Computers have thus far been applied in medicine most effectively in situations where a standard mechanism already exists for dealing with the data: in the accounting problems of administrative work; in sorting and printing out the results of laboratory tests; and in conventional types of mathematical calculation performed during research or other activities. Despite these obvious and desirable successes, computers have not yet had an important impact on the more inherently clinical features of medical strategy and tactics. The intellectual qualities of scientific practice in clinical medicine do not appear to have been significantly affected by the many theoretical models and grandiose systems proposed during the recent exuberance of "computers in medicine."

Perhaps the greatest barrier to true progress in applying computers to clinical problems is the premise that satisfactory scientific approaches now exist for acquiring medical data and for interpreting the data during diagnostic and therapeutic decisions. Since this premise is not valid, enormous amounts of time, effort and money may be expended in constructing computerized systems and models that will be obsolete or inadequate for the real needs of clinical medicine.

Computational approaches to diagnosis might have been useful 40 years ago, but are often obviated today by the modern precision of individual pathognomonic paraclinical tests. With the aid of radiography, biopsy, cytology, endoscopy, and diverse laboratory procedures, many diseases can be accurately identified today without the use of complex inferential logic or statistical computations of probability. The major intellectual need in diagnosis today is for a better way of choosing the tests rather than calculating the names of diseases. Such improved strategies cannot be devised and checked, however, until appropriate clinical algorithms are constructed to demonstrate the flow of logic in the diagnostic "work-up," and until appropriate medical data are assembled to show the values and risks of paraclinical tests at each step in the logical sequence. The construction of such algorithms and the assemblage of such data require attention not to computers and statistics, but to the basic ingredients of clinical reasoning and activities.

Current systems for acquiring and storing the data of patients' histories are ingenious but inadequate because the types of data, the necessary descriptive constituents, and their subsequent tactics of application are not clearly recognized or defined. Many critical types of information—such as iatrotropic stimuli, subtle nuances in symptom descriptions, sequential patterns of symptoms, and the effects of co-morbid ailments, as well as the entire class of communications that are transmitted non-verbally—are omitted from information now being stored in automated systems, and inadequate attention has been given to the different rational procedures that must be used when the same data are analyzed for different clinical purposes.

The automated interpretation of electrocardiograms and of other paraclinical tests cannot be effective until specific, rigorous criteria are established and standardized for the diagnostic interpretations. Such criteria have not been developed for most of the "diseases" of modern medicine. Most of the existing diagnostic criteria for disease are derived from observations made at necropsy, but the histopathologic concepts have not been subjected to careful studies of observer variability, and precise criteria have not been formulated and accepted for integrating the combination of clinical, technologic, and morphologic data that must be used for diagnoses made in living patients.

Concepts of "normality" are currently in a state of confusion because the "normality" defined by a statistical Gaussian curve is quite different concept
from the "normality" defined by a state of health or disease. Moreover, regardless of which definition is used for "normality," a satisfactory range of epidemiologic populations has not been assembled and followed as a source of reliable data for analysis.

"Support systems" for clinical decisions will be intellectually chaotic until they recognize and separate the different types of data and reasoning used for diagnosis, prognosis, and therapy. Each type of reasoning requires different data, different logic, and different criteria. Because the taxonomic categories for data are currently undefined or incomplete; because standardized interpretive criteria do not exist; and because the available data are not satisfactory either in epidemiologic range or in temporal extensiveness—the current attention to system rather than to data, clinical logic, and criteria seems directed at peripheral rather than basic issues.

By providing a magnificent means of storing, retrieving, and counting complex data, computers offer clinicians an opportunity for major improvements in the scientific practice of medicine. The opportunity will be lost if the computer is used merely to automate a defective status quo. A more exciting challenge of the computer is the incentive it offers clinicians to explore the basic data and complex reasoning of clinical medicine, so that intellectual clarity and precision can be established for constructing suitable clinical algorithms, for developing appropriate criteria for decisions, and for performing new research projects that will yield respectable data with which to enlighten the future rather than embellish the past.