

'Chemists for a Better Living'

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Dr. J.N.O.Fernando Professor of Chemistry, Open University of Sri Lanka and President of the Institute of Chemistry, Ceylon, recently delivered his Presidential address on the focal theme "Chemists for a better living". We publish here extracts from this Presidential address that raised many fundamental issues on teaching science and priorities for Science and Technology in the country.

What does the future hold in store for Chemistry? Will organic, inorganic and physical chemistry coalesce into a strong core subject providing a sound foundation for all areas of Science and Technology? Or, will the specialised developing areas of chemistry, such as analytical, colloidal and solid state chemistry follow the lead of biochemistry and become separate disciplines? Will polymer chemistry be engulfed in polymer material science and engineering with a consequential loss in chemical origin? There are questions which chemists must attempt to influence the answers in order to retain a greater role for chemistry as the central science.

Chemistry and Chemists in a Central Role in Interdisciplinary Areas

However, one clear message is that if we ignore the role of chemistry in interdisciplinary areas of Science and Technology, chemistry will stagnate as a profession and eventually decay. It is at the interdisciplinary interface between chemistry and the other sciences and between the environment and society that the most important research in the future will be conducted. It would be wrong to think that chemistry as a single discipline exists only by virtue of the service it renders. In its contributions to other fields of human activity it functions as the benevolent and lavish dispenser of concepts and ways of thinking, of structures and properties, of products and processes, to all these in need with-

out discrimination. This is particularly relevant to the teaching of chemistry since an interdisciplinary approach is strongly needed in the study of natural sciences; chemical education should be prepared to lead students to these important areas rather than confining them in basic chemistry. The Eight International Conference on Chemical Education in Tokyo last August had as its theme 'Widening the scope of Chemistry,' with this objective in mind. As the central science, chemistry lends itself to such adaptation much more readily and easily than any other science. It is no easy task to train students of today to be ready to solve problems which have not yet been identified using scientific knowledge which has not yet been formulated and technology which has not yet been invented.

Three particular problems have been identified in this respect:

- (a) Over emphasis on chemical principles has led to a decline in the presentation of knowledge of real chemical behaviour in our educational programmes.
- (b) The false idea generated in the student's mind that chemical behaviour is 'governed by' rather than 'explained by' theory.
- (c) What is commonly referred to as 'Learning Overload' representing the sheer success of chemistry over the past many years in terms of both expansion of knowledge and development of techniques.

Trends in chemical education over the past 40 years have shown progress in the proper recognition of the explanatory aspect of science. Learning Chemistry no longer consists of memorising the occurrence, preparation, properties and uses of typical substances.

It is our pride that chemists have played no small role in the multifarious activities they have involved themselves in. Throughout the 42 years old history of the SLAAS, Chemists have played a lead role in its activities. It is significant to note that in this multidisciplinary association, it is the Chemists who are continuously called upon to take on many posts of office-bearers. Even today, both General Secretaries, most office bearers and almost half the members of the Council are chemists. Continuously for the past 15 years, at least one General Secretary has always been a Chemist. (12 of all the 20 past General Secretaries have been Chemists). It is a singular tribute to the discipline and profession of Chemistry, (playing such a central role in this multi-disciplinary organisation) that the SLAAS is considering a proposal to set up a separate section for Chemical Sciences; when that happens, hopefully by the end of the year, Chemistry would be the first discipline and profession to have a 'SLAAS' Section for itself.

Chemists have played a pioneering role in research activities in Sri Lanka; it is again to the credit of chemists that every year the research papers presented by them at the SLAAS Annual Sessions are so numerous and stand out.

In that context, we find it extremely difficult to understand why not a single chemist, young or old, found a place in the Presidential Award List

announced on Independence Day, 1986.

Chemists can however make an invaluable contribution only if the manpower is there. In the use of chemists for a Better Living, the basic issues therefore are, firstly, the production of the Chemists we need and, secondly the retention and use of these chemists.

Production of Special Degree Chemists in Sri Lanka

The lower priority given to the basic sciences in Sri Lanka over the past few decades has resulted in the almost exclusive choice of medicine or engineering by most Advanced Level Science students. It is unfortunate that the choice of a career is determined largely by the financial return rather than a student's interests and capabilities; the continued reference by the UGC to Medicine and Engineering as prestigious courses, instead of popular courses assists further in syphoning off more students towards such courses in preference to basic science courses. Science is thus losing some of the best brains who might otherwise have chosen it. Are we not wasting our best creative brains for all time by over emphasizing medicine and engineering? This was not the situation a couple of decades ago. The intense competition for university admission has now turned tables completely in respect of the Physical Science Course, which is more versatile, employable and useful than the Biological Science Course. The number qualifying for Physical Science this year is less than half the number of places available. Remedial attention should therefore be taken to make our science courses more attractive to our high school children. Otherwise the same fate that befell Physical Science might fall on Biological Science before long.

Expenditure on education, including higher education, has registered a considerable increase since 1977. A

sum of Rs. 5.2 billion or 7.5 percent of the total budget has been allocated to education this year. The expenditure on higher education has also registered an increase, unprecedented in the annals of education in this country and a sum of Rs1 billion has been allocated in the current year. However, the Chairman of the UGC has pointed out that in terms of the GNP, the expenditure on education has decreased from 3 to 2.3 percent, a figure which is well below that of other countries and is comparable only to that of Pakistan and Bangladesh. He has made a plea that the allocation for education should be 5 percent, with at least 1 percent of the GNP being allocated for higher education. The investment on education has a direct bearing on the level of development a country wishes to achieve. Expenditure on education is an investment on human capital and is not a social overhead. If it is the government's policy to provide tertiary education to everyone who qualifies, then a drop in the allocation for education and higher education in terms of the GNP cannot be justified.

The annual admission to conventional universities has increased by 50 percent from 4,150 to 6,000 while the total enrolment has increased by a third from 15,000 to 20,000 over the past decade. Other than the technologically based University of Moratuwa, all other Sri Lanka Universities have science faculties. In accordance with UGC policy, there has been a steady increase of student intake into these faculties. Perhaps only the Peradeniya University has been able to resist such an increase altogether. A committee headed by Prof Cyril Ponnampereuma has also been appointed by the UGC to report on how the Biological Science intake can be almost doubled to 1,000 over the next few years.

Though academic cadres have been

increased, universities are however finding it increasingly difficult to recruit and retain qualified staff, particularly with a Ph.D at the ridiculously low salaries we are continuing to pay them. With even a country like Bangladesh paying academics double our salaries, science faculties have been very badly hit in respect of staff numbers. Apart from the University of Sri Jayawardenapura, there has been a drastic reduction in the staff of all other chemistry departments. The Ruhuna University 8 years after its founding as a College has only 2 Ph.D's. Jaffna has only 3 Ph.D's, Batticaloa University College is producing its third batch of graduates and will be conferred university status by October (5 years after it started) with no qualified staff member in chemistry, physics or mathematics. The continued increase of student intake into science faculties and chemistry departments in the context of such acute staff shortage amount to burning the candle not at both ends but right round and if we are not careful, soon nothing may be left. The efficiency and productivity of a University cannot be measured by the student intake.

Matters came to a crisis recently when Deans and Heads of 4 university science departments resigned their so called 'prestigious' posts and reassumed them only after much persuasion. The Professor's maximum is said to be comparable to that of a Ministry Secretary but few seem to realise that even a Dean of a University does not get official travelling even to come to work; nobody points out that a Ministry Secretary and other high Government Officials have official cars with Driver and these can be used for virtually unlimited private travelling for Rs. 150/- per month. Telephones, houses, pensions, railway warrants and similar benefits are not compared. Within the university, science

teachers are paid less than their Engineering and Medical counterparts. All efforts to get this anomaly rectified have been an utter failure. I wish to ask as to why a Science Professor should be discriminated against and be paid a lower salary than a senior lecturer in Engineering? Such gross discrimination for the past 20 years, resulting from the continued non-payment of the 20 percent exodus allowance to science academics, does not help in achieving a solution to the problem of acute science staff shortage in universities. Building a chemistry laboratory is not easy. However, equipping it and staffing it is much more difficult. Unless adequate funds are made available to recruit and retain staff and obtain necessary equipment, chemicals and books, we are creating tremendous problems on an already bursting university system by continuously increasing the student intake.

Specialisation in chemistry has been for a long time and continues to remain the star attraction for many science undergraduates. Reasonable job opportunities available has given

chemistry a decided premium in the Sri Lankan context. The conduct of a special chemistry course is however not easy by any yardstick, least of all from the financial point of view.

The results of a statistical survey I have done on the production of special degree chemists from 1944 (one university) to 1985 (five universities) are in your hands. The total output over the four decades is 903 (with 77 first classes and 474 second classes) including 101 produced from the 3 newer universities of Sri Jayawardenapura (over 9 years from 1975/76) Jaffna (7 years from 1978/79) and Kelaniya (5 years from 1980/81).

The increase in the production of special degree chemists, from 1975 onwards has not been commensurate with the increase in number of universities or the phenomenal increase in student intake on the country's need for more chemists for a better living. (The total output in 1986 will in fact decrease to 30 since Peradeniya has no special final batch). The average unit cost

of producing special degree chemists at 5 universities and at 100 percent state expense is therefore very high.

The dissipation of the energy and effort of a few members of staff in each of the many universities on ever increasing student intake without adequate provision for the basic requirements of staff, books, journals, chemicals and equipment has been a very serious curtailing factor for the necessary increase of special chemists. A related factor is the paucity of funds for research within the university system since the limited funds available are hardly sufficient to service increasing undergraduate needs although research publications are an essential requirement for staff promotions. The ideals mentioned in the UGC corporate plan to divert resources from undergraduate to post-graduate training and research cannot find practical application in such a situation of ever increasing undergraduate student numbers.

The conduct of special courses in 5 universities raises another question. How equivalent are the standard of the chemists so pro-

SUMMARY OF OUTPUT OF CHEMISTRY SPECIAL GRADUATES

Period	Colombo + Peradeniya		5 Universities		
	Total Output	Average Per Year	Total Output	Average Per Year	Production Details
1944-1955 (12y)	96	8.0	96	8.0	} One output from Colombo
1956-1966 (11y)	126	11.5	126	11.5	
1967-1968 (2y)	48	24.0	48	24.0	
1969-1974 (6y)	194	32.5	194	32.5	One output from Peradeniya
1975/76 to 1977/78 (3y)	100	33.5	109	36.5	Col.+Per.+J'pura
1978/79 to 1979/80 (2y)	69	34.5	93	46.5	Col.+ J'pura + Jaffna+Peradeniya
1980/81 to 1984 (4y)	156	39.0	211	53.0	} Col.+J'pura+Per. Jaffna+Kelaniya Colombo+Jaffna+ Kelaniya(others not yet released)
1985	13		26		
	802		903		

duced? The question becomes very relevant to our Institute, on account of our own active involvement in the production of professional graduate chemists through our very popular graduateship courses. Each university is empowered to grant degrees and at least on paper all such degrees are considered to be equivalent although I know that when it comes to employment selection boards, whether in the public or private sectors, are rather more specific and choosy and tend to prefer one or the other university on the basis of their experience of the quality of similar graduates produced by the same institution previously. Also, at present, we accept a special chemistry graduate with a class from any university for direct admission as a graduate member. How confidently can the Institute continue to accept such a class as representing a comparable standard irrespective of the university or the year in which it has been obtained? All of us are aware that a class at the final examination is very crucial and could determine one's entire future. How validly can one compare a class today with one received some years ago? How validly can one compare a class today between the universities? How validly can one compare a class received from a given University from year to year?

The practice of some Universities not having foreign or even local external examiners to even moderate the question paper, leave alone moderate the marking, does not help in this connection. One of our past Presidents has repeatedly suggested that we should conduct a GRE type of examination open to all chemistry graduates to enable a meaningful objective comparison to be made: such an assessment even if it were organisationally feasible, will require the active co-operation of chemistry academics from all Universities but the response to

this suggestion from some has not been encouraging.

Examining the data I have presented, can we conclude that it is far easier to obtain a class in certain universities and that it is almost impossible not to obtain a class in some of these universities? Is this due to the techniques of examination, better teaching, or is it due to a better quality student intake? Or is it due to evaluation? Or is it due to a lack of uniformity? Should there be a meaningful standardisation of marks from year to year? Does the 55 percent which is accepted as a sacrosanct for a class have any logical comparable meaning among the universities.

If one examines the evaluation schemes at these five universities, observe how the all determining single final examination in which three years of study was evaluated once and for all and which existed until the late seventies at Colombo and early eighties at Peradeniya has given way to annual and sometimes terminal examinations at all the universities. The basic structure of the degree which used to be a qualifying year followed by 3 years of special chemistry, has changed in some universities to a 2 + 2 system, or even general degree followed by a single special chemistry year. A careful analysis reveals a wide discrepancy and variation in the evaluation procedure ranging from a heavy input from even first and second year general degree subjects in one university to a complete exclusion of first year performance for the evaluation in another. From university to university, the relative contribution from one year of study to another as well as that between special chemistry and the other general level subjects varies very widely. I made a detailed analysis of this in my Presidential Address to the Sri Lanka Section of the Royal Society of Chemistry 4 years ago and concluded that there is an

urgent need for a complete reappraisal of the existing special evaluation criteria in the various universities. I repeat my plea today since there appears to be a discrepancy of standards between universities and even within a university from year to year. Student numbers in the Sri Lankan context are so small for any meaningful standardisation and this makes our task doubly difficult and problematic. However, this is a question which academics must face in order that the certificate we give would for all purposes reflect a reasonable objective evaluation, and, employers may be assisted in their task to compare a degree or more so the class obtained from one or other university. My observations both from a consideration of statistics as well as from personal experience gained as a university teacher for 20 years has driven me to the inescapable conclusion that the entire matter requires early attention.

Sri Lankan universities continue today to produce best quality scientists and chemists who have proved their worth and competence in universities throughout the world from amongst students, most of whom have chosen science as a option to medicine or engineering. The apparent level of attainment at the point of admission to a course of study, particularly in the Sri Lankan context where District quota and under privileged area admissions are given a premium over apparent merit is therefore not necessarily a safe enough index to come to firm conclusions regarding the quality of the eventual product.

Connected to the same issue is the variation in the quality of students admitted to various science faculties. It cannot be denied that despite the commencement of

universities in the various regions there is still a preference to enter some of the more established universities with the result that the average quality of the students entering some of the newer universities are at least on paper poorer than the others. Does this however prevent the newer universities from producing chemists of excellence for better living from such an apparently poorer intake?

Then there is the question of the quality of the staff. The rapid increase in the number of science faculties to no less than 8, has inevitably resulted over the past 20 years in the average seniority and experience of the staff recruited decreasing. Does this mean that the average quality of the academic staff serving particularly in the newer universities is inferior? I do not agree that this necessarily follows and there is abundant evidence of instances in which staff with apparently lower qualifications have, given a reasonable opportunity, proved their worth in teaching, research and other aspects of university life. The absence of a first or second upper, which are the usual primary recruitment criteria for university staff has in many such instances not necessarily proved to be a drawback in the subsequent activity of the relevant university teacher.

The point I wish to make quite emphatically is that while minimum eligibility criteria are obviously required both for student admission and staff recruitment to any institution, one cannot and should not condemn or belittle any group of students or staff or Institution on the ground that only the minimum criteria have been fulfilled. Any Institution should rather be judged on the quality of the work output of the staff and the quality of the students who pass-out.