logical means, with the use of enzymes, in order to achieve low temperature, energy saving processes. The environmental crisis and the increasingly strict limits placed on the use of nitrates, phosphates, and other surface water contaminants mean that more efficient and more complicated waste treatment systems will have to be evolved. Also, wastes will be viewed in the future as valuable resources which can be treated to yield useful materials.

"Perhaps the most significant development affecting the future of biochemical engineering is the explosion of knowledge concerning genetic engineering techniques. Not only do we now possess the ability to cultivate both animal and plant tissue cells in large-scale reactor systems, but we can transfer their genetic information for making various biologically active molecules such as insulin into more easily cultivated bacterial cells by gene splicing techniques. Soon the scientist will be able to create cells with virtually any desired metabolic activity. When this comes to pass, the biochemical engineer will become active in efficiently simulating and optimizing many of nature's special reactions in stainless steel fermenters. In many ways biomass can be regarded as the crude oil of the future. Just as crude oil now serves as the feedstock of the petrochemical industry, from 'barrels of biomass' will come a number of the chemical feedstocks of the future. It would not surprise me to see biomass refineries emerging within the next decade.

"I for one will welcome the change. I believe the chemical engineering textbooks of the future will reflect this change and will include examples of biomass problems along with those from the petroleum industry. Chemical engineering is a truly broad-based discipline, and I believe it is already demonstrating its concern not just with physical and chemical changes, but with biological changes as well." □

ChE book reviews

CONTACT CATALYSIS, VOLS. 1 and 2

Edited by Z. G. Szabo, Elsevier Scientific, 1976
Reviewed by John B. Butt, Northwestern U.

This monumental two volume set is an essay of the Catalysis Club of the Hungarian Academy of Sciences with individual chapters contributed by thirteen different authors. In many ways the work is reminiscent of the series "Catalysis" edited by Prof. P. H. Emmett in the 1950's, and it promises to be as useful. True to the title, the entire field of contact catalysis is treated, starting with the fundamentals of solid state science, chemisorption and kinetics in the first volume, with applications concerning preparation, characterization, and catalytic reaction engineering in the second volume. The topics included are treated in quite some detail and in many instances represent current state of the art in both catalysis research and applications.

With so many different aspects of the field treated in such detail, it is difficult in a review of reasonable length to do other than cite certain parts that are of particular use to the reviewer. In this respect, there are particularly fine treatments of adsorption on solid surfaces and physical characterization methods which eclipse much existing literature. For example, the characterization methods discussed include x-ray diffraction, electron-optical methods, magnetic properties, electrical properties, adsorption, infrared and EPR spectroscopy.

Another very useful chapter deals with the preparation of catalysts. This is particularly timely now, since we have attained sufficient abilities in characterization that the long-time

Continued on page 44.

TABLE 5
Real-Time Computers or Microprocessors Currently Installed (53) or On Order (19)

EQUIPMENT AND VENDOR	NUMBER OF DEPTS.
Minicomputers	
Digital Equipment Corp.	24
Data General Corp.	8
Hewlett Packard	5
IBM	5
Texas Instruments	3
Foxboro	2
Interdata	2
Miscellaneous (one each)	6
Not specified	7
Microprocessors	10
Total	72

other departments which use minicomputers or microprocessors exclusively in research laboratories. The 22 departments in the third category in Table 4 typically are in a preliminary planning stage or are seeking funds to purchase a real-time system. Thus the results of this survey indicate a continuing trend for incorporating a real-time computer system in the undergraduate curriculum.

Table 5 presents a summary of the 62 minicomputers and 10 microprocessors which are currently operating in chemical engineering departments or on order. The numbers in Table 5 do not correspond directly to those in Table 4 since several chemical engineering departments use more than one real-time computer in the undergraduate curriculum.

CONCLUSIONS

THE RESULTS OF THIS survey indicate that the topic of process control has become firmly established in the chemical engineering curriculum. Only 3 of the 143 departments surveyed do not teach any courses in process control. One hundred and eight schools (75% of the respondents) have required undergraduate courses while 87 schools (61%) teach graduate level courses in process control. Laboratory experiments in process control are now available at 100 schools (70%). There is a continuing trend toward providing students with exposure to real-time computer systems in conjunction with process control experiments; 67 departments currently have such a system operating or on order while an additional 22 departments have tentative plans for such a system.

Fifteen years ago, process control was generally regarded as a new, specialized topic which was not part of mainstream chemical engineering. The present survey demonstrates that this situation no longer exists. Process control has joined the more traditional topics such as transport phenomena, thermodynamics and reactor analysis in playing a central role in the chemical engineering curriculum. □

REFERENCES

1. Eisen, E. O., "Teaching of Undergraduate Process Dynamics and Control," paper presented in a mini-session at the 68th Annual AIChE Meeting, Los Angeles (November, 1975).
2. Barker, D. H., "Undergraduate Curriculum 1976," *Chem. Eng. Educ.*, Vol. XI, No. 2, (Spring, 1977).

BOOK REVIEW: Contact Catalysis

Continued from page 12.

hope of being able to reproduce catalysts of a given type in different laboratories is rapidly becoming a reality.

As one might infer from the variety of topics and extent of treatment, these volumes are not exactly for the beginner. One might have wished some discussion of homogeneous catalysis, at least in terms of analogs to heterogeneous systems, and a more general inclusion of the concepts of coordination chemistry as they relate to catalysis. In all, however, some balance must be struck between coverage and length and the editor has done an admirable job. The English translation of the original Hungarian edition of 1966 is excellent and the text has been updated. The dust jacket states that "the book will be useful to workers studying catalysis in industrial and university laboratories." The present reviewer feels this is a correct statement and commendable for its modesty. □

ChE news

ART HUMPHREY HONORED

Arthur E. Humphrey, dean of Penn's School of Engineering and Applied Science, became the eighth honoree to receive the James M. Van Lanen Distinguished Service Award for his "life long dedication and service to fermentation science and the fermentation industry.

The award is named for a pioneer in fermentation technology and was established in 1976 as the foremost award and citation of the ACS Division of Microbial and Biochemical Technology.