

INDUSTRIAL-ACADEMIC CONTACTS IN CHEMISTRY AT THE UNIVERSITY OF EAST ANGLIA, U.K.

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The rising cost of higher education, and particularly of academic research in science-based subjects, has led in the U.K. to increasingly insistent demands from the Government that the activities at university level be related to national needs. In the field of pure science this has frequently been voiced in terms of urging closer university-industry collaboration, and there is no doubt that in Great Britain, such contacts have in the past been markedly deficient and require fostering. National needs are in themselves a justifiable criterion, but in addition suitable industrial-academic contacts can be very much to the benefit of individual universities and to their staff and students.

Such considerations were in the minds of the writer and his colleagues from the very inception of the new University of East Anglia. Starting a new university provided an ideal opportunity to put into practice some of these (and related¹) concepts, and the purpose of this article is to review the progress that has been achieved in the first six years of the university's life; it is hoped that others may benefit from our experience.

THE RANGE OF POSSIBLE CONTACTS

A typical pattern of university-industry contact in pure science in this country around 1960 was quite close collaboration between the heads of departments and research directors—perhaps in the form of a consultancy. Lecturers were invited to visit industrial research departments and vice versa, but all too often it was difficult to pin down a specific reason for such a visit and no incentive for other than social politeness. Frequently, the only contact between students and industry was a sporadic programme of visits to works (breweries being the most popular) together with the (often dreaded) round of interviews for the third-year man who '*has to go into industry*'.

In analysing this situation, and in formulating a comprehensive plan to achieve a 'surface to surface' contact to replace the previous 'point to point' contact, the emphasis was placed on *incentive* and *interest*. A keynote in the attitude towards the value of such contacts is played by the lecturers. Students come and go, and the senior staff members have relatively less contact with individual students; hence, the lecturing staff must provide the real continuity if there is to be any. In the writer's opinion, much of the prejudice held by students against industry as a career has been a reflection of the

(conscious or unconscious) distaste for industry, above all else due to perforced ignorance, of the lecturers who have taught them.

In designing direct contacts for the students with industry, it seemed important to have these well integrated into the course as a whole, to approach the matter gradually, and to try and overcome the instinctive fear of the unknown by making industrial scientists familiar figures to both undergraduate and graduate students. Finally, we have been at pains to initiate a retraining scheme for industrial students.

LECTURER-INDUSTRY CONTACTS

We are attempting to put each of our lecturers into a 1:1 relationship with a chemical company in the role of a junior consultant. In this capacity the lecturer makes four to six visits a year to the company when he will have informal discussions with the research staff—preferably at bench level. In addition, he will be the contact man for the company at the university, where he will help with recruiting and perhaps also in getting specialized physical measurements carried out, and will be available when members of the firm visit the university, etc. Such an arrangement has had the following visible advantages for the lecturer (not necessarily in order of importance!): (a) A fee of a hundred pounds or so paid by the firm, which is particularly welcome at this stage in his career. (b) The interest shown in a young man by a well-known company can have a very important psychological effect in interesting him in his subject and increasing morale. (c) The possibility that the company at sometime in the future may become interested in his personal research and help to sponsor some of it. (d) The ability to be able better to advise his own students on conditions in industry.

The advantages to the company of such an arrangement are somewhat less distinct and more long-term. It should be emphasized that an arrangement of this sort will usually involve in the lecturer strong loyalties towards the company which may in the future be much to its advantage. Also, the younger members of an industrial research department will welcome the opportunity to talk informally about research and allied topics to a university lecturer, and such intercourse can be a significant factor in raising morale in an industrial laboratory.

Such arrangements must, of course, be based on real mutual interest. A considerable proportion of the time spent by a young academic scientist at an industrial location must be with industrial colleagues working in the same field or with similar techniques. This will lead to equally important visits for younger industrial staff to the university and hence to the formation of a wide range of contacts and the generation of enthusiasm that arises from real scientific discussion.

The role of the professor in this is that of marriage broker: although it is usually (but by no means always!) easy to get the lecturer to the altar, negotiations with the companies can be involved and protracted. Some companies are easily frightened off and the professor must restrain not only his own impetuosity but that of his protégé. The best line has appeared to be: 'Why don't you try it for a while, you cannot lose very much and you might gain a lot'. In the writer's experience, once the marriage has been arranged it will be happy: no divorces yet out of about a dozen UEA-Chemistry

pairings. One tends to hear little more directly about the detailed arrangements and a typical enquiry recently brought the response, 'Oh yes, I'm still going there and they have just raised my fee so they seem to be satisfied with me'. Of course, the arrangement can be almost too successful and one recent case led to the person concerned joining the company in a full-time capacity only 18 months after the arrangement had been made.

The spin-off from such arrangements at the university concerned is difficult to measure in quantitative terms, but we at East Anglia are all convinced that it is considerable.

VISITING FACULTY FROM INDUSTRY

There have been several examples of the appointment of senior industrialists to honorary appointments at universities over the past ten years. Many of these have concerned men who have strong academic leanings, were carrying out fundamental research in industry, and have achieved recognition, often international reputations, for their success in work which could frequently have been done at a university and which could be judged by the same criteria as are used to judge aspiring full-time university professors.

Our approach was wider in scope. We felt that our students (and staff) would gain more from contact with industrialists who had been successful according to the criteria of industry, i.e. the initiation, management and exploitation of chemistry designed to produce a high return of profit on capital employed. Initially, it appeared that the relative isolation of Norwich from the main British industrial centres would be a severe disadvantage. In practice, this has not been so. We have appointed Visiting Faculty usually on the basis of one week attendance at the university in each term (i.e. three weeks per year). Spending a complete week at the university means that integration into the full range of informal and social contacts can occur naturally. We find also that the visitors appreciate, and are stimulated by, the period in a completely different environment (and I have been asked to emphasize this point on their behalf). Schedules are arranged well in advance, and although particularly the more senior persons clearly sometimes find it necessary to alter their dates, or get called to an important meeting in the middle of a week, the administrative arrangements have worked very well.

Visiting Faculty at East Anglia are seconded from their companies for the time that they spend with us. Travelling expenses and a displacement allowance are paid by the University, and the University offers to the company a (nominal) fee for the services rendered. These expenses are met by leaving unfilled one full-time lectureship on our establishment and utilizing the salary for this purpose. One full-time salary is enough to pay for a wide range of part-time visits.

In our system we have distinguished between two types of person, visiting professors and readers, who are persons of considerable standing and experience in industry, and visiting lecturers who are persons recently having joined an industrial organization from an academic background. We believe that each of these types has his own special part to play in developing the University-Industry links.

CONTACTS FROM THE VIEWPOINT OF THE VISITING FACULTY

Visiting professors (this term will henceforth be taken to include readers), have formal contacts with students of the following types:

(a) General orientation seminars

These are given to groups of 12 to 14 undergraduates in the third term of their first year and in the first and second terms of their second year. These seminars have no set subject and are left very much to the discretion of the visiting professor. He usually commences by a short discourse on something like 'the pharmaceutical industry', 'interviewing graduates', 'importance of polymers'. Once the students get drawn into the discussion it is found to range widely, covering safety in laboratory and factory operations, the organization of industry, taxation and incentives, the scientist's contribution to raising the standard of living, and the general benefits of university education to the individual. In addition, the discussions can get on to such matters as 'excess' profits, chemical warfare, safety, drugs and society, etc. It should be emphasized that the purpose of these orientation seminars is not the passing of factual knowledge, but the establishment of an 'image' of industry in the minds of the students.

(b) Lectures and seminars to undergraduates

A short course of lectures (usually three) dealing with a special topic of general industrial and chemical importance together with seminars serving these lectures (one seminar to each group of about twelve students). These lectures are usually held in the third term of the second year of the undergraduate course, and the topics which are currently held are: 'the design of new pharmaceuticals' and 'versatile polymers'.

(c) Lectures to graduates

A variable number of lectures to the graduate students. These are specialized lectures on the particular speciality of the visiting faculty member.

(d) Consultation sessions

Consultation sessions with third year undergraduates and with final year graduate students on career prospects. These are held individually or in groups of two or three and give the student opportunity to speak frankly about promotion or remuneration prospects in various industrial openings with people who are really familiar with the situation.

Over a year, a visiting professor will have a total of about 15 seminars [nine of type (a), six of type (b)], about 8 lectures, and about 12 hours of consulting sessions, i.e. around 11 to 12 contact hours per week for the period he is at the university. In practice, they find that they are able to spend some of the remaining time in the library or on some of their own activities, but that there are many unscheduled contacts with staff and students.

Visiting lecturers have contacts of the following types:

(e) Seminars

Seminars linked to the general course in the three main branches of chemistry. The lecturers are previously sent details of the material to be covered in the lectures (given by full-time faculty) to which the seminars are linked.

(f) Lectures to undergraduates

A short course of lectures in one of the third year options in a chemical topic.

(g) Lectures to graduates

A short course of lectures to the graduate students (this corresponds to (c) above).

(h) Laboratory work

Demonstration periods in the laboratory.

A visiting lecturer will have some 12 to 14 contact hours during each week at the university made up over a year approximately as follows: about 15 seminars, about 8 lectures, and about 15 hours demonstrating. Again, there are many informal contacts.

CONTACTS FROM THE VIEWPOINT OF THE INDIVIDUAL STUDENT

To assess the contacts that a typical individual undergraduate student has, it is necessary to outline briefly the organization of the honours chemistry courses at East Anglia. In their first two years, the students receive six to eight lectures and three or four seminars per week: approximately 75 per cent in chemistry and 25 per cent in mathematics with some physics and biochemistry. Individual students have little choice over this period, but in the third year, apart from a general course taken by all, about 66 per cent of the time is spent on two options, which may be chosen from a wide range of chemical and non-chemical topics (e.g. physical organic chemistry, chemical education, economics, biophysics).

Of some 330 lectures in chemistry received by a student over the first two years, up to 20 will have been given by visiting faculty. In each of the chemical options in the third year there are 45 lectures: the number of them given by visiting faculty ranges from zero to nine. For seminars, each year of 80 to 90 students is broken down into six groups of 12 to 14. Out of 27 seminars in chemistry during a term, up to four will have been given by visiting faculty. The proportion is the highest in organic chemistry: here each student will have had one (normal lecture-linked) seminar from (the same) visiting lecturer each term during his first two years and one (general orientation) seminar a term from (different) visiting professors from the third to the sixth terms inclusive.

It is hoped that in this way the proportion of teaching received by the students from visiting faculty is not unduly high, but is sufficient to have a real impact on the students.

Again, it is difficult to measure qualitatively the success of our system. However, all concerned are enthusiastic about the liveliness of discussion which the scheme has engendered and we all wish to continue with our experiment³.

TRAINING AND RETRAINING OF INDUSTRIAL RESEARCH SCIENTISTS

The provision of facilities for the secondment of industrial research workers to a university for a one to three year period to read for a higher degree is already widespread. While this practice is clearly of great value in many instances, it is of limited applicability. Industrial companies must scrutinize very carefully any plan which necessitates the absence of research personnel for a period as long as a year. At East Anglia we have tried to cater for the needs of further- and re- training by setting up schemes for an *Industry-based M.Sc.* and for *Short Courses* which are designed to offer the least interference possible with normal duties.

The Industry-based M.Sc. course

The industry-based M.Sc. is specifically designed for two categories (a) the laboratory technician who has qualified as Grad.R.I.C. or with an external B.Sc. mainly by part-time study and (b) the research worker who entered the firm with a B.Sc. and has had about four to eight years industrial experience. It extends over a period of a year and a half, but involves the absence from work of the candidate only for two 9 week periods separated in time by over a year. The first of these periods is the autumn term of an academic year and is spent at the university taking graduate and certain selected undergraduate lectures and seminars. The seven or eight graduate lectures come from our normal graduate course for full-time higher degree students. The four or five undergraduate lectures are selected from the third year options. The industry-based students also attend two graduate seminars (1½ h) each week which include problem and literature sessions and research talks; one of which they themselves give. Hence they have about 15 contact hours per week. In addition they carry out six hours per week (unpaid) demonstrating which bring them into contact with the undergraduates, to the benefit of both. The remainder of their time is taken up by reading in the library for general background and to prepare for their research work.

In the December of the first year they commence the research for their thesis. This is carried out at the industrial location and on a problem selected by and of importance to the company. A joint university supervisor is appointed, but the main supervision and the whole direction of the research is in the hands of the industrial supervisor, who will be the appropriate section or group leader.

Thirteen months later, the student returns to the university for the spring term of the succeeding academic year—middle of January to middle of March. He undertakes a similar programme of lectures and in addition writes up his dissertation. Industry-based M.Sc. students (like all higher degree students at East Anglia) take a series of written tests at the end of

each term of lectures. They are examined for the degree on the results of an oral examination conducted by an internal (university) and an external examiner. The name of a proposed external examiner is submitted to the company for approval to avoid any possible embarrassment regarding the confidentiality of the research.

This scheme has now been operating at East Anglia for three years and five M.Sc. have been awarded with a further five persons attending now. The companies involved have been very pleased with the results of this scheme.

Short courses

The initiation of short courses lasting a week or so in duration is actively contemplated by the School of Chemical Sciences. The first of these entitled 'Some recent advances in organic chemistry' is planned to commence in 1970 and will comprise some 16 lectures and seminars which are grouped during the morning and early evening to leave the afternoon free for informal activities. These courses are directed at industrial research scientists with ten or more years experience.

ACKNOWLEDGEMENTS

I would like to record my thanks to my colleagues, particularly Professor N. Sheppard, F.R.S., Dr R. A. Y. Jones and Dr C. D. Johnson for their suggestions, help and enthusiasm, to Dr F. L. Rose, F.R.S., for his interest in this scheme right from its inception, to Professor Sir Ewart Jones, F.R.S., for most helpful advice and encouragement, and last but not least to all our visiting faculty, particularly Professors E. W. Duck, T. I. Wrigley and G. H. Twigg.

REFERENCES

- ¹ Emphasis has also been placed on contacts with school and technical college teaching and with overseas laboratories. For an early outline of some of the initial aims see A. R. Katritzky, *Chemistry and Industry*, 1100 (1963).
- ² For a full account see A. R. Katritzky, S. F. Mason and N. Sheppard, *Education in Chemistry*, **1**, 202 (1964).
- ³ For a view of chemistry at the University of East Anglia from without, see G. Illuminati, 'La nascita di una nova universita', *La Chimica e L'Industria*, **51**, 269 (1969).