uphill struggle in Congress, and then it must be ratified by the legislatures of two-thirds of the states. If adopted, it will have far-reaching, positive effects on conservation theory and practice in this country and perhaps on human survival in centuries to come.

JOHN CLARK
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Milkweed Mystery

An unusually large number of the milkweed plants, *Asclepias*, in this area of Nassau County, Long Island, have not formed pods this year. The plants seem to be of average height for this time of year and in all other ways appear normal. Have readers in other areas observed lack of pod formation this year?

WALTER LENER
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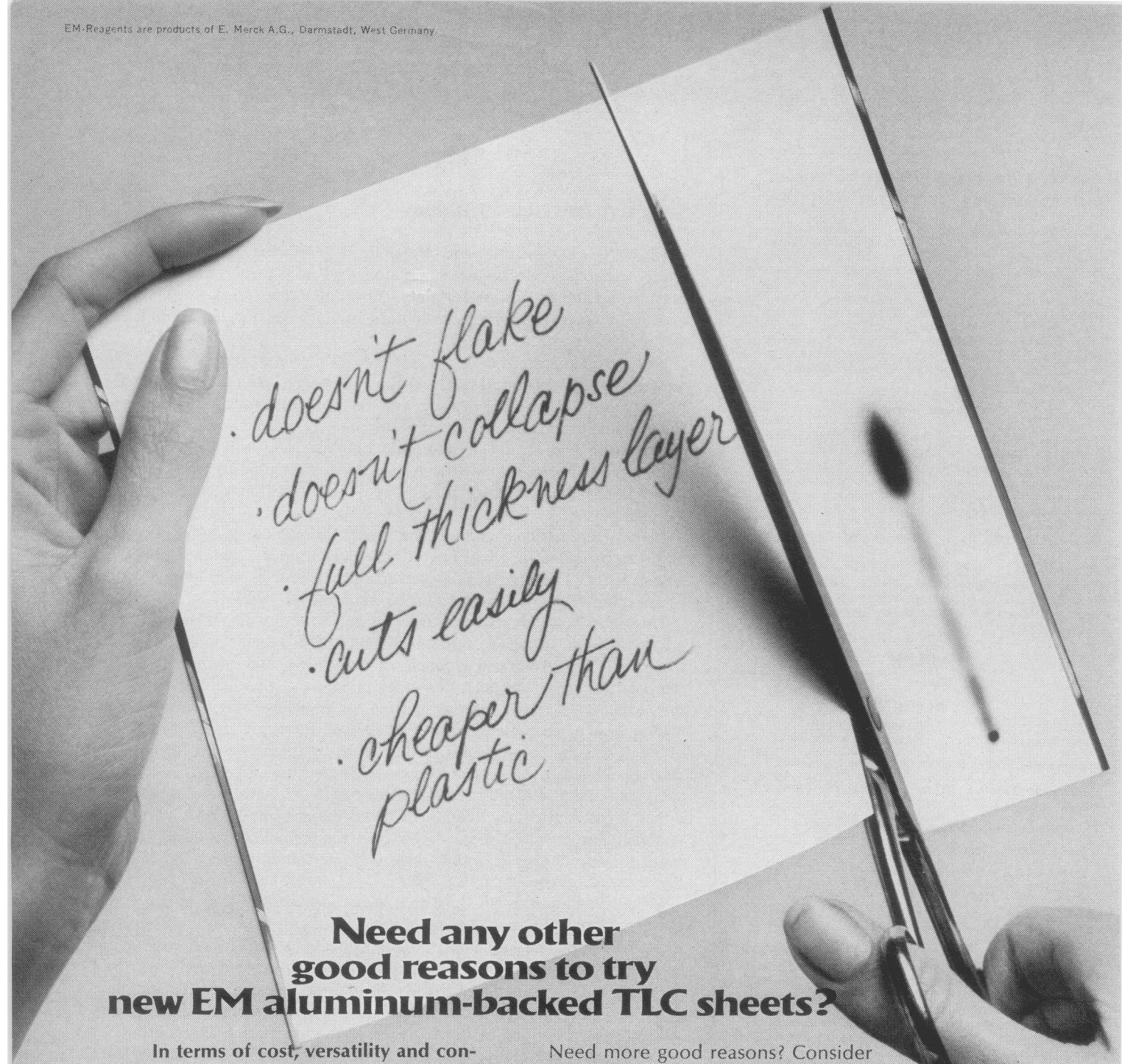

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