the passage of new laws. Fourteen actions are suggested as examples, including waiving the 1982 carbon monoxide emission standard for automobiles, rescinding the rule on airbags, relaxing 1983 and 1984 emission standards for heavy and light trucks, permitting more frequent violation of the air pollution standards for city ozone, and so on.

Here again the Administration may find it difficult to maintain the purity of its economic principles in the face of events. If the worst happens, will a waiver on carbon monoxide standards rescue Chrysler from its financial quicksand? If not, will the new President really tell the company it must survive without further help? Alternatively, if it becomes necessary to help Chrysler out again, will the new Administration turn away from other wounded companies: Ford, for example?

The point is that the economic and technological problems confronting the new Administration are growing so rapidly that decisions will have to be made early on a number of key issues—tax cuts, price controls, government involvement in the energy industry, and aid to the auto companies. These early decisions will have a profound effect on the shape of Reagan's economic plan.

The less ambitious course would be to muddle through, making only gradual shifts of emphasis in federal programs. But this choice would alienate some of Reagan's close economic advisers, like Stockman and Kemp. They predict that anything less than drastic action will lead to "severe demoralization and fractionalization of GOP ranks and an erosion of our capacity to govern successfully. . . ." It will be interesting to watch Reagan pick his way between the demands for adherence to his austere economic principles and the demands of the orthodox federal establishment.

—ELIOT MARSHALL

Pentagon Orders End to Computer Babel

To halt a proliferation of computer tongues, the Pentagon has built a universal language; but rebels fight the unification

And the Lord said, Behold the people are one, and they have all one language; and this they begin to do: and now nothing will be withheld from them, which they have imagined to do.

Let us go down, and there confound their language, that they may not understand one another's speech.

—Gen. 11:6-7

Confronted with a costly and at times chaos-producing array of more than 1000 computer languages, the Pentagon 5 years ago decided to develop a single tongue for the thousands of computers in the Department of Defense that aim weapons, watch for Soviet ballistic missles, guide patrolling submarines and bombers, and relay critical information to battlefield commanders. The language has now made its debut, and the Pentagon hopes it will eventually spell the end of computer babel.

As at the Tower of Babel, however, this single language is already under fire. Some academicians who perform research for the Pentagon feel that mandatory use of a single language will hamper their creativity. And the Navy is resisting introduction of the single language.

Called Ada, in honor of Augusta Ada Byron, the world's first computer programmer and the only legitimate daughter of English poet Lord Byron, the language will cut the Pentagon's cost of developing and maintaining computer programs and will increase the reliability and speed of computer networks.

Pentagon experts say that Ada, unlike many other languages, is simple to use since it mimics human languages by incorporating common words and phrases in its programming and printed answers. Further, it has the functional richness for a diverse and demanding set of applications and can be used on almost any computer. Ada is a "high-order" language, one in which a single command initiates a series of low-level computer operations, much as the order to "fire" from a military commander sets in motion a series of complex actions among many soldiers. In most applications, a high-order language such as Ada is easier to use than a low-order one. Ada and the unique characteristics that make it so attractive to the military are the result of a 2-year international competition held by the Pentagon, the first of its kind.

The Army soon expects to have 13,000 computers, the Navy 33,000 and the Air Force 40,000. The software bill for military computers last year came to more than $3 billion. One study estimates that the introduction of Ada will result in savings of more than $24 billion by the end of the century.

Ada should also result in less electronic chaos. During the past 20 years the electronic links among the Pentagon's computers have greatly increased in number, bringing serious problems in networking, similar to having speakers of French and Farsi struggling to communicate with one another on the telephone.

Consider the case of the Pentagon's illfated Tactical Operations System (TOS), a $4 billion program that was meant to use computers to assist battlefield commanders in making tactical decisions. TOS had its own software. While a prototype TOS system was being tested during the 1970's, Pentagon managers tried to tie the TOS computers into other systems under development, such as TACFIRE (Tactical Fire Direction System), a computerized program for linking forward observers with artillery units. Since the TOS computers were to be central for all division-level operations, this interoperability with other field units

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was essential. Unfortunately, TACFIRE used different software, and TOS program managers were forced to develop a scheme whereby TACFIRE data would be translated within the TOS computers—a process that slowed the exchange of data and introduced errors. The results were poor. In part because of this incompatibility with other systems under development, Congress in fiscal year 1980 killed the division-level TOS project after more than $100 million had been spent on its development.

While technical, or even random, considerations have often accounted for the use of different computer languages, their use has also been motivated by the turf-consciousness that often characterizes the branches of the armed forces. For example, the Air Force in some cases may not want the Navy to have unlimited access to its computers, and vice versa. Ada, on the other hand, will facilitate this exchange of information, which may be why the Navy has taken a wait-and-see attitude toward the introduction of Ada and is now basing its standardization efforts around the continued use of CMS-2, its own standard computer language.

Because of this type of resistance, and because of the service-wide benefits that are expected, a recent study by the General Accounting Office* suggests that the introduction of Ada be made mandatory in the U.S. military. For the moment, however, the Pentagon says introduction will be voluntary.

The Pentagon hopes to entice all computer users—not just the military. It wants universities to use Ada for teaching computer programming and software engineering, wants companies to exploit Ada in the commercial marketplace, wants foreign vendors to adopt Ada, and wants the NATO allies to accept it. The benefits for the U.S. military would be many, including easier hiring of programmers and easier purchasing of program-compatible equipment. The Pentagon even chose the name of the new language with enticement in mind. When development first began, the language was dubbed DOD-1, a name that many observers felt, in the aftermath of Vietnam, would inhibit the use of the language by universities and industry. Instead, the name Ada was eventually chosen, after the Countess of Lovelace. In the mid-1800's, the countess worked for Charles Babbage, a mathematician and inventor of a calculating machine.

Widespread acceptance of a Pentagon-inspired computer language is not new. The Pentagon was the driving force behind the development of COBOL (Common Business-Oriented Language), which was introduced in 1959 and is today used extensively around the world. This leads to a rather curious fact: the Pentagon fully expects that the Soviets will use Ada, both for the help it will give them in unraveling U.S. military information and for the general excellence of the language itself. "There's no way a language like this can be classified," says William E. Carlson, the top Pentagon manager for the Ada project. "It would be like classifying the English language. The Soviets might get some small amount of benefit from it, because it's better than a lot of other languages. But it will be minuscule compared to the benefit that we'll get."

The search for a single computer language began in 1975. After 1 year it became clear that the characteristics of such a language were definable. In November 1976, the Pentagon took a big step toward reducing the multitude of computer tongues by designating only eight of the hundreds of computer languages in use by the Department of Defense as interim standards. Then, in a sharp break with the decision-by-consensus traditions of the military, an international design competition was held for the creation of the new computer language—apparently the first such competition anywhere in the world. After 2 years of tests, a submission by Jean Ichbiah of Honeywell Bull in Paris and of the Honeywell Systems and Research Center in Minneapolis was selected.

Not everyone outside the U.S. military is anxious to get their hands on Ada. Consider the plight of some academicians working on artificial intelligence.

**The Department of Defense Standardization Program for Military Computers—A More Unified Effort is Needed* (LCD-80-69, General Accounting Office, Washington, D.C., 1980).

Culver Pictures, Inc.

A cure for the Pentagon's computer woes?

The new computer language is named after Augusta Ada Byron, the only legitimate daughter of English poet Lord Byron and the world's first computer programmer.

The Pentagon funds 80 percent of this research in the United States, and some of these researchers fear that the Pentagon, in its drive for widespread acceptance of Ada, will decide that anybody who does computer research for the Pentagon will have to use Ada. This, say the researchers, would inhibit creativity. "Some Pentagon people have a naive belief that if the research was done in this language it would be easier to apply," says Jerome A. Feldman, chairman of computer science at the University of Rochester. "That's silly."

To fend off this possibility, these researchers asked the Defense Advanced Research Projects Agency (DARPA) to study whether the use of Ada by the artificial intelligence research community was feasible. The study, performed by DARPA by SRI International, concluded that it was not. "We cut them off before it became an issue," says Feldman. Other areas may be affected, however, since there will be more academic support for Ada-related research than for all other such research combined. "To some extent that will have tremendously good effects," says Feldman. "But to the extent that these requirements are different than other ones, it may bias that whole line of work. Ada is a large, high-momentum object stuck into this research system. And its ramifications are going to continue to spread throughout computer science, for better or worse."

It remains to be seen whether the Pentagon's drive for language unification will be thwarted by academics, with their desire for freedom to choose which language to use for computer research, or by the Navy, with its apparent desire to keep secrets from the other services. If developments are similar to those described by the Biblical Patriarchs, the outlook for continued proliferation of computer languages is good.

—WILLIAM J. BROAD

The Complete Index to Man

There is a plan to catalog every protein produced in the human body; meanwhile DNA sequences accumulate apace

The complete understanding of man may remain a distant prospect, but a complete description in the language of molecular biology has suddenly begun to appear within the realm of possibility. A total analysis of the human genome, as well as an index of every protein produced by the various types of cell in the human body, are goals that through new techniques and advances in computing power have begun to appear almost feasible.

Neither goal is exactly around the corner. A total of some 350,000 DNA bases from the entire living kingdom had been reported in the scientific literature by December 1980, whereas a single human chromosome contains on the order of 500 million bases. Nonetheless, the power of the new rapid sequencing methods means that sizeable segments of the human genome can now be analyzed if the need arises.

Perhaps further off is the goal of identifying every protein made in the human body. Yet an ambitious project to do just that has already been devised. Its originators are two scientists at the Argonne National Laboratory, Norman G. Anderson and his son Leigh Anderson. Over the last few years they have laid much of the technical groundwork for cataloging the 50,000 or so different protein products that constitute the working parts of human cells.

A human protein index, in their view, would fulfill for molecular biology the role that sky maps do for astronomy or even the periodic table for chemistry. It represents the kind of systematic cataloging of basic subject matter which is the hallmark of a mature discipline.

"Only 300 to a thousand human proteins have been characterized in any reasonable detail—which is just a few percent of the number there. The alchemists knew a larger fraction of the atomic table," remarks Norman Anderson.

The Andersons' plan is simple in concept, technically arduous in design. Their intent is to identify each human protein by the coordinates of the position it takes up in a standard mapping system. The mapping system is a specialized version of the technique known as two-dimensional gel electrophoresis.

The proteins extracted from a particular human tissue are separated in one dimension according to their electric charge, and in a second dimension by their molecular weight. The result is a complex map, often of more than 1000 separable spots.

The Andersons' aim is to standardize the preparation and reading of the two-dimensional gels to such an extent that each human protein can be recognized by its map coordinates.

Construction of the human protein index would be no minor task. Asked recently by Senator Alan Cranston (D-Calif.) for the costs of a crash program to complete the index, the Andersons estimated that some $350 million would be needed over the next 5 years. Cranston became interested in the project through his attention to aging, nutrition, and biomedical research in general. The idea for a crash program seems now to have receded, but Cranston is still actively interested in the project and has a high-powered task force reporting to him on how the project should be supported. Funding on the order of $10 million a year seems to be the present objective. "This could be the basis for a major stimulus to the biotechnology industry in this country," remarks a Cranston aide, who says the senator plans to interest the Reagan Administration in the project.

> The human protein would reveal the pattern of cell development

What would justify a multimillion dollar budget, the Andersons believe, are the various potential applications of the human protein index, chiefly in diagnosing disease, measuring the human mutation rate, and assessing the genetic impact of environmental pollutants. They

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