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Twentieth Century**

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## Career Patterns in the British Chemical Profession during the Twentieth Century

The following three obituaries all appeared in the journal of the Institute of Chemistry between 1937 and 1948. All three describe, with an unusual economy of words, the lives of individual British chemists who lived in the first half of the twentieth century. In all three, it is careers which stand at the centre of the narrative.

HAROLD ALBERT GOLDSBROUGH died at Hurstmonceaux, Sussex, on 12th March, in his 54th year. He received his early training under the late A. Chaston Chapman, F.R.S., with whom he worked for three years, and from 1906 continued at Finsbury Technical College, London. Thereafter he became Chief Assistant and later Associate Partner with Dr. Philip Schidrowitz, with whom he published various papers in the *Journal of the Society of Chemical Industry* and the *India Rubber Journal*. In 1915 he enlisted as a Corporal in the Special Brigade of the Royal Engineers, later receiving a Commission in the same Brigade and being promoted to the rank of Captain. He returned to Dr Schidrowitz, but was subsequently engaged with Messrs. J. B. Keeble & Co., and then with Hedge Sherriff Paper Co., in Canada, until 1932, when he returned to England and engaged in poultry farming.

He passed the Intermediate Examination for the Associateship in 1908 and the Final Examination in 1910. He was elected a Fellow in 1913 (*Proceedings of the Institute of Chemistry*, 1937, 61, p. 191).

FRANCIS HENRY NEWAY LANE died at Coventry, on 26th August, in his 55th year. Educated at Portsmouth Grammar School and Plymouth College, he studied chemistry at Birkbeck College, and graduated B.Sc. (Lond.) in 1910. In September of that year he obtained an appointment as assistant analyst in the laboratory of the Admiralty Chemist, then the late Arnold Philip, Fellow, with whom he remained until December 1915, when he was appointed as assistant research chemist at the Imperial Institute. In 1917 he became works chemist with the Rover Company, at Coventry, where he also held a lectureship at the Technical Institute. He left the Rover Co. in 1925 and practised in Coventry until 1935, when he joined the staff of Modern Machine Tools Ltd. From 1938 he was chief metallurgist at Daimler Co.'s Factory until he was obliged to cease work owing to ill-health in October, 1939. He was elected an Associate of the Institute in 1919 (*Proceedings of the Institute of Chemistry*, 1940, 64, p. 340).

PERCY PARRISH died on 30 May, 1947, in his 63rd year.

He received his scientific training at Dewsbury Technical School, Huddersfield Technical College and the University of Leeds. In 1900 he became Chemist to J. Brown & Co., Ltd., of Dewsbury, and in 1914 was appointed General Manager and Chemist to the Eaglescliffe Chemical Company's Works in County Durham. The following year he joined the South Metropolitan Gas Company, becoming manager of the ammonia and acid works at East Greenwich, a position which he held at the time of his death. He was the author of *The Design and Working of Ammonia Stills*, *Sulphuric Acid Reaction Chambers*, *Sulphuric Acid Concentration* and [jointly] *Artificial Fertilisers, their Chemistry, Manufacture and Application*, in addition to

numerous papers contributed to the technical press. He was the inventor of several processes, for which he held patent rights. He was elected an Associate of the Institute in 1918 and a Fellow in 1931 (*Proceedings of the Institute of Chemistry*, 1947, p. 190).

Such obituaries were – and indeed still are - a standard feature in British scientific journals. During the twentieth century, nearly every issue of the journals of organisations such as the Institute of Chemistry or the Chemical Society carried obituaries of deceased members or leading chemists. Most follow a very distinct pattern, starting with schools and colleges attended, touching on contributions to scientific journals, and finishing with any honours from or offices in scientific societies, thus providing a measure of the esteem awarded the individual by the scientific community. As in the three obituaries above, however, it is the trajectory of the subjects' working lives which provides the central narrative to the life portrayed.

If, however, the focus on careers gives obituaries of scientists a common format, the careers described often vary enormously. Harold Goldsbrough began his working life as an apprentice with a leading consultant, A. Chaston Chapman. Later he worked for another consultant, before taking posts with two industrial companies, the second in Canada. He died back in England, as a poultry farmer. Francis Lane began his career in 1910 working for the Admiralty. In 1915 he moved to the Imperial Institute, a government-funded research establishment that sought to further the economic development of the Empire through applied science. Two years later, he moved to Coventry and a post with the Rover car company, whilst at the same time teaching at the local technical college. In 1925 he set up as an independent consultant. Ten years, he returned to industry, holding jobs with two separate firms in the four years before his retirement. Finally, Percy Parrish spent most of his working life with just two companies: J. Brown & Co. Ltd. and the South Metropolitan Gas Co. For 32 years, apparently, he served as manager of the East Greenwich ammonia and acid works.

The varied work-life histories of these three chemists were not unusual and there were other patterns too, as for example the individuals who progressed through the ranks of a single institution. As the demand for chemists grew in late nineteenth and twentieth-century Britain, chemists found roles across academia, industry and government. Some worked all their lives for a single company or university, for others, independent practice was always the goal; yet others pursued mobile careers, shifting location, employer and sector. If professions can be seen as 'knowledge-based groups' (Torstendahl, 1990), the expertise possessed by chemists proved highly transferable.

This versatility makes chemists an interesting case-study for exploring the development of professional careers. From the end of the nineteenth century, an increasing range of applications for chemical knowledge came to be identified. Not only did the chemical industry itself develop rapidly, but chemical skills were essential for a host of other industries. Government, from public health to armaments, also required chemical expertise; the rapid development of chemical education both reflected and further stimulated the demand for chemists. Turning this diversity to advantage, leading chemists highlighted the adaptability of their discipline: chemistry was a 'universal' and a 'useful' science, with a wide range of applications. Throughout the nineteenth century and well into the twentieth, chemists were Britain's largest scientific community. They were also one of the first of the new scientific or technical professions to establish themselves in Britain at the end of the nineteenth century. In doing so, it was versatility which was emphasized. Andrew Abbott argues that professions establish themselves by defining a 'claim of jurisdiction' where society recognises their exclusive rights (Abbott, 1988): in the rhetoric of the developing chemical profession, the wide utility of their discipline was always at the centre.

Much of the literature on professions in Britain highlights structural similarities. This is the case for the older literature which drew out features common to many professional occupations – qualifying institutions, entrance exams, self-regulating codes of conduct – in constructing models of how professions developed (Carr-Saunders and Wilson, 1964). In a different sense, it is also true of a more recent literature which uses the growth of the professions as a central theme in explaining the development of British society in the twentieth century (Perkin, 1989; Savage, Barlow, Dickens and Fielding, 1992). Both approaches stress the role played by the 'liberal professions' and particularly law and medicine in shaping how professions were perceived. There can be no doubt that the success of the traditional professions served as an ideal for many of the occupational groups that organised in the final decades of the nineteenth century and the first half of the twentieth. When chemists first began to organise in the 1870s, engineering and especially medicine were frequently cited models (Russell, Coley and Roberts, 1977). Yet this focus on similarities can hide differences, not only between broad sections of the 'service class' or between the experience of professions in Britain and elsewhere, but also between the experience of the many 'knowledge-based groups' that developed in the UK (Mackie, 2000; Mackie and Roberts, forthcoming).

Many of these differences relate to careers. This becomes evident when the related typologies developed by David Vincent and Andrew Miles to examine the work histories of people in Britain in the nineteenth and early twentieth centuries are used to examine the careers of

professional groups. Vincent talks of 'four basic models of career development' in his study of the working lives of the sample collected by Paul Thompson and colleagues for the 'family life and work before 1918' oral history project (Vincent, 1993, p. 224; Thompson, 1975). Miles uses three categories with similar titles (Miles 1993; Miles 1999). Both use a category of 'professional careers', which Vincent describes as 'organised on the basis of the largely non-hierarchical exploitation of a specific craft or skill' (p. 224). This might seem the obvious category for most chemists and other professional workers. Yet, all three of Vincent's other categories, the bureaucratic, the entrepreneurial, and the dynastic, contain elements central to the career paths both of chemists and of other professional groups.

Thus, for many professionals, independent practice was - and indeed remains - an aspiration. Interestingly, in the first half of the twentieth century, this was the standard destination of many in the liberal professions of medicine and law. As Ann Crowther and Marguerite Dupree argue in their study of general practitioners, such doctors possessed a career path with little mobility. A successful practice depended on good local contacts and many returned to their place of origin, perhaps to take over an existing practice (Crowther and Dupree, 1996). Success was not related to moving up a career ladder but to the growth of the practice and perhaps such external measures as status in the local community. As such, the career paths share some of the characteristics of the entrepreneurial model identified by Vincent and Miles, although, as Crowther and Dupree emphasize, there might be a dynastic element too, since independent practitioners often developed an inherited practice. Certain chemists followed similar career paths, either opening independent practices or working as public analysts for boroughs or counties. Indeed, as with medical practitioners, such posts were often combined, thus bridging the public/private divide. In addition, a few chemists entered entrepreneurial careers in business, either launching or inheriting companies that manufactured a wide range of chemicals.

Other established professions followed career paths much closer to the bureaucratic careers that both Vincent and Miles identify. Anglican clergy or army officers typically had only one possible employer and advancement depended on success within the institution. Savage points to the importance of loyalty to the firm in the careers of bank clerks. In the early twentieth century, clerks attempted to enhance the importance of banking qualifications, but such moves were rejected by their employers concerned by moves towards professional status (Savage, 1993; see also Stovel, Savage and Bearman, 1996). For chemists entering central government service, or large companies, or the major universities, progress might also mean a succession of jobs up a more or less clearly defined career ladder. ICI was notorious for preferring its own men to outsiders when it came to top appointments (Reader, 1975).

For a third group of professional or semi-professional workers, switching employers at irregular intervals was a normal part of career progression. British metal mining engineers gained experience by working for different companies in different countries (Harvey and Press, 1989); merchant navy captains served on a series of renewable contracts. Such careers were 'based on and defined by possession of a recognised skill' that the professional could transfer to a new setting (Miles, 1999, p. 112). Again, many chemists had careers which conformed to this format, switching during their working lives between similar institutions: chemistry masters often taught at a number of schools, whilst smaller companies which employed few chemists might offer few prospects of advancement so that moving up a grade meant changing firm. In other cases, job changes involved greater shifts. Even leading chemical academics or industrialists might have spent part of their career in a completely different sector, or like Frederick Donnan, professor of chemistry at University College London from 1913 to 1937, might hold important industrial consultancies whilst pursuing an active academic career (Roberts, 1997).

The career paths of professionals, in short, varied enormously. What is interesting about chemists is that this diversity was contained within a single profession. The wide utility of chemistry meant that different professional avenues, with widely diverging career patterns, were open to them. If choice is too strong a word – for many chemists felt that their opportunities were limited by the short-sightedness of employers – there were at least different options, options, moreover, which reflect the range of career types which other British professions pursued.

This paper focusses on how individual chemists constructed careers from the options available. A central issue is the tension between career stability (staying in the same job, or with the same employer) and career mobility (shifting between employers and between sectors). Which were more common and did this change over time? Can we identify trends in the career patterns of chemists? Miles suggests that the end of the nineteenth century saw the beginnings of a shift towards career patterns defined by formal and external structures (1999, pp. 113-4). Is such a framework helpful in understanding the development of careers in chemistry? A further set of questions relates to the relationship between stability, mobility and success. Were mobile or stable careers more likely to lead to the top? Did this change over time? Although our data explores behaviour rather than motivation, pathways to success may also raise questions about how we understand work-life histories. When thinking about careers – and perhaps especially professional ones – it is easy to ascribe value to certain patterns. Thus career stability can be seen either as commitment or as parochialism, mobility

as independence or inconsistency. Exploring the patterns of chemists working lives may help us to understand why they – and other 'knowledge-based groups' - moved or stayed put.

The following section explains our sources and methods and their strengths and limitations for the study of professional careers. It is followed by sections that, in turn, explore career mobility, stability, success, and career types.

### **The Institute of Chemistry and the profession of chemistry**

This paper forms part of a larger study of the British chemical community in the twentieth century. For this study, we have used collective biography methods to explore the experience of chemists in Britain between the 1880s and the 1970s and to compare this experience with the rhetoric of a developing profession. A central tool of this project is a database including representative samples of the membership of the three major chemical societies in Britain, the learned Chemical Society (CS), the professional body, the Institute of Chemistry (IC; from 1944, the Royal Institute of Chemistry), and the Society of Chemical Industry (SCI), which aimed to act as a bridge between science and industry. This paper draws on data collected for certain of those samples: the three cohorts that entered the Institute of Chemistry between 1887 and 1917, 1918 and 1943, and 1943 and 1956, respectively.<sup>1</sup>

Data for the collective biography database came from a wide range of sources. Obituaries, such as those quoted above, were a major source, as were the membership records of the major chemical institutions, which have been preserved by the Royal Society of Chemistry and the Institution of Chemical Engineers. In addition, a range of standard biographical sources, such as *Who Was Who*, was used for the more prominent individuals. These essentially biographical sources were complemented by others which more closely approximate census data. Use was made of the lists of members regularly produced by the IC, CS and SCI which included details on qualifications, job titles and workplaces, and of directories of the holders of chemical positions, or of science teachers. As a result, data collection was a process of record linkage in which longitudinal and cross-sectional data were combined to obtain results which avoid some of the pitfalls inherent in either type of data. Inevitably this record-linkage process resulted in certain individuals being more fully covered than others. Yet, if the quantity of information has varied, it has been possible to collect at least outline data on nearly all the members of the three samples considered here. We know of

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<sup>1</sup> Further details on the project and some of the data used can be found on our website: <http://www5.open.ac.uk/Arts/chemists>. For data protection reasons, only data on individuals known to be deceased is available on the website; that is for approximately 40% of the entire database.

at least one career for all but 5.4 per cent of the individuals in the three samples and have careers stretching over 30 years for more than half of them. As illustrated by the obituaries, certain types of information were more readily available than others. Our focus on the education, qualifications, careers, and society affiliations of chemists builds on the strengths of the sources we use.

The Institute of Chemistry was established in 1877 as a self-consciously professional body. Its background lay in conflicts within the Chemical Society (founded 1841) over how it should respond to external demands for clear membership criteria. From its beginning (and in contrast to the Chemical Society), the Institute insisted that admittance should only be on the basis of academic qualifications and it rapidly created an entry route based on examinations (Russell, Coley and Roberts, 1977). In this it preceded many other professional bodies, including the engineering institutions, and as such was a pioneer of a new style professional body which saw certification as crucial. During the two World Wars, qualification routes were revised to take account of the growing number of chemists with qualifications from academic institutions. By easing access for chemists with a university degree, the IC was able to keep abreast of the growth in numbers of trained chemists. Both revisions led to a surge in membership and, once this fell back, still left admissions on a higher level than before. A comparison can be made with admissions to the Chemical Society and the Society of Chemical Industry, neither of which acted as a certifying body. As can be seen in Figure 1, 'Admissions to the 3 main British chemical societies' (appended), both had higher admissions in most years than the Institute of Chemistry. Nevertheless, the higher retention rates of the Institute meant that it grew much faster especially after 1918. As shown in Figure 2, 'Membership of 3 main British chemical societies' (appended), before the First World War the Institute of Chemistry, was always the smallest of the three organisations. However, it overtook both the Chemical Society and the Society of Chemical Industry during the 1920s and by 1956, was twice the size of the SCI and 50 per cent larger than the Chemical Society.<sup>2</sup>

The members of the IC were, therefore, by their own definition, professional chemists. To become members they had had to sit entrance exams or demonstrate that they had obtained similar recognised qualifications elsewhere. They were entitled to use the designation AIC

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<sup>2</sup> The growth of the Institute means of course that the cohorts entering it varied in size. Between 1887 and 1917, there were 1717 entrants, between 1918 and 1943, 9024 entrants, and between 1944 and 1956, 7862 entrants. So as to achieve statistically useful samples, we aimed for a sample of 200 from each period. As a result, the ratio between sample and cohort varies. Our samples are systematic samples with a random start of all chemists entering the Institute organised by date of entry. That is the year that an individual first became a corporate member either as an Associate or a Fellow of the Institute.

(Associate) or FIC (Fellow). Unlike a university qualification, since the membership was the qualification, if members wished to continue using the title, they needed to retain their membership by paying an annual fee. Fees were set at a high level – 2 guineas per annum in 1934. That retention rates were nevertheless so high was not because membership of the Institute was formally required for any office. In contrast to the position of some other professional bodies, and despite the occasional efforts of the Institute's leaders, government never made membership of the Institute a condition for holding any post. It was also quite possible to keep abreast of scientific knowledge without IC membership. Both the Chemical Society and the Society of Chemical Industry produced prestigious learned chemical journals, and large numbers of chemists, including many leading academics, joined those societies and not the Institute. Membership of the Institute can therefore be seen as a conscious decision taken either because of perceived advantages in terms of career advancement or because applicants wished to align themselves with a particular form of professional identity. The rapid increase in the membership of the Institute in the twentieth century was a vindication of the insistence of its founders in establishing a professional association based on qualifications: the steep upward curve in Figure 2 is evidence of the increasing importance of academic credentials. During the twentieth century, certification became important in a wide range of fields; among scientific and technical professions, chemistry was one of the pioneers in this process.

### **Career Mobility**

Tables 1 and 2 look at the mobility between 'sectors' experienced by the chemists in each of the three samples.<sup>3</sup> For this purpose, we have identified the five main fields – here described as sectors – in which chemists worked: academia, including both universities and technical colleges, school teaching, 'consultancy', by which we mean independent practice, government, both central and local, and industry. 'Other' includes posts that fit in none of these categories, such as chemists working as medical practitioners or for public utilities. Table 1 looks at the percentage of chemists who worked in one, two, or three or more of these sectors.

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<sup>3</sup> Note that in all tables, figures are for careers as a whole. Since most IC members joined the Institute in their youth (average age for those where we have a date of birth is just over 28 years) and working lives may have lasted for approximately 40 years, the careers of the first cohort may have lasted into the 1950s, whilst some in the final cohort may only now be on the point of retirement.

**Table 1. Mobility: Chemists working in one or more sectors (percent)**

Sample	1887-1917	1918-43	1944-56
<i>n</i>	225	193	208
Worked only in one sector	50	51	52
Worked in 2 sectors	28	29	36
Worked in 3 or more sectors	17	12	7
Insufficient data	4	8	4

Among the patterns highlighted by this table is a striking consistency over the three sample periods in the percentage of chemists who only ever worked in one sector – just over half in the case of all three samples. However, more than 40% of each sample worked in at least two sectors. Among those who switched between sectors, there was a decline in the percentage working in three sectors or more over time so that in the post-war sample, this was true of under 10 per cent. From this perspective, the experience of Francis Lane, the subject of our second specimen obituary, was becoming increasingly rare.

Table 2 looks at the sectors in which members on whom we have sufficient data worked. Two figures are given per sector for each sample: ‘All’, the percentage of the entire sample who worked in that sector; and ‘Only’, the percentage of the sample who – as far as we know – worked exclusively in that sector.

**Table 2. Mobility: Distribution of chemists’ posts among sectors (percent)**

Sample	1887-1917		1918-43		1944-56	
	All	Only	All	Only	All	Only
<i>n</i>	225	225	193	193	208	208
Academic	32	9	30	5	26	5
School	8	2	7	4	4	1
Consulting	30	3	12	1	5	0
Government	32	12	30	6	28	9
Industry	54	25	59	33	73	37
Other	4	0	8	2	10	1

That the ‘All’ column for each sample totals more than 100% is a consequence of individuals’ working in more than one sector as shown in Table 1. For all three samples, the figures for industry stand out, with half, rising to three-quarters, of all chemists working for at least some part of their career in industry. Between a quarter and a third of chemists spent part of their

careers in academia, government and – for the first sample – consultancy. By contrast, only small numbers of school-teachers seem to have joined the IC.<sup>4</sup> These results provide an interesting perspective on debates about the destination of graduates in the years immediately preceding the First World War. At the time there was widespread concern that industrialists showed too little interest in employing chemists. Table 2, however, suggests that even though the Institute had been set up primarily to serve chemists in independent practice, industry was already becoming a major career destination from the turn of the century (see also Roberts, 199X). Over time, this became even more markedly the case. The percentage with industrial experience rose from sample to sample, whilst that working in academia and government was largely static, and the percentage who worked as consultants declined precipitously. This can partly be explained by changes in how industry 'bought' expertise. In the pre-1914 era, independent consultants were often used, whereas, from the First World War on, it became increasingly common for firms to employ their own chemists. As a result, independent practitioners, the group closest to the traditional ideal of a profession, gradually became a minority among Institute members.

If industry was increasingly dominant, it was, however, never an exclusive employer. A comparison of the percentage of everyone who worked in a sector with the percentage of those who worked only in that sector, shows that in virtually every case fewer than half those who worked in a sector spent their entire career there. Perhaps surprisingly, this is particularly true of academia and government where it might be expected that large institutions would develop exclusive recruitment patterns. A larger proportion of chemists working in industry only knew that sector, yet even here around half of all those who worked in industry worked in other sectors as well and this remained true over time, despite the rising percentage working in industry. These figures do not of course say how long individuals worked in each sector, yet they do indicate that experience of working in more than one sector was – and remained – common. In this sense at least, chemistry remained a unified profession with transferable skills, for which barriers sectors never became insurmountable.

### **Career Stability**

Tables 3 and 4 consider career stability. We have taken 20 years – approximately half a working life - as the unit of measurement. Table 3 shows the percentage in each sample who spent at least 20 years with the same employer in the same post and the percentage who

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<sup>4</sup> Cardwell argued that school-teaching was the destination of most science graduates at the turn of the century (Cardwell 1972; but see also Donnelly 1991). Our figures do not of course mean that chemistry graduates did not enter teaching – it may well have been the case that those who did saw little reason to join the Institute.

worked for 20 years for the same employer – company, academic institution, or government department – but in more than one post. Table 3 also shows the percentage of those whose careers included no period of stability as long as 20 years. Almost a third of each sample cannot be allocated because our data on their careers cover a period of less than 20 years. A number of reasons may account for this. In the case of the 1887-1917 sample, early death was a factor with at least 5 per cent of the sample dying before the age of 40, many during the First World War. Furthermore, because we have sought data widely within but to a lesser extent outwith the chemical literature, we are less likely to have data on those who dropped their membership of the Institute and the other chemical societies. It is therefore possible that some, and perhaps a considerable proportion, of those about whom we have limited data abandoned chemistry for some other occupation, in the same way as did Harold Goldsbrough, the subject of the first of our specimen obituaries.

**Table 3. Stability: Chemists with stable careers (percent)**

Sample	1887-1917	1918-43	1944-56
<i>n</i>	225	193	208
20 years with one employer <sup>5</sup> : one post	36	19	6
20 years with one employer: more than one post	18	29	24
< 20 years with any single employer)	17	19	37
Unclassifiable (data on < 20 years of career)	28	33	33

Table 3 shows a marked decline over time in the percentage staying in the same job for 20 years or more. The high percentage with stable careers in the first sample may seem to clash with the evidence of mobility presented in Tables 1 and 2. Very often, however, this represented different career stages: high mobility in the first decade of employment was followed by later stability, perhaps because an independent practice had been opened or a desirable niche had been found. Over time, however, careers such as that of Percy Parrish, the third of our specimen obituary subjects, became increasingly uncommon. For the inter-war sample, such stability was partly replaced by a rise in the percentage spending over 20 years with the same organization, rising (we presume) through the ranks. Such careers were apparently in decline after the Second World War, although the difference is at the margin of statistical significance of our data. There is no doubt, however, that those starting their careers

<sup>5</sup> By ‘employer’ we mean company, academic institution, government department, etc.

after 1945 were far more likely to work for a number of employers, the percentage in this group from the 1944-56 sample being roughly double that in the 1887-1917 and 1918-43 samples.

Table 4 explores the distribution of stable careers among the four principal employment sectors (school-teaching was excluded because of the relatively small numbers).

**Table 4. Stability: Distribution of chemists working 20 years with one employer as percent of all chemists employed in sector**

Sample	1887-1917		1918-43		1944-56	
	One post	> One post	One post	> One post	One post	> One post
Academic	18	10	7	9	7	11
Consulting	32	3	4	0	0	0
Government	33	21	9	24	5	25
Industry	21	13	19	32	3	18

Each sector displayed a slightly different trajectory. For the pre-First World War cohort, stable careers were least common in academia, and they remained unusual. As Halsey demonstrates, the British university system in the first half of the twentieth century was an ‘evolving hierarchy’, and academic careers often included periods at different universities within it (Halsey, 1995). The percentage with stable careers in consultancy collapsed after the first sample, suggesting that the establishment of an independent practice was – as our subject Francis Lane may have found – an increasingly unrealistic career goal. Government employment saw an almost equally sharp decline in the number holding one job for 20 years, but this was replaced by a rise in the number who (presumably) climbed a career ladder in one department. Civil service restructuring and the inter-war development of government Research Associations may be explanatory factors here. A similar trend can be identified in industry, but the shift away from ‘a job for life’ appears to have been later, whilst the percentage working only for one employer, peaked in the inter-war years. These trends in industry may be related to firm size, with ‘one post for 20 years’ more common among the many smaller firms, which were such a feature of British industry, and ‘bureaucratic’ careers the norm in the large conglomerates which came to dominate the chemical and oil industries from the 1920s. After the Second World War, full employment may have reduced the ability of employers to demand firm loyalty from skilled workers.

## Career Success

Tables 5 and 6 examine career success measured by the ‘rank’ of individuals’ career titles. A scale of 1 to 5 was used, with ranks 1 and 2 representing senior posts and rank 4 the standard grade. Chemists were categorized according to the highest rank they obtained at any point in their lives. Where too little of an individual’s career was known for us to be confident that the highest rank recorded was the highest rank achieved, the individual was classified as uncertain. Table 5 gives figures for the samples as a whole. The relatively high percentage of individuals classified in the uncertain category is due to the percentage for whom less than 20 years of their career is known (see Table 3). Most of this group only attained careers ranked 4 in the period for which we have information and it is possible that our data reflect a career path out of chemistry.

**Table 5. Career success: Highest rank attained<sup>6</sup> (percent)**

Sample	1887-1917	1918-43	1944-56
<i>n</i>	225	193	208
Rank 1	23	16	19
Rank 2	31	23	29
Rank 3	15	18	20
Rank 4	13	18	10
Uncertain	18	26	23

Table 6 shows the distribution across the four principal employment sectors of those who attained posts ranked in one of the top two bands as a percentage of those who held posts in that sector.

**Table 6. Career success: Percentage of all with career in sector attaining high rank posts**

Sample	1887-1917	1918-43	1944-56
Academic	34	18	21
Consulting	57	75	55
Government	19	14	27
Industry	46	39	48

The main result emerging from the two tables is the dip in the percentage attaining high ranks in the inter-war cohort. This dip occurs not only in the global figures in Table 5 but in three of

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<sup>6</sup> Career titles were ranked according to a scale of seniority. For the industrial sector, rank 1 are owners and directors; rank 2 senior management; rank 3 middle management; rank 4 standard grade posts. Roughly equivalent scales were constructed separately for each of the other sectors.

the four sectors analysed in Table 6. The exception is consulting where the inter-war percentage is the highest result recorded. As we know from Table 2, the numbers with consultancy careers dropped dramatically in this period. The inter-war percentage for consultancy suggests that only the most successful remained in the sector.

The more general dip is harder to explain. It is possible that it reflects changing career titles and, as such, is simply an artefact of the ranking system we used. However, this seems unlikely, because the same ranking system was used for all three samples and the way the figures are constructed means that there was considerable chronological overlap between the careers analysed in each sample. It is also possible that the widening of the membership of the Institute at the end of the First World War brought in many chemists who did not reach high office. This may explain the drop shown in Table 5 from 54 per cent for ranks 1 and 2 in the first sample to 39 per cent in the second one. However, it is less helpful in accounting for the rise to 48 per cent in the third sample, after membership criteria were widened even further. Moreover, even if part of the explanation for the dip lies in trends in the total IC membership, these were not unrelated to wider social trends: admission routes were simplified because the leaders of the Institute realised it would otherwise come to represent a declining proportion of a rapidly growing pool of university-qualified chemists (on numbers of science graduates, see Edgerton, 1996, pp. 18-24). The dip must therefore be at least partly explained in terms of supply and demand: compared to the pre-First World War cohort, chemists entering the profession in the inter-war years faced a situation where the supply of chemists was outpacing demand and access to top rank posts was more restricted. After the Second World War, the demand for chemists grew rapidly (Sanderson, 1972, pp. 352-3) and our table suggests that prospects once again improved.

### **Career types**

In the final set of tables, we pull together our data by allocating each of the chemists in our samples to one of a number of defined career types. Table 7 and Figure 3 (a graphic representation of the data in Table 7, appended) do this for the samples as whole. Career-types, a development of the categories in Tables 1 and 3, were defined on the following basis. ‘Cross-sector mobile’ represents the career of an individual who worked in three sectors or spent at least five years working in each of two sectors. ‘Stable in one job’ describes the career of an individual who worked for only one employer in only one post for 20 or more years. ‘Stable in one organisation’ refers to the career of an individual who worked for only one employer for 20 or more years but in more than one post. ‘Mobile within one sector’ represents the career of individuals who worked for a number of employers, all within the same sector. In this and the following tables allocation is additive and has been done in the

order set out in Table 7. If an individual met the criteria for one career type, they were allocated to it and were not considered for the following type, even if their career would also have matched its criteria.

**Table 7. Career Types: Percentage of each sample with careers conforming to different types**

Sample		1887-1917	1918-43	1944-56
<i>n</i>		225	193	208
Cross-sector mobile	<i>Mobile</i>	28	21	18
Stable in one job	<i>Stable</i>	23	16	4
Stable in one organisation	<i>Stable</i>	15	23	19
Mobile within one sector	<i>Mobile</i>	5	8	22
Career fits none of above categories		4	1	5
Data insufficient to allocate category		25	32	33

This order of allocation is important to our analysis; a different order would have produced slightly different results. It was chosen because it seemed to us to reflect the likely impact different career types might have. If an individual had extensive experience of working in different sectors, this was probably highly significant for their professional identity, even if they also spent 20 years in the same post for part of their career. The result is a table with four positive categories, two each for stable and mobile careers. The table also contains two negative categories: a small percentage of careers where we have adequate data, but the individual's career does not fit any of the defined types, and a group for which our data are inadequate to allow allocation. Most of these are, of course, the individuals for whom our data covers a span of less than 20 years (see Table 3).

Each of the four positive categories moves differently over time. The proportion of cross-sector mobile careers dropped gradually. The 'stable in one job' group dropped far more dramatically. The proportion of 'stable in one organisation' peaked with the inter-war cohort before falling back slightly, whilst the 'mobile within one sector' group remained low until a sharp rise in the post-1944 cohort. If we amalgamate the two mobile categories, the percentages are 33, 29 and 40 per cent respectively, whilst the stable pair add up to 38, 39 and 23 per cent, suggesting that the most significant change came after the Second World War. Inside both pairs there was a significant shift in the relative weight of the component categories between the first and the last sample.

Clearly, such figures cannot be interpreted simply as a shift towards one category or away from stable careers. The pre-First World War sample combined high cross-sector mobility with stability in one job – indeed 13 per cent of the total sample combined these features and had careers that could have been allocated to both categories. However, both such career types formed a declining proportion of later samples. They were replaced by two new forms of career. First, the inter-war years saw a rise in the percentage who spent a large part of their career within one organisation – men like Percy Parrish who enjoyed what Vincent describes as 'gold watch' careers (Vincent, 1993, p. 225) – and then, after the Second World War, there was also a rise in the percentage who had mobile careers within one sector.

Table 8 relates these figures to the figures on career success. The top row gives the percentages of chemists achieving posts ranked 1 or 2 for the samples as a whole; the following two rows, those who attained this status either by mobile or by stable careers as defined in table 7. Figures for mobile and stable careers have been grouped to retain cells of a certain size, but, clearly, the make-up of 'mobile' and 'stable' careers shifts in line with the trends in table 7. The figures for the entire samples are slightly larger than the figures for mobile and stable careers combined since some chemists in each sample reached high ranked posts by routes which it has not been possible to classify.

**Table 8. Career success by career type: Percentage attaining high rank posts**

Sample	1887-1917	1918-43	1944-56
<i>n</i>	225	193	208
Whole sample	54	38	48
With mobile careers	25	12	26
With stable careers	22	22	14

Table 8 and Figure 3 (appended), which is based upon it, show that both mobile and stable careers could lead to high ranked posts and this was indeed true for all the four categories used in table 7: it was not the case that any single career type was consistently linked to ultimate career rank. The percentages for the entire sample reiterate the dip in the inter-war years discussed in the section on career success. This is mirrored in the figures for mobile careers; indeed the rise in the post-1944 sample is even more marked than is the case for the entire samples. By contrast the figures for stable careers show a different trend: unchanging until the Second War and then declining. Two trends combined to produce this pattern. First there was a sharp rise in the success rates of those with 'stable in one organisation' careers in

the inter-war years; later the combined figures are affected by the post-Second World War collapse of the percentage staying in one job for 20 years or more.

These trends are further elucidated when those with industrial, academic, and government careers are looked at separately as in Figure 4 (appended) where the pattern of mobile and stable careers of those attaining posts ranked 1 or 2 in a sector are given as a percentage of all who held posts within it. The result is three sets of paired lines – for industry, for academia and for government. In the case of both government and academia there was relatively little change over time. High rank was always harder to come by in government posts, with fewer attaining posts ranked 1 or 2, and stability (that is, long service in one government department) remained more likely to lead to higher-ranked posts. Nevertheless, some always achieved success despite (or because of) mobility. By contrast, in academia, mobile patterns were more likely to lead to higher ranked posts. We cannot of course say what was cause and what effect – in academia was it switching between universities that led to success or did success permit switching between universities? For both government and academia differences between mobile and stable career paths in the achievement of higher-ranked posts virtually disappeared after the Second World War. Industry, however, shows a markedly different pattern. The lines for industry bring out yet more sharply the changes over time visible in Table 8. Before World War One, mobile and stable careers were similar in terms of highest rank achieved, in the inter-war years it was stable careers that were the route to the top as bureaucratic careers were rewarded. However, post-1944, the higher success rates of those with ‘mobile within one sector’ careers pushed up the overall success of mobile careers.

## **Conclusion**

The trends highlighted are often complex; however, perhaps the most important is the continued importance – and changing nature of career mobility. The decline in the proportion of the sampled chemists who held one job for 20 years or more as outlined in Tables 3 and 7 is striking. This pronounced stability was replaced by either careers which included long service to one employer in a series of posts rising in status, or mobility between employers. In terms of the categories used by Miles and Vincent, one might talk of a shift away from ‘entrepreneurial’ (and perhaps ‘dynastic’) careers towards ‘bureaucratic’ and ‘professional’ ones. Mobility of course was displayed throughout the period and, indeed, the earliest sample shows the highest percentage of chemists with experience of several sectors. However, we suggest that mobility might be seen as becoming more focussed. From a situation where individuals might move through a series of apparently random posts, there was a shift towards what appears to be more ordered movement - within one organisation or between similar institutions. This might be seen in the context of the shift towards a more formal career

process described by Miles (1999, p. 113). Those who followed such career paths achieved higher rank posts. If, in all periods, each of the four main career paths identified led to high-ranked posts for some, by the post-1944 sample more such posts went to those who followed careers that displayed this 'ordered mobility' than to those who did not. Within the increasingly important industrial sector, there appear to have been surprisingly few barriers to switching employers. Interestingly, Savage and colleagues suggest a decline in the significance to business of internal promotion in the final decades of the twentieth century (Savage, Barlow, Dickens and Fielding, 1992, pp. 64-9).

For the founders of the Institute of Chemistry, the ideal type of a professional was an independent practitioner. Careers that included long spells in independent practice declined dramatically as a percentage of all careers over the period. Yet, the types of career that became increasingly common and increasingly successful were also built round the professional ideal. Mobility between employers required a recognition – not least from employers themselves – that skills were transferable. In the inter-war years, it seemed for a time that loyalty to one organisation might become the key to success, but the rise in the percentage of 'mobile within one sector' careers after the Second World War swung the pendulum back towards career mobility. Indeed, even 'cross-sector mobility' remained impressive: 43 per cent of the post-1944 sample worked in more than one sector. With increasing numbers of chemists and increasing specialization in both university departments and company research, we might have expected chemical skills to become more narrowly focused to the extent that mobility became problematic. That this was not the case is evidence of the success of the chemical community and its leaders in preserving the unity of the profession and the discipline. Chemical knowledge and skills remained a passport to many careers.

The continuing strength of this professional ideal is also highlighted when we focus on the percentage in each table that defied classification. When appearing as a figure in our tables, this group seemed often to be awkwardly large. Yet, from another perspective it is surprisingly small. In most cases, it was not possible to classify these careers because we only know about part of them. As explained above, there are good reasons for thinking that a major reason for this is that a large part of the working lives of these individuals was spent outside chemistry. The corollary is, of course, that for more than two thirds of every sample, over 20 years (and in many cases far longer) was spent within the profession. In the absence of comparable data it is hard to judge whether seepage out of the chemical community was high

or low, but, since the acquisition of professional qualifications was arduous, it is perhaps to be expected that professional qualifications, once acquired, were used. There can be little doubt that membership of the IC was of continuing importance to most of its members.

The importance of job mobility to professional career paths raises questions about the links between occupational change, job security and social change. Since social class is usually analysed in terms of occupation, individuals who change occupation are most likely to be seen as changing class. Job stability is often also equated with security. Yet for chemists, and, we imagine, for many other professionals, success was most likely to be achieved by job mobility within one occupation. If for many workers continuity of employment was a goal to strive for, for many professional or knowledge-based occupations, successful careers were built upon mobility as transferable expertise was demonstrated and progression achieved. Some might climb ladders within one organisation, but for others, success was achieved by switching employers. In the case of chemists, it is interesting that those who entered the profession after World War Two in a period of expansion, when demand for scientists was high, were more likely to switch employers (and achieve high ranks by doing so) than those who entered the profession during the troubled inter-war decades. Where choices existed, mobility was preferred. In this, chemists were conforming to an ideal in which professional expertise and not organisational loyalty was seen as the key to success.

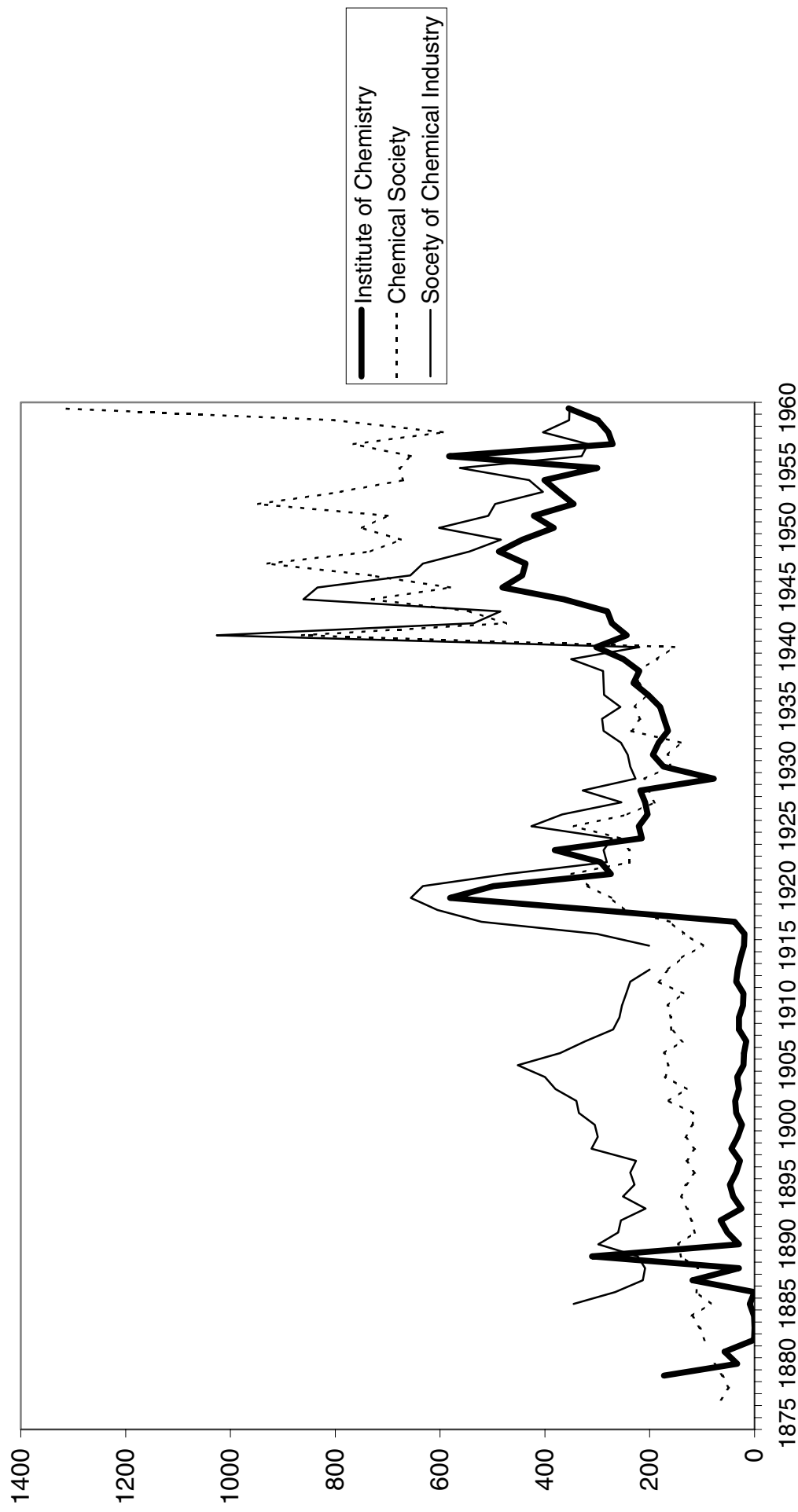
In his study of a series entitled 'Men of Note in the British Coal Industry' run by the *Colliery Guardian* between 1923 and 1929, Michael Dintenfass highlights how little the profiles said about their subjects' working lives (Dintenfass, 1999). Rather than stressing business achievements, the profiles focused on representational and civic roles. The contrast to the obituaries with which this paper started is surely not just one of genres. The professional identity of chemists was closely bound up with the world of work. The close attention given by the writers of the obituaries to work titles and career moves reflects their importance in shaping the life-histories of the deceased. The careers of men such as Harold Goldsbrough and Francis Lane may seem to consist of a series of random moves, yet, in staying put or moving on, chemists were following paths bounded by professional expectations. Over time, there were shifts in the patterns of these paths towards a more ordered mobility, but careers thus ordered entailed no loss of professional identity.

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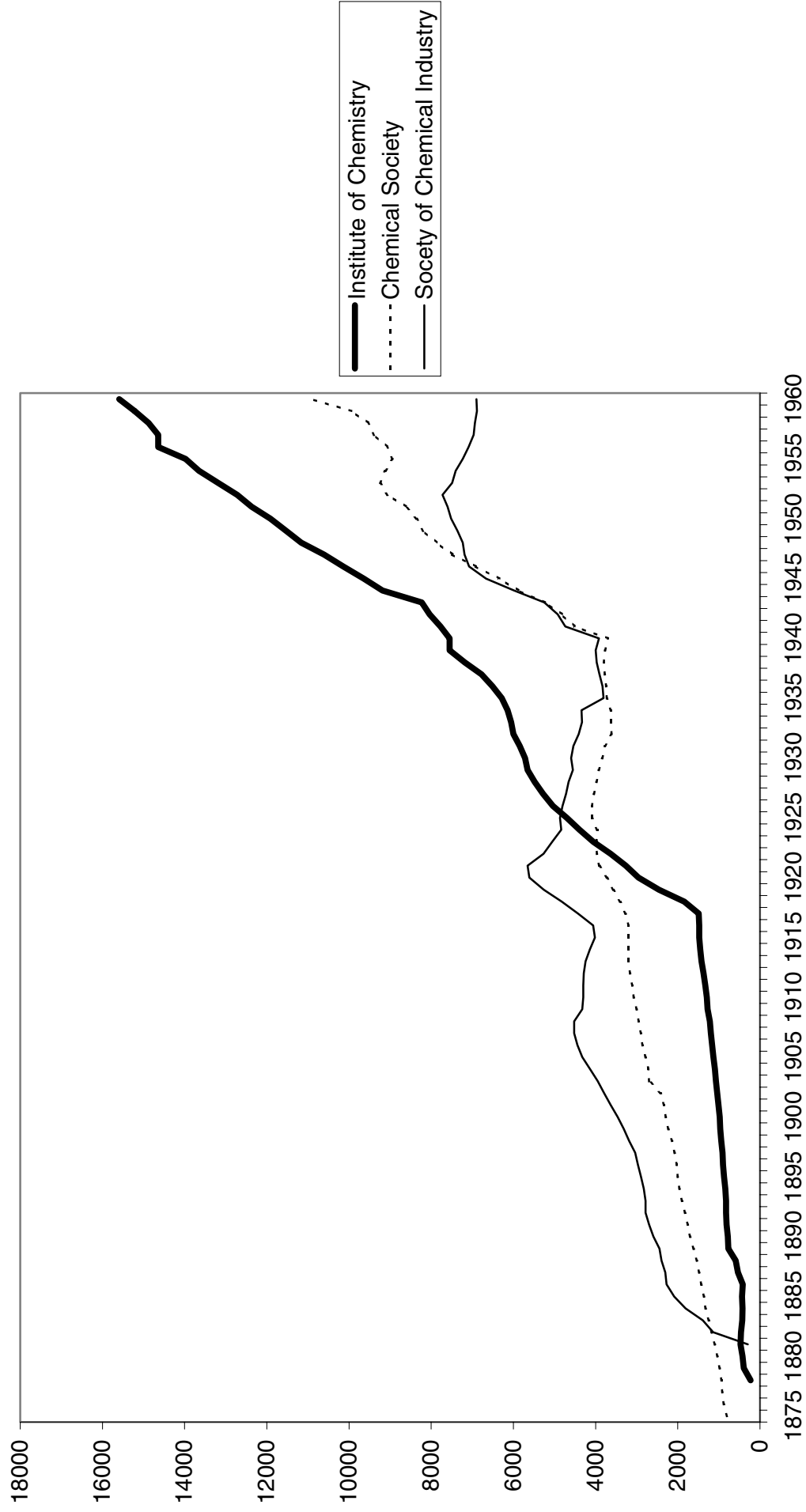
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**Figure 1. Admissions to 3 main British chemical societies**



**Figure 2. Membership of 3 main British chemical societies**



**Figure 3. Career types (percentage)**

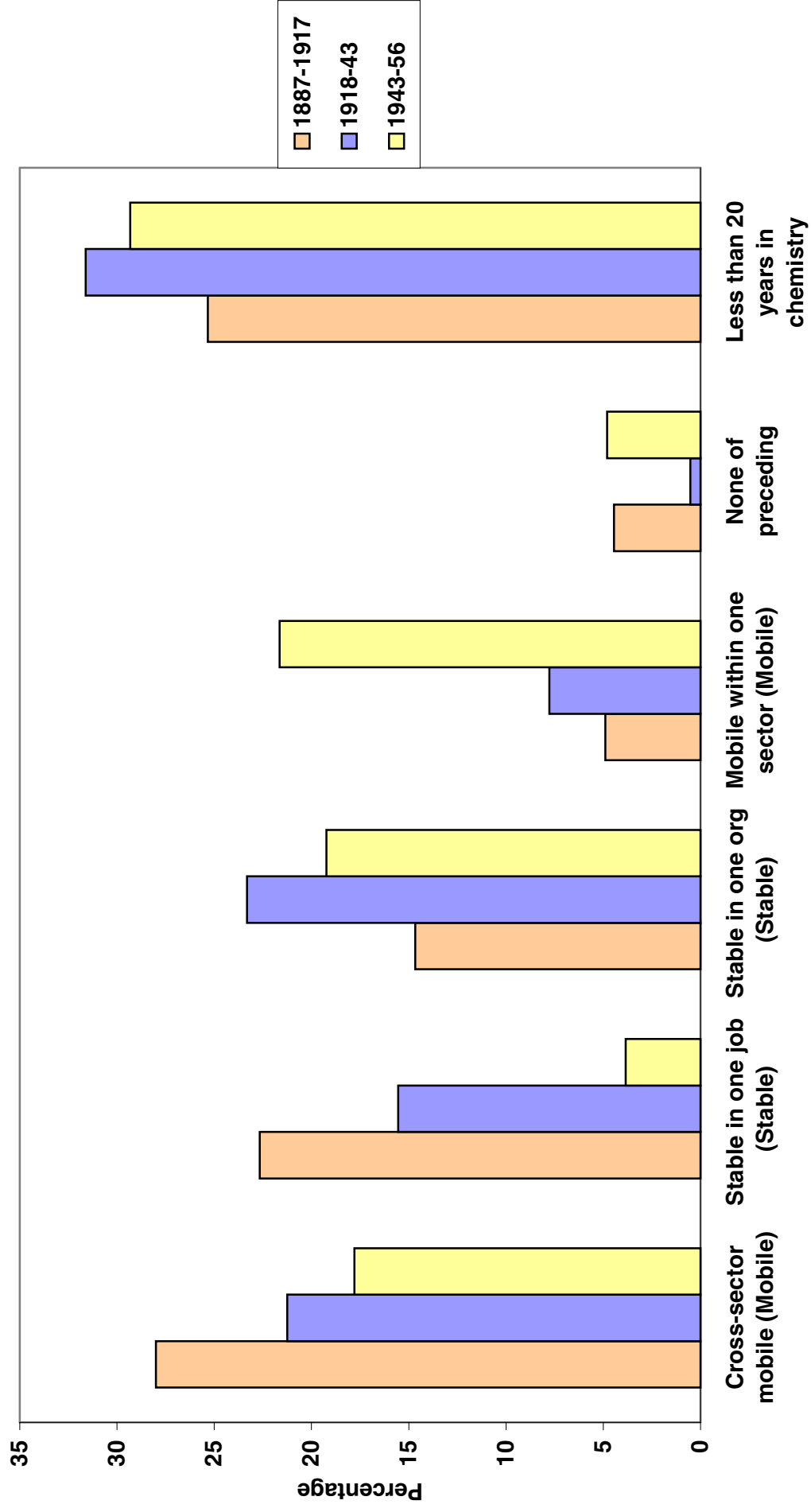


Figure 4. Top jobs by sector (percentages)

