Preface

The first four IBM Scientific Centers were chartered in 1964, making this year the twenty-fifth anniversary of the Centers. We join in the anniversary celebration by presenting articles from IBM Scientific Centers around the world, reflecting and representing the wide variety of work in progress at the 17 Centers. We are indebted to D. N. Saul of the IBM Cambridge Scientific Center in Massachusetts for his contributions to the creation and preparation of this issue.

The issue begins with an introduction to the IBM Scientific Centers—their origins, history, mission, contributions, and a list of selected publications. Kolsky and MacKinnon present a rich heritage, including the four earliest Centers in Cambridge, Massachusetts; Los Angeles, California; New York City, New York; and Palo Alto, California. Kolsky, a retired IBM Fellow from the IBM Palo Alto Scientific Center, and MacKinnon, manager of the IBM Cambridge Scientific Center, discuss the 17 Centers that exist worldwide today and also the nine that have merged or moved during this quarter century. In all, 26 cities have hosted an IBM Scientific Center.

The contributions from the individual Centers begin with a paper from the IBM Los Angeles Scientific Center in California. The author, Shu, provides an overview of the challenge of visual programming, along with a presentation on the state of the practice in this expanding field. The paper continues with a discussion of visual programming languages of all three types: diagrammatic, iconic, and form based. Shu concludes with a description of the experimental FORMAL nonprocedural visual programming system, as developed at Los Angeles.

Burridge et al., of the IBM United Kingdom Scientific Centre in Winchester, England, have written the first of three contributions that describe the development and use of the WINSOM software system for solid modeling. This paper discusses WINSOM, its technological foundations as a set-theoretic constructive solid geometry modeler, its user controls and the ESME language, and the wide variety of applications for which it has been used. Two of those applications are evidenced in two other contributions: the use of WINSOM for archaeological visualization and for the creation of computer sculptures, such as those shown on the covers of this issue.

The paper by Reilly of the IBM United Kingdom Scientific Centre in Winchester, England, shows how WINSOM and other software tools are being used to visualize the kinds of three-dimensional data that result from archaeological fieldwork. The result is computer reconstruction of excavated structures and sites. The software additionally provides the ability to view those results from any angle and to explore the exterior and interior of those structures or the distribution of artifacts at those sites. Since the actual archaeological sites are often far afield and seldom available, these tools allow the archaeologist to greatly extend the ability to study the record and perceive the relationships of the artifacts. Reilly also discusses the use of these techniques to train archaeologists and study their methods.

Ultra large-scale integration and very large-scale integration for integrated circuits present serious challenges for the engineering disciplines and for the computer-aided design systems that support them. De Lima, Martins, Stern, and Carneiro of the IBM Rio Scientific Center in Brazil describe their work on the GARDEN system for such computer-aided design. This system is designed to give the user a consistent view of applications and tools, while providing for growth and flexibility in those applications and in the underlying computing environment. The

authors also discuss their use of the Vienna Development Methodology in developing GARDEN.

Much of the work on language processing by computers has focused on European languages. For languages that do not have a European alphabet, structure, and writing direction, the development of computerized systems is occurring in parallel at locations such as the IBM Cairo Scientific Center in Egypt. El-Sadany and Hashish give a thorough presentation on their work with Arabic languages. Their paper discusses the structure or morphology of written and spoken Arabic and the challenges these present for automated analysis, translation, and generation. For example, Arabic is usually written without vowels, yet vowels are necessary for resolving ambiguity and for speech synthesis. The computer system described by El-Sadany and Hashish is designed for eventually processing all forms of the Arabic language.

Koide, of the IBM Tokyo Scientific Center, Japan, describes three graphic systems that have been built for molecular simulation, chemical formula interpretation, three-dimensional molecular geometry, and chemical reaction visualization. Such work allows computer analysis of chemicals without the necessity of actually building them in the laboratory, thus avoiding expensive trial and error experimentation. The visualization elements of the MolWorld system have required use of artificial intelligence and direct intervention by users. As an example, molecules that are mirror images (optical isomers) are commonly represented by the same chemical equation, but often have different chemical properties. Together these three systems offer effective use of computers in industrial chemical research.

A contribution from the IBM Los Angeles Scientific Center in California discusses a system for planning the use of information and information technology. Called S*P*A*R*K, the system presented by Gongla et al. is an expert system for addressing strategic issues within a widely spread organization of potential contributors. As such, S*P*A*R*K operates in the style of a human facilitator, but with the advantages of automated communication, analysis, and recording of the participants' ideas. A number of examples are provided that illustrate how companies have used this technique and tool to improve their customer support or in-house applications.

Gazdag and Wang present a new approach to the use of shared-memory multiprocessors in the solution of scientific problems that are amenable to parallel processing. This work at the IBM Palo Alto Scientific Center in California opens opportunities through domain parallelism, or sequential staging of tasks, as opposed to the earlier technique of domain decomposition. The result is the partial overlapping or pipelining of the sequential tasks. In this way, time-dependent simulation problems can be effectively pipelined by allowing different processors to operate on different time values in the problem. Examples are given for solutions to partial differential equations in electrostatics and exploration geophysics.

Dadam and Linnemann from the IBM Heidelberg Scientific Center in Germany describe their prototype system, AIM-P, that is used to explore how database technology can aid the integration of applications. This work is applicable to information management areas such as computer-integrated manufacturing (CIM) and office systems. The environment in which a database system must operate is characterized by the presence of many data types, different views of those types by different users, and the need for consistent and efficient manipulation of those types. The advanced information management efforts at Heidelberg incorporate and expand on Non First Normal Form (NF^2) extensions to the relational database model.

The covers of this issue are the product of advanced use of the WINSOM system at the IBM United Kingdom Scientific Centre in England. WINSOM is described in the paper in this issue by Burridge et al. Latham and Todd have written a technical note on how such computer sculptures are created, including the use of stored forms, form evolution, and advanced techniques for presenting realistic three-dimensional images: solid texturing, shadowing, coloring, surface detailing, stereoscopic projection, and animation.

This issue contains papers from eight of the Centers. The Centers have been and remain a significant resource within IBM. They focus on the scientific marketplace and the use of advanced computer techniques for our customers and for IBM.

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Editor