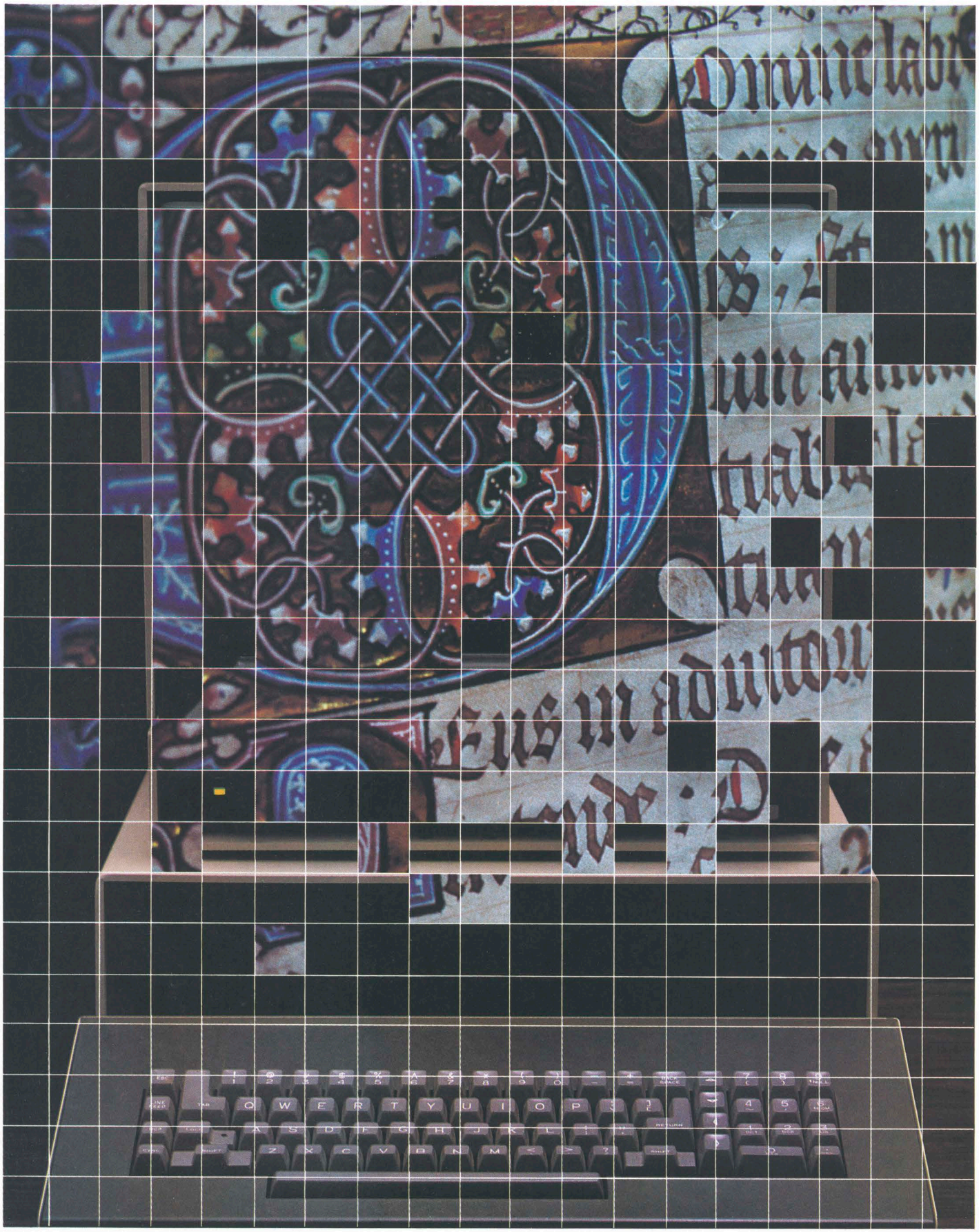

The Unity of Knowledge

by J. Alan Robinson

One of the more helpful, not to say profound, graffiti I have seen recently said: "If you aren't completely confused by now, then you still haven't grasped the problem."

Given the state of my mind at the time, I found this most encouraging.

All of us who are members of Syracuse University are responding to the same fundamental urge. Each of us is here to work on some part of what is known. We are aware of an enormous heritage, accumulated over dozens of generations of human-kind, which is accessible in and through a university; we call it "knowledge." Each of us wants a share of it to use and to enjoy for a lifetime. Some of us hope to add to it in some way by research or to help to preserve and disseminate it by teaching, or both.

By "knowledge" I mean not just factual, scientific knowledge, but also the scholarly knowledge of the humanist and the skill of the performing artist; the dexterous wisdom of the surgeon and the verbal precision of the lawyer; anything which can be made the subject of serious academic study.

There is so much to know; but we are so limited by our short lives, and our small slow brains, and by all the distractions and fripperies intrinsic to ordinary human existence, that no one person can hope to assimilate more than a minuscule fraction of what is already known.

It was not always so. There was a time when a single human being might aspire to know personally the whole of extant knowledge. Aristotle certainly thought he knew everything worth knowing, 22 centuries ago. Perhaps Leonardo da Vinci came as close as anyone has in the past thousand years. As late as the end of the 19th century, an Oxford wit could write, twitting the Master of Balliol College Benjamin Jowett:

First come I; my name is Jowett,
There's no knowledge but I know it.
I am the Master of this College:
What I don't know isn't knowledge.

But Dr. Jowett only thought he knew everything, or at any rate that his classical training would make it easy for him to become an expert on anything in no more than a fortnight. In 1890 there was already far too much for even Dr. Jowett to know more than just a little bit of it.

At times this mismatch, this absurd and pathetic

J. Alan Robinson is SU's only University Professor, as well as the research director of the Syracuse Center for Advanced Technology in Computer Applications and Software Engineering (CASE Center). The first title, conferred by SU trustees last December, recognizes the breadth of Robinson's scholarship: Once a student of the classics, then a professor of philosophy, Robinson is now internationally known for his work in computer programming.

We are on the brink of major advances in understanding what knowledge is and how it works.

disparity between how much there is to know and how little of it each one of us will ever know, can seem like a rather cruel joke.

A university is a glorious response to the human "need to know" in light of the feeble capacity of any one individual to do much alone. In some higher sense, a university does indeed know everything that is known and is worth knowing. A good university library contains, or at least can provide access to, almost everything that has ever been seriously written down. A university faculty is a sort of living library. Every scholar and scientist, every artist and performer, is a repository of some particular human-sized module of knowledge, an example of what can be learned in one dedicated life span.

Every graduate student has taken the first steps along this road. There is no more honorable or exciting or satisfying way to spend a life.

A university in its own way excites the same kind of awe, the same sort of wonder, as does the universe itself. And so it should; the university is an instrument which has evolved in response to our need to know. Its function is to store, organize, and display all the knowledge that there is; to maintain, so to speak, an up-to-date model of all of reality, a model which is continually expanding and improving as new knowledge is incorporated into it.

In this higher, institutional sense, knowledge is one, single whole. Just as the universe is by definition the whole of reality—everything that there is—so mankind's entire knowledge, viewed collectively rather than from wherever each of us individually happens to have taken a stand, is a unity.

As knowledge advances, its unity and coherence become more evident. Indeed, many of the major improvements in our knowledge actually consist of unifications. Our model of reality gets better by becoming simpler. Albert Einstein once said that in physics one must strive to make one's theories "as simple as possible, but no simpler." It is beginning to seem that instead of there being, as Shakespeare wrote, "more things in heaven and earth than are dreamt of in your philosophy," there may after all be fewer.

Some of those responsible for such simplifications in our own time have been among the recent distinguished visitors to the Syracuse campus.

The physicist Sheldon Glashow last year told us of the "grand unification" of three of the four fundamental forces in nature, of the new view of matter and energy, and of the life and extent of the cosmos, which is provided by the resulting simple, elegant, scheme of elementary particles and their various interactions.

The linguist Noam Chomsky was on campus not long ago to tell us his idea of how the brain of each new developing human is programmed to learn whatever natural language surrounds it in its first years. This idea enormously simplifies our model of language and how it works, and gives us hope that one day we may be able to mimic the whole process in artifacts such as the computer.

The neurophysiologist Thorstein Wiesel last year lectured at Syracuse about the amazingly regular structures grown in the part of the brain devoted to managing the vision process.

The ideas and discoveries continue to mount up. It is really very difficult sometimes to refrain from jumping up

Transcending Normal Boundaries

On a campus with more than its share of brilliant minds, J. Alan Robinson is a particularly bright star.

Philosopher, logician, mathematician, computer scientist, he is a man whose intellectual scope cuts across traditional fields of study and defies categorization.

Robinson came to SU in 1967 as a professor of computer and information science. At that time, he had already acquired an international reputation for his invention of "resolution," a theory incorporating the principles of logic into computer programming. It was a breakthrough discovery that laid the theoretical foundation for logic programming, a system which allows computers to perform deductive reasoning.

Characteristically, Robinson's achievement in computer science came in a field he had not intended to study. A philosophy major at Cambridge, he originally came to the United States for a doctorate in modern philosophy at Princeton University.

After completing that, he accepted a job as an operations research engineer at the E.I. duPont Company in Delaware, despite the fact that he had no formal background to prepare him. But, as he explains, it was a time of exhilarating experimentation in the field, and no one was trained for it.

At DuPont he received what amounted to a new education—in math, physics, chemistry, and engineering. He also worked with a computer for the first time and was immediately captivated.

After a brief stint at Rice University as a professor of both philosophy and computer science, he moved to Syracuse, where he had a hand in shaping SU's

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and down with glee as the picture becomes clearer and more beautiful.

In the past 30 years we have been learning how, for all of us, life, at least here on earth, is based on the programs stored in a common universal code as patterns in the structure of the DNA and RNA molecules.

One feels like asking, with the physicist Isador Rabi: "Who ordered this?"

The mathematicians have been for centuries, but ever more rapidly in recent times, finding deep regularities and common, unifying abstractions within the bewildering variety of symbolic-structures and processes in their domain. Mathematicians are par excellence the ones among us who seek to organize what they know in a few simple axioms and definitions from which everything else can be deduced.

The chemists have today arrived at a virtually complete theoretical understanding of their world of molecular structures and reactions. Given enough computing power and time, they could deduce from the basic equations of quantum electrodynamics all of the properties observed in the laboratory.

And, yes, the computer.

What a difference the computer has already made in our ability to pursue the consequences of what we know! Not only in technology and the sciences: The scholar, the writer, the musician, the lawyer, the designer, all have felt the simplifying power of this universal instrument. The drudgery of searching literary texts for occurrences of a given word or phrase; the repeated rewriting and revising of an essay or a book; the frequent redrawing of a design after making changes; there are now things which the individual can more and more relegate to the computer.

By providing us with such enhancements of our capabilities, the computer liberates rather than threatens. This magnificent device can in these simple ways expand our creativity because of a powerful unifying idea, the idea that symbols and symbolic structures of all kinds can be represented and manipulated as patterns of electronic activity.

The computer is more than simply a tireless, lightning-fast literary assistant. It is a marvelously flexible and penetrating general-purpose instrument for investigating a world of symbolic phenomena which previously were beyond the range of observation. In this respect it should be compared to the telescope and the microscope.

It is also, at least in embryo, a model of that part of ourselves which deals with information and indeed knowledge. We are now beginning to see how we can represent knowledge—at least some kinds of it—inside a computer by writing programs of a special kind. The practical benefits of this so-called "artificial intelligence" have been noted widely, but these may pale by comparison with the possible benefits to our understanding of our own nature. Our ability to know is perhaps our most essential characteristic and at present the least well understood. We are now, some people think, on the brink of major advances in understanding what knowledge is and how it works.

This may mean that we can at last make real progress in carrying out the command which is said to have been inscribed over the portal of the Delphic oracle in ancient Greece: "Know Thyself."

University Professor J. Alan Robinson is among America's pioneers in logic programming research.

School of Computer and Information Science.

Robinson's work was a critical factor in SU's selection as the site for the New York State Center for Advanced Technology in Computer Applications and Software Engineering (CASE Center). Robinson now serves as the center's research director.

Robinson has also been appointed "University Professor," the first SU faculty member so designated. In recognition of the fact that his work transcends the normal boundaries of academic disciplines, he will not be tied to any one department. Robinson now serves as a resource for the entire University.

Today Robinson continues his efforts to develop a computer that thinks like a human. It is a goal he shares with researchers all over the world, particularly the Japanese, who have launched a massive program to build the "Fifth Generation" of computers: those with artificial intelligence. And Robinson may just pull it off; he is a man local IBM officials call "in a class by himself in logic programming—in the top 10 in the world."

—Carol North Schmuckler