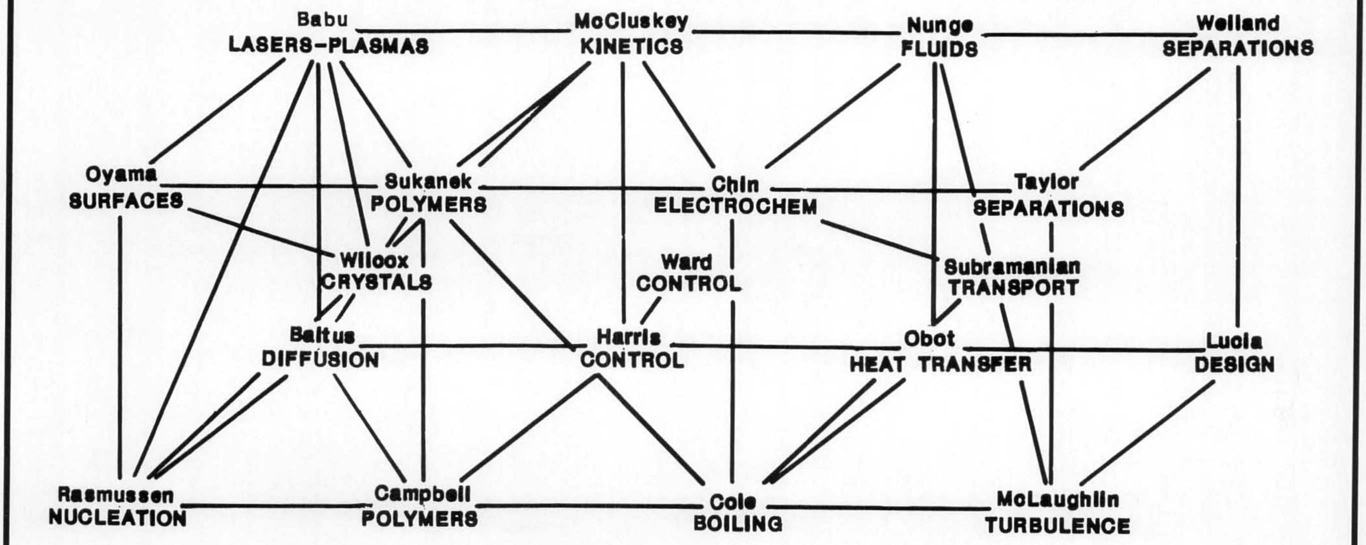
ChE department



CLARKSON UNIVERSITY

ROBERT COLE, DON RASMUSSEN
Clarkson University
Potsdam, NY 13676

Clarkson University is a private co-educational institution located in the village of Potsdam in upstate New York, twenty miles from the Canadian border and the St. Lawrence Seaway. The university was founded by three sisters as a memorial to their brother, Thomas S. Clarkson, a local businessman and humanitarian who was accidentally killed in his sandstone quarry in 1894. The first classes were held for seventeen young men and women on September 2, 1896.

Chemical engineering was inaugurated at the Thomas S. Clarkson Memorial School of Technology in 1903, and the first chemical engineering degree was awarded in 1904. In 1913, the charter was amended, authorizing the awarding of graduate degrees and changing the name to the Thomas S. Clarkson Memorial College of Technology. The first masters degrees were awarded in 1916. It was not until 1964 that the first PhD was awarded (in chemistry). The first PhD in chemical engineering was awarded one year later in 1965. Continued growth and development resulted in the New York State Board of Regents designating Clarkson as a university in 1984.

For many years, chemistry and chemical engineering were combined as one department. In 1958, this association was dissolved and Herman L. Shulman became the first chairman of chemical engineering. Shulman was committed to expanding the graduate program, and under his leadership, graduate activity increased from three to twenty-three full time graduate students and the department increased in size from three to seven faculty members. By 1965 Shulman was Dean of the Graduate School and Head of the Division of Research, and William N. Gill from Syracuse University was appointed as the new chairman of chemical engineering. Exciting times were in store for chemical engineering over the next six years. In 1968 Shulman became Dean of Engineering. In September 1969 the department was awarded a $590,000 NSF development grant. That same month Eli Ruckenstein joined the department as an NSF visiting foreign scientist, and in the spring semester of 1970, T. Brooke Benjamin, F.R.S., joined us as a Distinguished Visiting Professor. By 1971 the department had doubled in size to fourteen full time faculty members and the graduate enrollment had risen to fortyfive. In September of 1971, Gill left Clarkson to become Provost of Engineering and Applied Science at SUNY Buffalo.

Gill had built a strong department with many outstanding faculty members, and for the next few years, Joseph Estrin, E. James Davis, and Richard J. Nunge successively occupied the chairman's position. In 1975, William R. Wilcox from USC was appointed as Gill's successor. At USC, Wilcox had been professor of both chemical engineering and materials science. This latter area of expertise, combined with the strength in transport phenomena left by Gill, was to shape the nature of the department and the school of engineering for years to come. With the resurgence of NASA and the successful launch of the space shuttle, many of the faculty, with the help and encouragement of Wilcox, found themselves involved in one way or another with NASA's "Materials Processing in Space" program. Simultaneously, undergraduate enrollments recovered from the early 70s, the graduate program flourished (reaching a high of seventy-six), and the faculty increased in number to a maximum of twenty-one. During this time period, Estrin, Davis, and David O. Cooney left to become chairmen at the universities of Rhode Island, New Mexico, and Wyoming, respectively. Joseph L. Katz and Marc D. Donahue also left the department and, in succession, took over the chairmanship at Johns Hopkins University. Nunge was appointed Dean of the Graduate School and head of the Division of Research at Clarkson. In July of 1986 Wilcox stepped down as chairman and became director of the newly formed "Center for Advanced Materials Processing" (CAMP) and the "NASA Center for the Commercialization of Crystal Growth in Space," both at Clarkson. Shortly afterwards, Clarkson's CAMP was designated as a "Center for Advanced Technology" by the State of New York.

In January of 1987, R. Shankar Subramanian was appointed chairman of the Chemical Engineering Department. On July 1 of 1987, Wilcox was appointed Dean of Engineering. Since 1971, the Chemical Engineering Department at Clarkson has been consistently ranked in the top ten in the U.S. in terms of numbers of BS degrees awarded annually. The undergraduate program is the foundation upon which the strength of the department depends, and the graduate program builds upon that strength. Undergraduates are encouraged to become involved in research projects to discover "what it is all about." In 1986, new external research support in chemical engineering climbed to well over one million dollars annually. The key to the future of chemical engineering at Clarkson is "flexibility." We must be prepared to direct our expertise to new and upcoming fields, both in terms of research effort and in undergraduate course offerings. At Clarkson, this will no doubt be influenced by "CAMP," which has already guided our activities toward such areas as fine-particle processing, polymer processing, electronic fabrication processing, microcontamination control, and materials processing in space.

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FACILITIES

Since 1948, chemical engineering has been located in Peyton Hall, a three-story structure having a total of 32,000 square feet of floor space. Originally, the building contained the college library on the third floor and strength of materials and machine tool laboratories on the first floor. The unit operations laboratory occupied the second floor, and the traditional well, which occupied 1650 square feet of floor space on the ground floor, rose the entire height of the building. By the mid 1960s, chemical engineering was the exclusive occupant of Peyton Hall, and with the continuous expansion of the graduate program and increase in faculty size, many modifications of the interior have been required in order to provide sufficient laboratory and office space. The most significant of these have perhaps been the covering over of the well at the third floor level to create research laboratories, the partial covering of the well on the second floor to create both faculty offices and research laboratories, and the renovation of the basement area to create additional laboratories. Today, the building houses twenty-one faculty offices, twenty-seven laboratories, two departmental offices, two fifty-student classrooms, a computer laboratory for the design course, a computer terminal room for the graduate students, the departmental machine shop, and the chemical engineering senior laboratory which still occupies a major portion of the second floor plus the well.

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Every undergraduate student entering Clarkson is issued a personal computer. In the first year of this program, 1983, all entering freshmen were issued a Zenith Z-100 microcomputer. In subsequent years (it) was updated annually to keep pace with rapid developments in computer technology. . . . Each faculty member is also issued a microcomputer, the version depending upon undergraduate teaching assignments.

program, 1983, all entering freshmen were issued a Zenith Z-100 microcomputer. In subsequent years, the Z-100 was updated annually to keep pace with rapid developments in computer technology. By September 1986, every Clarkson undergraduate had a Zenith computer. The class entering in 1986 was issued a special version of the new IBM AT compatible Z-248 computer. This special version was also Z-100 compatible. In 1987, the entering class was issued the enhanced graphics version of the Z-248 and compatability with the Z-100 was eliminated. Each faculty member is also issued a microcomputer, the version depending upon undergraduate teaching assignments. For example, all faculty teaching freshmen courses in 1987/88 received new EGA Z-248 computers to replace whatever version they were previously using. Many of the faculty members in chemical engineering find that the capabilities of the current microcomputers are now quite sufficient for their research needs. Unfortunately, the graduate students are not issued computers, so it is necessary to provide appropriate facilities for them either in the research laboratories or in departmental terminal rooms. Our graduate terminal room contains three Sun workstations, three Z-248 computers with 30M hard drives and expanded memory, one Z-248 with an Opus board, 318M hard drive and expanded memory, and two Z-100 computers, one with color monitor. Except for the Z-100s, these are all linked together with similar facilities in the other engineering departments and with the university mainframe computers by an ethernet. The mainframe computers include an IBM 4341, Gould 9080, VAX 11-780, and an Alliant FX8 mini-supercomputer. The IBM machine is now used largely for administrative purposes and the VAX for undergraduate instruction in computer graphics. Because all faculty offices in the school of engineering are wired into the ethernet, all of the above facilities and their software are directly accessible for use by the faculty from their office. Further, through BITNET, EARN, ARPANET, UUCP, *etc.*, electronic mail transfer to faculty at other universities and to colleagues in industry, both in the U.S. and abroad, is easily accomplished.

The research laboratories scattered throughout the building contain a large variety of equipment and facilities reflecting the research interests of the faculty. Among the major large-scale facilities are an extruder, injection molding machine, blown film line, hot press, Instron universal testing machine, Perkin Elmer differential thermal analyzer and differential scanning calorimeter, Siemens D500 X-ray diffractometer, Plasmatherm PECVD and plasma etching reactors, CO2 and excimer lasers, and commercial scale crystal growth equipment. There are many well equipped research laboratories associated with individual faculty or groups of faculty but which do not necessarily contain large scale facilities such as identified above. These include the electrochemical engineering laboratory (Chin), chemical metallurgy laboratory (Rasmussen), nucleation laboratory (Rasmussen), crystal growth laboratory (Wilcox), glass processing laboratory (Subramanian, Cole), bubble dynamics laboratory (Subramanian, Cole), chemical kinetics laboratory (McCluskey), holographic interferometry laboratory (Sukanek, Cole), gas treating laboratory (Weiland), polymer fabrication and properties laboratory (Campbell, Sukanek, Harris), separation process design laboratory (Taylor), plasma and laser processing laboratory (Babu, Sukanek), heat transfer laboratory (Obot), oil residual characterization laboratory (Baltus), and the multiphase flow laboratory (McLaughlin). This summer, a new materials preparation and ultra-high vacuum surface analysis laboratory will be established by Dr. S. Ted Oyama who will be joining the faculty.

FACULTY RESEARCH

Our faculty's research interests and interactions can be represented schematically as three connected body centered cubic unit cells with each faculty member as a lattice point. Conveniently, there are nineteen faculty members to be placed on the lattice. An arrangement is presented which optimizes cohesive energy by forming the bonds with the strongest individual interaction. It can be observed that the two outer unit cells are centered with the past chairman of the department, Bill Wilcox, and the current chairman of the department, Shankar Subramanian. Each has his influence within the department through a maximum number of immediate interactions within his own area of specialization.

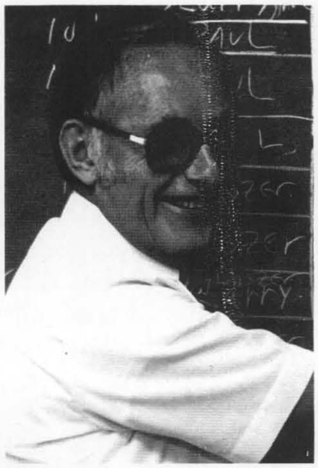
Bill Wilcox's research interest is in materials and materials processing. Specifically, he is interested in the effects of crystal growth on the quality of the re-

S.V. Babu

Ruth E. Baltus

Gregory A. Campbell

Der-Tau Chin



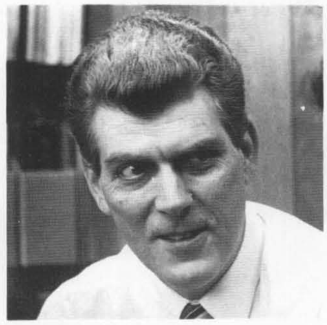
Robert Cole

Sandra L. Harris

Angelo Lucia

Richard J. McCluskey

John B. McLaughlin

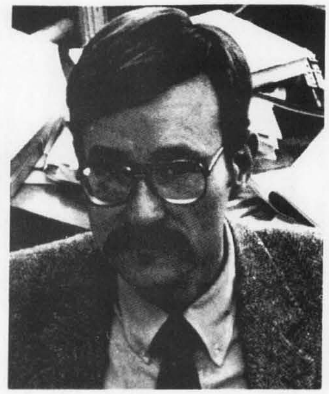


Richard J. Nunge

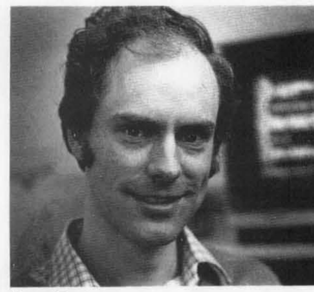
Nsima T. Obot

Don H. Rasmussen

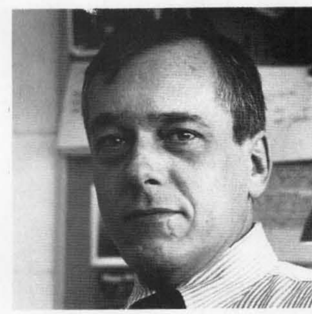
R. Shankar Subramanian



Peter C. Sukanek



Ross Taylor



Ralph H. Weiland

William R. Wilcox

sultant crystal or composite eutectic structure. During his tenure as chairman, a number of faculty with interests in materials or materials processing have joined the department. Obviously, as indicated by the lattice connections, the materials and the processing methods are wide ranging and of current commercial and theoretical interest. Rasmussen, Babu, Sukanek and McCluskey, as well as Wilcox, have an interest in electronic materials and on-chip processing. Each of these faculty members have spent at least one summer or sabbatical year with an industrial electronics manufacturer. Campbell, a polymer processing engineer, and Sukanek, a polymer rheologist, combine to work on polymer processing in bulk, injection molding, blown film and spin coating. They are also involved with Rasmussen in work on foaming of polymeric and multicomponent systems. Baltus's interest in hindered diffusion in porous systems and McCluskey's work in kinetics and catalysis complete the left hand unit cell.

Shankar Subramanian did his doctoral dissertation under Bill Gill and joined Clarkson's faculty in 1973. His ascent to the chairmanship of the department in 1986 brings continuity to the research group—originally founded by Gill—interested in transport and transport related problems. McLaughlin, Chin, Nunge, and Cole combine with Subramanian to study turbulence, electrochemical phenomena, fluids, and bubbles. Weiland has worked in slurry rheology and fluid flow in filled systems. Taylor, Weiland and Lucia have interests in mass transfer and separation processes. Cole and Obot are interested in boiling and convective heat transfer. Harris's work on digital control and Ward's work on analog control complete both this unit cell and help to tie together the left and right hand parts of the department, as does the interaction between Cole and Sukanek on optical measurement techniques.

A number of important interactions have not been included in the lattice connections because of inability to place the appropriate parties in nearest neighbor relationship. For example, Cole's interest in nucleation during boiling is not far removed from Rasmussen's interest in nucleation of crystals from the liquid state or solution or his interest in polymeric foams. Wilcox, Subramanian and Cole all study materials processing in low gravity and both Wilcox and Cole enjoy flying NASA's KC-135 aircraft to monitor low-G experiments themselves. Again, McLaughlin and Campbell have an interest in fluid rheology of filled systems under high shear, though our model cannot indicate this collaboration. The newest faculty member, S. Ted Oyama, is included in the matrix where he is expected to interact. His background is in the study of surfaces on solids and processing at surfaces. Oyama will arrive on campus this summer.

The research interests of our faculty are constantly evolving. The future will combine materials and transport phenomena. The obvious evolution continues to materials processing and the establishment of a center for materials processing, CAMP. The building of a physical facility for CAMP which will include our entire department indicates Clarkson's commitment to our research interests. We will move on. □

ChE book reviews

THE CHEMICAL ENGINEERING GUIDE TO HEAT TRANSFER: Vol. 1, Plant Principles; Vol. 2, Equipment

Edited by K. J. McNaughton and the Staff of Chemical Engineering; Hemisphere Publishing Corp., Washington, DC and McGraw-Hill, New York, NY; 362 pages, $49.95 and 300 pages, $49.95, respectively (1986)

Reviewed by
Robert Cole
Clarkson University

Each volume consists exclusively of papers originally published in the McGraw-Hill Chemical Engineering magazine. The editors have classified ninety-three articles into two major categories depending upon whether they emphasize plant principles or equipment. These categories are further broken down as

- Heat exchangers
- Design
- Steam
- Shell-and-tube equipment
- Heat recovery
- Cost

for the former, and

- Boilers
- Heating and insulation
- Dryers
- Cooling
- Condensers
- Other equipment

for the latter. In general, the classification has been well done and the articles on heat recovery, for exam-