RAE 2001 Chemistry Panel Overview Report

General impressions. The 2001 RAE Chemistry Panel received 45 submissions; in 1996 the number was 62. In view of the cost of conducting and maintaining research at an internationally competitive level, the Panel welcomed this selectivity, concentration and focusing of effort in academic research and teaching in chemistry. Concentration of higher quality research is realistic and, **overall, academic chemistry research in UK universities is now in a lively, buoyant and well balanced state.**

The overwhelming impression gained from the detailed examination of all RAE indicators[1], was that the discipline of chemistry in those UK universities currently active in research had greatly improved between 1996 and 2001. The subject was undoubtedly stronger and its practitioners were more optimistic and more effective, which is reflected in the increased proportion of higher grades and the elimination of submissions in the lowest grades. The Panel recognized several key factors that had contributed to this significant progress. Many institutions have made large investments in new buildings or refurbishment, in infrastructure including instrumentation, and in new academic staff. The Research Councils have played a role in revitalizing the discipline through increased (though increasingly insufficient) funding and there has been selective investment from industry. The Wellcome Foundation's initiative leading to JIF has had a large impact in several departments. It cannot be over emphasised that the substantial focused investment during this review period has had a significant impact but this improvement cannot be maintained unless the level of investment is substantially increased. Areas requiring urgent attention include the unsatisfactory career position of many fixed term contract research staff, the immediate need to maintain the number and quality of graduate students in the face of declining secondary school rolls, and to address the low staffing levels in technical, secretarial and managerial support functions. Recent investments have contributed to overcoming the general degradation of facilities and spirits that occurred during the 1970 to 1990 period but it is essential that funding agencies recognize that equipment lifetimes are finite, that buildings and facilities degrade, and mechanisms for writing off assets and maintaining levels of investment are required to avoid repetition of past decay. In keeping with the published criteria, size has ***not*** been a factor in determining ranking in this assessment but it is clear that chemistry thrives best where the size of the activity exceeds a threshold minimum. There was a correlation between investment and performance. The level of commitment in departments with increased ratings has particularly impressed the Panel.

Interdisciplinary research. The Panel was encouraged to see the growth of high quality interdisciplinary research, which now thrives in, and between, many institutions. The interfaces between chemistry (as a strong core discipline) and physics, biology, materials and engineering have strengthened. These cross disciplinary interactions were very broad; the interaction with biology for example, involved not just synthetic organic chemistry but spectroscopy, physical, inorganic, theoretical and computational chemistry. Such interactions are essential since the major task of deriving scientific and commercial value from recent advances in genomics and proteomics requires massive inputs from chemistry and computing. Similar comments apply to

[1] Data were received recording staffing; research outputs; graduate student, research fellow and research assistant numbers; higher degree completion rates; research income from all sources; research management, resources, support staff and infrastructure; self assessment and evidence of esteem. The data were subjected to detailed examination, comparative analysis and discussion. Specialist advisors were consulted in areas of uncertainty. Four of the eleven panel members served on the 1996 RAE and parts of the 1996 submissions were available. The Panel was helped by observers from the Research Councils (NERC, BBSRC and EPSRC) and excellent secretarial support (provided by HEFCE).

photonics, molecular electronics, biomaterials and nanotechnology. Possibly as a consequence of these factors, some departments have restructured their research activity to reflect evolving interests, rather than the traditional inorganic/organic /physical groupings. However it essential that universities, funding agencies and research councils recognize that these interdisciplinary strengths are predicated on the maintenance of the strength of the core discipline of chemistry.

The strategy of identifying and aligning with new growth areas is obviously appropriate but carries some risks. Where several institutions identify similar topics it may be difficult to find, in the immediate future, a sufficient number of people qualified to lead such emerging areas. A number of recent developments have come into this category and institutions should balance quality against selectivity with great care if they are to avoid dilution and weakening. On the other hand, the Panel accepts that limited resources dictate selective strategies and it has commended the policies of some of the smaller departments which have focused on niche areas and collaboration between departments.

Staffing. The increasing internationalisation of UK chemistry departments, at staff, student and postdoctoral levels, during the period of review was welcomed, and it may help in solving some of the problems indicated above. In particular, the recruitment of talented graduate students internationally offers an opportunity to strengthen the UK science base. The revitalising effect of the Royal Society and Research Council Research Fellowship schemes, which have contributed to the appointment of many talented young staff, was apparent. The EPSRC's successful fast-stream starter grants had also accelerated the development of new staff's research programmes. Although complaints about "brain-drain" losses were rare, the Panel noted the departure of some highly talented researchers during the assessment period; the careful nurture and future retention of the many excellent recent new appointees will be vitally important. In this regard, the high reliance on temporary contracts, and the use of talented individuals as "lieutenants" were both seen as inhibiting the development of research talent.

Research strengths and quality. Many areas of research were assessed as internationally competitive, including traditional strengths, for example, synthesis, catalysis, electrochemistry, nanoscience, theoretical and computational chemistry. In addition, the successful development in several centres, of chemical and structural biology, and of the chemistry of materials was also applauded. On the other hand, the innate conservatism of the peer review system was inhibiting innovation at home and discouraging a rapid response to international developments and new opportunities. While welcoming the increasing successes of computational modeling, the Panel was concerned that this should not be at the expense of experimental research: synergy here is key to much of the continuing development of the subject. The importance of new instrumental techniques, for example the many varieties of imaging, was very apparent. However, under-investment in the development of new or more advanced instrumental techniques, for example in mass spectrometry, was seen as a weakness in the UK.

Industry. While the interaction between academic and industrial chemistry appeared to have increased substantially during the period, the level of funding from industry appeared to have declined slightly and is likely to become more selective. Interactions with industry through consultancy, visiting positions and secondments were frequent and the generation of IPR and spin-off companies had increased during the review period. It is clear that despite realignments within the chemicals and pharmaceuticals sectors, a continued supply of well trained chemists will be essential to enhance the competitiveness of our traditional industries, for the commercial success of the burgeoning biotech industry, for the attraction of inward investment in other new technology based industries and for increasing wealth creation in the UK.