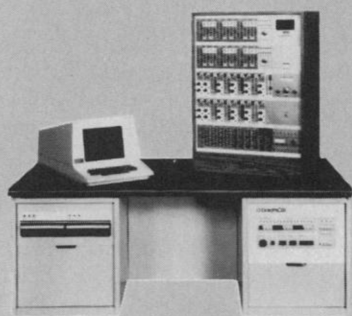

selves up as being the sole judges of the kinds of research they do. This is implied in our country, for most of us attain our research funding through the cooperative endeavor of our scientific peers and of publicly responsible legislators. To state otherwise, and I get the strong impression that this is what the advocates of recombinant DNA research state, is to go against the historical precedents already legalized in our country.

My scientific argument can be stated within the context of a few questions. Do we really know that much more about the world that we can definitely state, or even state with reasonable doubt, what scientific research will lead to? Are we really that much further along on the path to comprehensive knowledge that we can forget the overwhelming pride with which Dr. Frankenstein made his monster and the Rabbi of Prague made his Golem? Those who would answer "Yes," I would accuse of harboring that sin which the Greeks held to be one of the greatest, that of hubris, of overweening pride, even of arrogance. Like the physicists before us, we have entered the realm of the Faustian bargain, and it behooves all of us biologists to think very carefully about the conditions of these agreements before we plunge ahead into the darkness.

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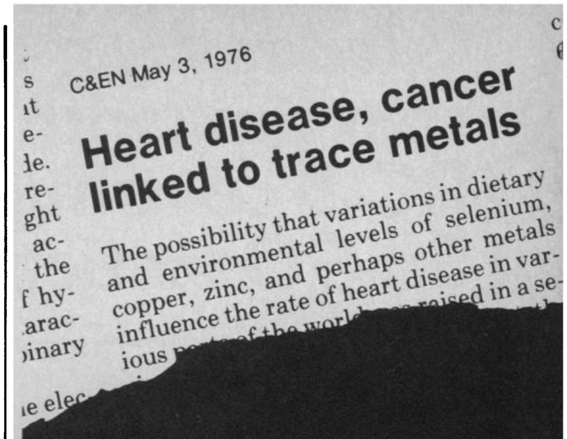
Computers: Minis and Maxis

Arthur L. Robinson's article discussing the increasing use and apparent cost advantage of minicomputers for chemistry computation (Research News, 6 Aug., p. 470) is an incomplete report on trends in computing support for American science. Some time ago the issue passed beyond a simple competition between minis and maxis. The problem now is how universities and research laboratories can best enable scientists to conveniently and economically exploit a rapidly developing technology. The complete story includes considerations raised by Robinson but also the following.

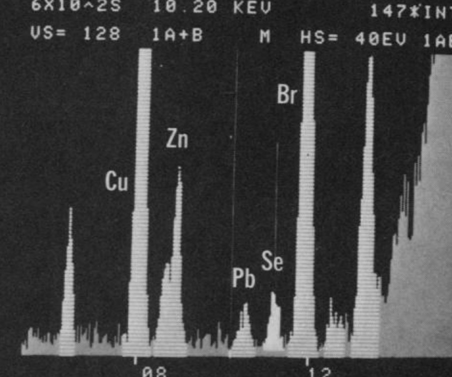
1) Minicomputers can be brought into production by their manufacturers with a development cycle of less than 2 years, compared with the 5 to 6 years required for large, full-range systems. This means that, on the average, manufacturers of minis can make use of components and fabrication techniques 3 years newer than those for large-scale computers.

2) There is no dichotomy between minis and large-scale machines. Some


C&EN May 3, 1976

Heart disease, cancer linked to trace metals

The possibility that variations in dietary and environmental levels of selenium, copper, zinc, and perhaps other metals influence the rate of heart disease in var- ious



so-called minis are really quite large and powerful (what Robinson calls "high-performance minis"), differing from the machines usually considered large only in that they come from a less established manufacturer who has selected a more specialized market and provides fewer customer support services. In particular, there are limits (at least very long delays) in the software provided—manifested, for example, in operating system capabilities. The greatest costs these days in computer system manufacturing are for software design and development. Any vendor who wants to avoid these areas can sell at lower prices, whether he is selling small or large machines. But that means that the machines must be functionally equivalent to machines for which software already exists: otherwise, the customer must be in a position to develop his own software, or his application must be one that doesn't need a lot of sophisticated and complex software. This is the case for scientists needing to do large but straightforward numerical calculations, such as some of the work of the chemists discussed by Robinson.

3) Most university campuses have inadequate computing power and services, especially in areas which depend on recently developed hardware or software technology, for example, graphical input and output, archival data storage, data base management systems appropriate for research uses, and operating systems which economically support large-volume time-sharing. Increased dependence on minis (probably managed in a decentralized way) will meet some of their needs, but far from all of them.

4) Given their traditions of minimal cost accounting, unpaid and underpaid student labor, and the expectation that faculty members will do many things for themselves, autonomous university departments tend to be self-sufficient: they have trouble acquiring services (of any kind) from a service center that must fully and explicitly charge back all its costs.

In their glee at finding apparent large cost differences between their own minis and centrally managed service-center computers, scientists are overlooking significant differences in the type of service obtained. Should research scientist (or apprentice scientist) manpower be devoted to procuring, operating, and repairing computers? It was sad but revealing, the day after the Wisconsin chemistry department's machine was approved, for us to receive a call from a member of that department asking for our help with the acquisition process.

Those of us who have evolved itemized billing schemes over the years rankle at charges that they subsidize special groups and force some customers to pay for a lot of equipment they don't use. Research scientists often end up using more than they think they need, for example, development software, differential scheduling by job size and job urgency, high-quality mathematical software, and a reliable file system.

A scientific computer center in the future will have to offer a variety of services from several kinds of machines, achieving economies by combining newer technology with specialization of function. It is likely that there will continue to be demands from scientists for the service of a large, general-purpose system as well.

Finally, there is an apparently unintended irony in the accompanying article by Robinson (Research News, 6 Aug., p. 471) reporting that the chemists expect to have their cake and eat it too. They are acquiring their own minis, yet they are arranging to have access when needed to what may be the biggest center of them all, the National Resource for Computation in Chemistry.

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Earthquake Light in Focus

In his letter on earthquake lights, J. J. Lloyd (17 Sept., p. 1070) cites obsolete speculation with facetious effect. This is a field of mystifying and elusive observations (only some of which appear to be erroneous or misinterpreted), discussed briefly in my textbook (*1*). Not cited there are observations (*2*) of numerous luminous phenomena ("total or partial illumination of the sky, the ground, the mountains, and lines of electrical connection and transmission; luminous tongues, sparks, falling balls . . . of prevailingly reddish color") for the Rumanian earthquake of 10 November 1940, which originated at a depth of about 100 kilometers. The Chinese, with their current large earthquake program involving many observers, are in a good position for investigation.

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