University - Industry Interactions in Chemistry

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Chemistry as a science permeates every industrial activity. Its role in development is gaining a new meaning and the need to harness chemical sciences towards solutions of socioeconomic problems is receiving international recognition. The role of a University as an exclusive centre for academic pursuits and high learning is being constantly reviewed. There is a need to recognise the diverse purposes of a University and that of training people for industrial needs in all their variety is particularly important.

It is generally observed that there is little research and development activity in the industrial sector in the developing countries. The local expertise in academic and research institutions have hardly been utilized for building new industries or renewing existing industrial activity. The University is often without experience or even knowledge of the nature and needs of industry. There is much energy often wasted on pointless arguments about 'pure' and 'applied' research. This distinction in Chemistry is becoming more blurred.

In most developing countries, University provides the only opportunity for tertiary education. Increased pressure for University admission results in greater emphasis in the University on teaching and less on research. The lack of the latter ingredient dampens the quality and stimulus for innovative teaching. The finding of the education commission in India portrays the reality of this situation. 'A majority of teachers teach mechanically and listlessly. The subjects in which they lecture do not often involve their intellectual position, even the intellectually ambitious younger members of the staff are soon caught up in the general atmosphere of indifference or cynicism and there is a deadening of the spirit of intellectual curiosity and adventure'.

The picture in the developed world is in sharp contrast. The cooperation between chemical industry and Universities in Germany has always been very close. Since the middle of the 19th century, Universities and chemical industry have based their work on the scientific results and achievement of the chemists. Chemical research was successfully exploited for industrial growth. University research on aniline dyestuffs and plant metabolism laid the foundation for large chemical fertilizers, chemical industry in effect flourished on the efforts of academics at a University. The tradition of close cooperation between industry and the Universities has provided opportunities for the exchange of experience and the promotion of chemistry for chemistry from industry, Universities and government authorities. The industry has profited from the transfer of scientific and technological results provided by the University. The University Chemists in turn hold prominent positions in large industrial companies often as consultants and endowed professorships at Universities. This close interaction between University — Industry has grown and successfully emulated by the developed countries. Science for development has been vital for continued progress of the developed countries.

The relevant statistics emphasise the difficulties of the 'third world' countries and perhaps justify the apt description of most developing countries as 'poor rich' countries - - rich in their resources but their people are poor: only 5% of the world's research and development activity is conducted in developing countries. Over 80% of the world's scientists and technologists work in Europe, USSR and North America, while about 80% of the world's people live elsewhere. A recent study has shown that less than 1% of the total research effort of the developed countries has any significance for the developing world.

The bridging of the widening gap between University and Industry is therefore an urgent priority particularly for the third world. This is not to say that we should plan to transform the University to a vast industrial complex. Many propose increasing the responsiveness of education policies and systems to country needs. A reorientation of the formal and informal education systems to meet national needs through the application of science and technology is often recommended by international conferences. These changes could have the reverse effect. While it should be recognised that curricula should incorporate ingredients to provide awareness and relevance, they should also contain a solid core of fundamental or basic chemistry. Training of University chemists deficient in the fundamental principles of their subject could be equally unbalanced and encourage dependence on assistance of outside 'expertise' to sustain economic growth. How then are we to promote this interaction between University, Chemistry and Industry? To what extent should teaching and research at the University be geared towards the economic growth of the community? The basic philosophy of any developmental process is that you must start from where you are. It would not, for example, be appropriate in a developed country for a University to concern itself with details of village scale soap manufacture, manufacture of good paper glue from manioc starch or be involved in improving methods for rural bricks and tiles. But these are

some of our small scale local industries. Should not our Universities channel some of its energy to develop projects through transfer of laboratory findings and development to industry? No turnkey strategies or institutionalisation is likely to prove successful. Each University should evolve its own mechanism to promote interface activity with industry.

CHEMISTRY AND INDUSTRY IN SRI LANKA.

Sri Lankan industry is largely production oriented. Little evidence is found for research and development for the effective utilisation of the natural resources as raw materials in industry. The mineral resources of Ceylon range from raw export items as graphite, ilmenite and zircon, materials for local industry as clays, limestone, dolomite, feldspar, etc., to revenue earning items as gemstones. There are those that await exploitation as iron ore, apatite and peat to mention a few, and a host of other minerals as thorianite and fluorspar that are little mined. The utilisation of silica sands for glass is minimal, graphite and mica industries remain to be established. Some of these raw materials find use in the cement and ceramics industry and there is much more that could be achieved.

In the agriculture sector, much effort is required to produce value added products as in the tea, rubber and coconut. Utilisation of agricultural wastes, fractional distillation of essential oils, oil from rubber seed, post harvest preservation of food and many more illustrate the importance of interaction in the chemical expertise of University and industry for development. In all these activities, a multidisciplinary approach is necessary not only among the sciences, but as well in managerial and marketing skills to determine technical priorities and to effect changes in the educational system to ensure that these skills are made available. Industrial chemists and managers could contribute to academic teaching programmes in areas of their competence. University research should direct at least a part of its efforts in the study of some of these resources. Such diversion of the academic community would not provide immediate publication of their efforts and it is here that institutional provision is essential for recognition of such work for academic credits. This then is a challenge for chemistry departments in Universities to reorder their research priorities and perhaps reorient academic programmes to meet some of the needs of industry.

The **private sector** chemical industries in Sri Lanka is not without its development and research programs into new substitutes or product improvement. This activity is isolated and without much cooperation of University chemists. This perhaps stems from the Industry requiring a certain level of confidentiality to be maintained about the technology they would like to develop which must be appreciated by the academic community. A 'person to person' interest and involvement is often necessary for this cooperation to prove a success. Chemists in the Sri Lanka private sector have shown interest in the extraction and isolation of perfumery material from locally grown plant material. Ionone from lemongrass oil is an example of this activity. The use of cashew nut shell liquid as an antioxidant in natural rubber compounding, and extraction of valuable constituents from this source illustrate the potential of study of this natural material. Essences in the food industry, manufacture of activated charcoal, precipitated calcium carbonate and other bases for toileteries are items that interested the private sector in their search for import substitution. These are surely areas where cooperative efforts of University and the private sector chemists could have yielded innovation, development and emphasis on product quality.

University — Industry interaction is a 'two way' process. Just as much as the staff of Universities are without experience and knowledge of the nature and the needs of industry, the industry itself is unaware of the curricula and programs of University Chemistry. There could be several ways of bringing these two groups together to work closely in developing programs which would satisfy the needs of industry. Developing University programs to meet industry requires mutual appreciation of each others efforts. University chemistry courses should clearly bear an intelligent relation to what goes on in a modern chemistry laboratory and so courses must be modified as knowledge expands and the needs of society change. Such changes should be carefully monitored and the system should evolve itself over a period of time.

There are still other ways of making University chemistry programs meaningful to the community. Service centres is one such method of approach. Analytical service is a good starting point. Instrumental and other facilities at the University should be made available to industry related largely to small scale and local industry. Such service centres would then grow from undertaking preliminary project investigations to carrying out research projects for industry. This is one way of enlisting the support of industry for University chemistry programmes and vice versa. Organisation of technical workshops for industrialists and conduct of specialist University chemistry courses by specialists from industry is yet another 'two-way' approach where the practical applications of basic and theoretical knowledge would pave for greater involvement of the University and Industry in the study of problems of relevance to the country.

An orientation of University programmes could also consider cooperative curricula between the University and Industry — what is commonly referred to as 'sandwich courses'. This feature could have the added advantage of a higher student intake into Chemistry — a recurring problem of University admissions. This needs to be carefully worked out with a balance between academic requirements and industrial inputs and could best be achieved by direct cooperation between University chemistry departments and industry. This program could even serve as useful opportunities for middle level technicians to obtain

expertise equivalent to their counterparts with the formal University courses of study.

The **University of Colombo** has taken meaningful steps in this direction. Chemistry at Colombo provides for both oriented and academic programs, both of which are built on a firm core of basic fundamental chemistry. Oriented programs at present cover the final year of the general degree course. Courses of an introductory nature are offered in Analytical Chemistry, Industrial Chemistry, Polymer Chemistry, Natural Products Chemistry, Biochemistry and Solid and Surface Chemistry. The course titles provide for optimum staff participation and bring even in a small way scientists from industry to give the specialist flavour so necessary for the vitality of the program.

Each of these courses would provide for postgraduate courses of study and the first of these in Analytical Chemistry has been conducted since 1975. Industrial Chemistry is the obvious choice for the next postgraduate programme planned by the department. Chemical technology, unit operations, process control are some aspects presently covered. There are of course other disciplines as economics, management and chemical engineering so necessary to provide an integrated program to reveal the industrial operations to University students.

The academic programs of a specialised nature are research oriented. These constitute the final two years of the special degree course in Chemistry. Exposure to industry for this course takes the form of visits to industries for a casual interaction. A prolonged attachment to industry is also provided by a work experience program where each student is assigned to an industry or research institute for about 2 months. It is hoped that staff attachments to industry for short periods would also be possible. This would then be a means of bringing back to the laboratory, projects of relevance to industry. There is adequate material from the industries to engage the interests of a group of active and productive chemistry researchers for a considerable time. This University to Industry movement should also have the reverse interaction where specialists from industry would be involved actively in research and teaching programs in the University.

I have attempted to present a general account on this subject. An indepth study is required to evolve strategies for effective University-Industry interaction in Chemistry for national development. Problems in Industry in developing countries often present common features where the experience of one developing country could be of mutual benefit to the other.

The programme activity of UNESCO for 1981 provides for cooperative efforts from different countries to share their experience. Meetings have been held in Canada (1978) and in India (1980) on this subject. The Regional Workshop on University — Industry and the Citizen scheduled for 14 — 16 June 1982 at Colombo would prove a focal point for discussion in our own efforts to harness the chemical sciences towards solutions of socioeconomic problems.

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