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Chairman's Summing-up Remarks

The idea of holding this First International Symposium on University Chemical Education arose from suggestions made by our Italian hosts. It was sponsored by the IUPAC in general and the IUPAC Committee on the Teaching of Chemistry in particular, and financed by the CNR, the Ministry of Education and U.S. funds, together with fares provided by various national bodies. By bringing together people from nearly twenty different countries, a unique opportunity was provided to enable representatives of these countries to become familiar with the basic systems operating elsewhere and to learn something of current and proposed developments.

Perhaps one of the most obvious things which emerged was the great variation in the type, flexibility and content of chemical courses in universities, not only between different countries but in the same country as well. Several contributors expressed the view that this variation in courses inside the same country was in fact highly desirable since it encouraged educational experiment and ultimately changes in the system. Some of the changes being tried out in the U.S.A., for example, were discussed in some detail; the view was expressed that universities should be encouraged to try out changes and other places could then learn by example. This was considered preferable to the setting up of a Committee to enunciate a new and untested dogma for any country as a whole.

The relative amount of time which should be devoted to practical work, lectures, seminars etc. at the undergraduate level was discussed at some length. Although some criticism of the lecture as a teaching method emerged, there was a feeling that if well prepared and well delivered with the maximum amount of supporting material (synopses, demonstrations, films etc.) the lecture still has a valuable part to play to bring out generalizations and to provide stimulation; above all students could learn a lot about the thinking processes of established scientists if free interplay between students and staff occurred and spontaneous solving of problems posed by students occurred by the lecturer on the blackboard.

The central role of laboratory work in the teaching of chemistry was generally accepted, it being agreed that in 1969 chemistry is still an experimental science. But several speakers emphasized the need to ensure that this practical work was purposeful, i.e. that there is an integration of the various objectives of the subject and in particular that it ensures that students acquire a clear understanding of the meaning of an experiment as distinct from solely the repetition of a recipe for preparing a compound or the carrying out of a particular type of measurement—important, of course, as the acquisition of these experimental techniques is.

The assessment of students at the undergraduate and graduate level was discussed. The role of the so-called 'external examiner' system in the U.K. was outlined and a useful discussion took place concerning the relative

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value of continual assessment, written examinations and oral examinations. It was recognized that all forms of examination have their place in student assessment. No final conclusions were arrived at but it was clear that a more detailed report on this subject is highly desirable.

At the postgraduate level it was generally agreed that the student is *de facto* assessed well before he completes his course, apart from the thesis! It was recognized that there was a good deal of variation in the standard of Ph.D.s at different universities but this was less objectionable than any attempt to impose national standards of uniformity which could tend to lower standards at the better universities. The use of an external examiner could, if he were well chosen, be of value for smaller universities but the value of this procedure in larger institutions was doubted.

The usual divisions of chemistry, organic, inorganic, physical etc. were critically examined and although no generally agreed conclusion was arrived at, sound arguments in favour of alternative methods of sub-division of chemistry, such as synthesis, structure and dynamics were proposed. Any different method for dividing chemistry should emerge from mutual agreement between staff and are unlikely to prove successful if imposed on a staff untuned to the approach by age, experience or conviction.

It was agreed that there is at present no universally acceptable method for training of research students. The central importance of the research project was widely accepted but there was debate as to the number and content of the course work and the assessment thereof.

Perhaps the most vigorously debated topic concerned problems of the university/industry interface. Two aspects of this subject were discussed at length. First, concern was expressed in some quarters that universities may be producing more Ph.D. graduates than industry could make use of; but others asked whether all Ph.D. graduates in chemistry should necessarily be employed *in* chemistry. In short, that as in other fields of study one should distinguish between the training of a man *through* chemistry and the training of a person for a chemical job later. Secondly, concern was expressed also over the fact that whereas in Germany and the U.S.A. about 70 per cent of Ph.D. graduates went into industry the figure was only about 20 per cent for the U.K. However, it was pointed out that Ph.D. graduates from the U.K. completed their course on average two to three years earlier than in the U.S.A. or Germany; many more U.K. Ph.D. graduates did in fact enter industry after completing postdoctoral work. The smaller percentage of Ph.D.s entering industry during the past few years was partly due to the recent rapid U.K. university expansion which has now levelled off and many more Ph.D.s are available for industry.

The difficulties of adjustment of graduates on entering industry was discussed. It was suggested that this was more of a problem in the U.K. than in other countries, e.g. Holland, U.S.A., Germany and Italy. But it seemed that U.K. graduates adjust satisfactorily in U.S. industry in particular. No firm conclusions were arrived at but it was clear that universities had a responsibility to their students to give information on the kind of transition needed to enter industry—assisted by visiting professors from industry. Similarly, industry needs to think carefully about the way in which it can introduce university graduates into industrial jobs, especially

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since a large capital investment has gone into their training and an even larger overhead will be required when the men join industry. Whilst it is obvious that Ph.D. graduates cannot expect to continue in industry with an extrapolation of their Ph.D. problem and must regard themselves as problem solvers in many different areas, industry needs to ask itself whether it does all it should to integrate new arrivals into an environment different from that of a university.

The Chairman accepts personal responsibility for the foregoing remarks but has discussed them with members of the Organizing Committee, who are in general agreement with them.

In conclusion he wishes to thank the Italian Ministry of Education, the C.N.R. and above all Professor G. Illuminati for all the work put in before and during the Conference to make it such a pleasant and successful occasion.

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