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The Nobel scientists and the origins of scientific achievement

Sociographic analysis of the origins of high achievers, besides being relevant to the formation and functioning of élites, can suggest factors that may be important in promoting outstanding achievement. Although Cattell[1] has shown that creative research scientists share a quite well defined personality structure, and tend to be stable, self-sufficient, dominant introverts, we know rather little of the social and cultural context within which such a personality develops. The present paper attempts to shed light on this. Although earlier work has suggested some social and biographical common features of distinguished scientists, it has tended to be limited by incomplete samples (e.g. Moulin[2]) or by the use of national samples, (e.g. Roe,[3] Zuckerman[4]), which leaves unclear the generality of findings.

Nobel scientists have been chosen as a data-base because they represent a wide sampling across countries and across time (birth dates range from 1835 to 1940).

The criteria applied by the Nobel committees are not revealed, but they probably remain fixed over long periods, and it is notable that, compared with awards in other areas of human achievement, the Nobel science awards are remarkably non-contentious. Whilst it is true that a considerable number of 'prize-worthy' scientists do not win the Prize, very few winners have, with hind-sight, not been deemed worthy of it, a fact which helps account for the prestige it enjoys among professional scientists.

The areas of achievement for which Nobel awards are made are both broad and fairly well-defined, and within-science comparisons can be made, as well as comparisons with achievers in the non-science areas of Peace and Literature.

The present work examines the cultural origins of the Nobel laureates in terms of national, regional, institutional and family backgrounds. A statistical compilation was made of the basic biographical data of winners up to 1977 from published sources, supplemented by short questionnaires sent to about fifty living laureates. Consequently, full information on place and date of birth, places of

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secondary education, universities attended and father's occupation was available for all but a dozen or so winners. Religious and national origins, the early loss of a parent, special distinction of a parent and incidence of serious early illness were noted where the information was available.

NATIONAL, REGIONAL AND RELIGIOUS DIFFERENCES

To derive rational and consistent indices of scientific 'productivity' based on cultural origins, attention was given to national and regional background during the future laureate's childhood, rather than the country in which the Nobel Prize-winning work was done. Laureates were allotted to a particular country if they were both born and received their secondary education there *and* at least one parent was a national of that country. (Fifteen individuals who did not meet this criterion were omitted from the national and regional analysis.) Productivity indices for countries and regions within countries were obtained by calculating the number of winners per million of the relevant population in 1900, a year for which demographic data are readily available, and close to the median date of birth for science winners in most countries. US indices were based on 1910 population figures because most American Science winners were born some time after 1900. To maximize ethnic homogeneity, both Germany and Russia were defined by their 1919 frontiers and Alsace-Lorraine omitted from France and Germany. Austria-Hungary, lacking a single predominant ethnic group, was treated as an entity in the national analysis.

As a first step in comparing cultural backgrounds, separate yield-per-million indices were calculated for prize-winners reared in the principal western religious traditions. A Jewish cultural background was ascribed on the basis of entries in standard works of reference or report in the questionnaire. Thirteen laureates of mixed descent or from a family having embraced an alternative tradition were omitted from the initial analysis on this criterion.

Table I shows the productivity indices for those countries which have produced more than one Nobel science laureate. It is immediately apparent that 'protestant' societies are more fruitful than 'catholic' ones. The difference is statistically significant, both for the data shown, and for all countries with Science winners (Mann-Whitney U-tests; $p < 0.02$). The productivity indices for Jewish communities are overall significantly greater than among compatriot gentiles (Wilcoxon Matched-Pairs Signed-Ranks test; $p < 0.05$).

Regional analysis of productivity (Table II) shows the yield is reliably higher in the major metropolitan centres than in their regions, and again higher in predominantly protestant than in

TABLE I *Number of Nobel Scientists per million of 1900 population for countries with more than one native-educated laureate (to 1977).*

	Protestant	*Catholic*	*Orthodox*	*Jewish*
Switzerland	1.8			66.7
Netherlands	1.8			0.0
Denmark	1.7			–
Sweden	1.6			–
Norway	1.4			–
Australia	1.4			–
UK	1.3			5.0
USA	0.8			20.0
Germany	0.7			20.0
Belgium		0.4		–
Austria–Hungary		0.3		6.3
France		0.3		17.7
Italy		0.1		33.4
Spain		0.1		–
Russia			0.05	0.8

Sources of underlying population estimates: Mitchell's European Statistics, US Bureau of the Census, Encyclopaedia Judaica.

Note: Dash indicates a Jewish minority of less than 20,000.

predominantly catholic regions. As before, for each type of source, the range of the scores is again low. Marked regional differences are evident in Germany and the USA. In the latter case (see map) regional variations are not accounted for by protestant–catholic differences alone because extremely low productivity is characteristic of the protestant ('Fundamentalist') south. The extreme regional imbalance is reflected in the fact that about 60 per cent of American-born Nobel scientists come from only two areas: New York City and the states of the Mid-West. The latter source has been predominantly protestant, the former Jewish.

Although the disproportionate contribution of the Jewish cultural tradition to the ranks of the Nobel laureates is clear, the evidence for the importance of religious tradition is circumstantial for protestant–catholic differences. The question remains whether the individual laureates are of predominantly protestant family background. Direct evidence on this point is hard to obtain, and the data are as yet incomplete. However, of the 'christian' laureates whose family tradition is known, 59 are of protestant origin (2 of

TABLE II *Regional productivity indices (by place of birth) for Nobel Science laureates expressed as proportion per million of 1900 populations*

	Regions		
	Catholic	*Protestant*	*Metropolitan centres*
Holland		1.7	2.0 Amsterdam
Sweden		1.4	8.0 Stockholm
Denmark		1.3	3.4 Copenhagen
UK Home Counties		1.5	1.5 London
North		1.2	1.8 Manchester & Liverpool
West		1.0	6.9 Bristol
Scotland		0.9	3.0 Glasgow
Midlands		0.8	2.0 Birmingham
Norway		0.5	8.8 Oslo
Germany (West) North		0.6	4.5 Hamburg
South	0.2		7.4 Munich & Stuttgart
Austria	0.5		4.0 Vienna
Belgium	0.3		1.7 Brussels
France	0.2		3.3 Paris

Jewish descent) and only 12 of catholic origin (of whom 2 had protestant mothers and 4 were of Jewish descent).

SOCIAL CLASS DIFFERENCES

Analysis of fathers' occupations shows that the Nobel scientists have come overwhelmingly from professional and business families (Table III). An indication of the over-contribution of these backgrounds is given by comparing the data with the proportional class sizes for the USA in 1910 shown in the final column of Table III.

The percentage contributions of occupational classes to the Nobel Science ranks are strikingly similar for the USA and the rest of the world (Professional classes 50.7 *vs* 54.3; Business 28.8 *vs* 27.7; Employees 6.8 *vs* 10.4; Land 4.1 *vs* 5.7 per cent). In view of the social and institutional variations, this probably indicates that very robust underlying factors are at work. These factors cannot, however, be simply a matter of broad class differences, since some relatively small occupational groups within the professional classes contribute out of all proportion. About 20 per cent of Nobel scientists with professional fathers are the children of university professors and a further 19 per cent the children of doctors. If the professional-background group are split into those where the fathers were concerned with education, research and scholarship on the one hand and all other professional occupations on the other, it is also apparent

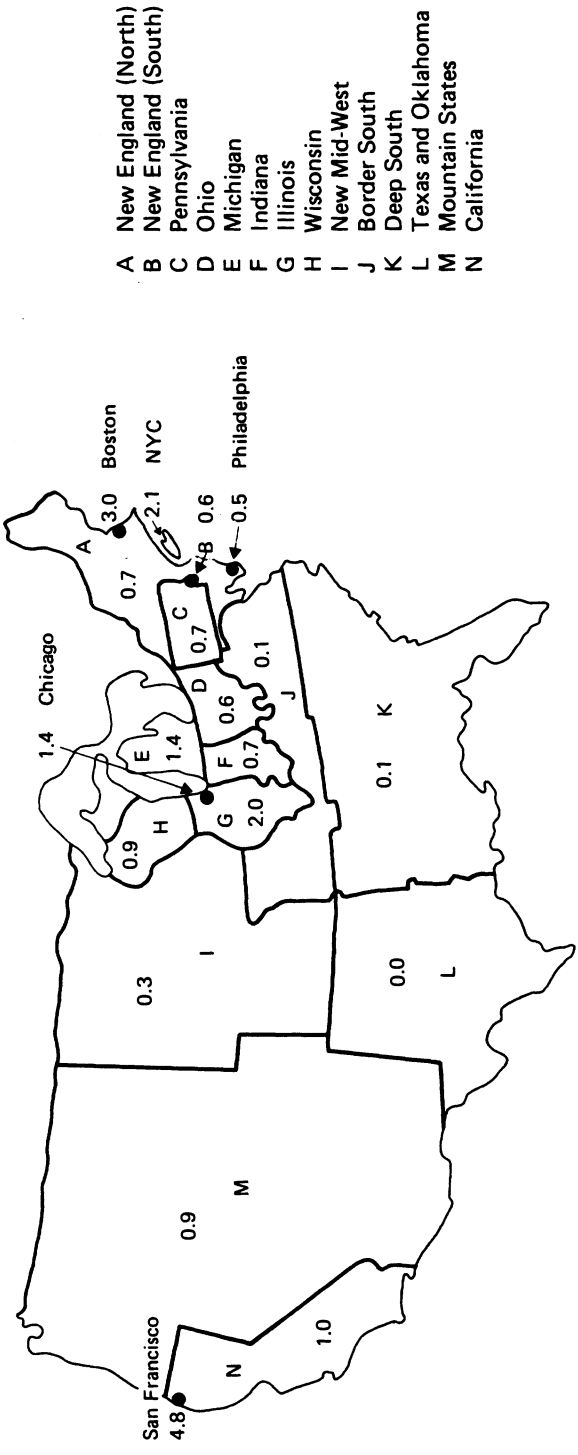

FIGURE 1 Nobel Prize-winners in Science: regional productivity in the USA (yield-per-million based on 1910 populations)

TABLE III *Percentage breakdown of fathers' occupations*

	Physics	*Chemistry*	*Medicine*	*Literature*	*Peace*	*USA (1910)**
Academic professional	28.0	17.0	20.1	5.6	8.5	
Non-academic professionals	20.4	31.1	36.3	42.4	34.8	10.9
Business	27.6	29.3	21.8	13.9	26.3	
Employees	11.2	7.8	6.4	6.3	3.4	57.9
Others (inc. land)	7.8	2.8	3.8	15.3	15.3	31.0
Lost fathers by age of 16 years	2.0	10.7	6.9	16.7	3.4	–

*Derived from Chinay, E., *Society: An Introduction to Sociology*, New York, 1961.

Note: Columns do not total to 100 because occupations of some laureates' fathers are not known.

that the children of academic professionals achieve success overwhelmingly in the sciences and hardly at all outside them, whereas children of non-academic professionals contribute at least as heavily to non-science areas (see Table III).

EARLY EXPERIENCES

There is a marked contrast in the early experiences of the Nobel Science and Literature winners. Over 30 per cent of the latter either lost at least one parent through death or desertion or experienced the father's bankruptcy or impoverishment, whereas Science Prize winners have experienced such 'disorder and early sorrow' rather rarely. The physicists, in particular, seem to have remarkably uneventful lives. Some suggestion remains that losing a father, especially around the early teens, may tend to push future laureates towards achievement in medicine or chemistry. Also, although hard to index clearly, a rising socio-economic background is a frequent feature of scientists' family backgrounds. In general, successful scientists tend to be produced within rising stable backgrounds, often academic or technical, whereas Literature winners more often originate from disturbed or declining backgrounds of traditional non-academic, professional occupational focus. These possibilities remain tentative at present and need to be tested on more widely-defined samples of high achievers.

Only a tiny handful of Science laureates were found to have suffered from physical disability or from serious or prolonged illness in childhood.

DISCUSSION

A salient feature of the Nobel data, when analysed in a way which takes account of cultural origins, is the narrow ranges of productivity values for each type of country or region. This suggests that Nobel awards are probably unrelated to national characteristics *per se*. Rather, national 'success' is related fairly directly to the numerical strengths within a country of protestant and Jewish traditions. Individual success tends to be related to certain class and occupational family backgrounds.

In asking the question what makes scientists of high achievement, Krebs[5] has pointed to the significance of research supervision by eminent older scientists. We are now on firmer ground in answering the further question of who gets access to and, more importantly, benefits from contact with these distinguished supervisors? To an overwhelming extent, the answer seems to be those in radical

protestant and Jewish family traditions from middle-class backgrounds. So powerful are the religious tradition effects, that 'protestant' and 'catholic' societies are distinguished more clearly on this limited data than by the measures of economic performance used in McClelland's[6] well-known study.

It has variously been suggested from past work that besides tending to be of protestant or Jewish origin, the fathers of Nobel laureates are almost always of 'very high social position' (Moulin[7]), and that a sizeable percentage of scientists come from the middle and lower classes (Mahoney[8]): also that loss or absence of the father or physical handicap in childhood is common (Roe,[9] Eiduson[10]). Roe also claimed that geographical origin is not important. The present results, based on an almost complete analysis for over 300 Nobel scientists, represents a larger and more exhaustive sample than Roe's and Moulin's studies together. Moulin, who reported on the origins of Nobelists up to 1950, was able to discover the father's occupation for only 77 of his 164 winners, and his conclusion on class clearly illustrates the dangers of sampling bias with incomplete samples of biographical data.

Little evidence was found here to support Roe's finding that distinguished biological scientists have frequently suffered early bereavement or that physical ailment was a factor with eminent chemists and physicists. Likewise, her conclusion about the unimportance of geographical factors is not supported. It should be noted that if, as much evidence, including Roe's, suggests, most eminent scientists have Jewish or radical protestant origins, the 'success' of countries or regions in producing them should reflect the relative numerical strengths of these traditions geographically. In fact, when differences in population size are taken into account, Roe's own data give a very similar distribution of origins to that shown here, including the over-contribution of the Mid-Western region which is also apparent from the work of Knapp and Goodrich[11] on the collegiate sources of science Ph.Ds.

The improbable-looking stability of the productivity data referred to might suggest that quotas of awards were being allocated. It is however difficult to see why the Nobel committees would differentiate between countries on the basis of their prevailing religious tradition or individuals on the basis of their personal backgrounds, or *how* they could do so, since any operation of quotas would require elaborate compilation of information and extended collusion between different Nobel committees.

The rarity of blue-collar backgrounds among the prize-winners can hardly be due to lack of potential ability in view of estimates of the incidence of very high intelligence in national populations outside the professional and higher business classes. (Terman's California study suggests from about one third; Parkyn's New Zealand

study about two thirds.) It appears that fairly high financial and social status *per se* may be important, as the winners as a group clearly come from limited types of social background. The unevenness in the contributions of middle-class occupational background seems to rule out simple notions of gross differences in socio-economic status. However, occupational focus alone also does not appear to provide an adequate account either. For example, most of the academic-sector fathers of Nobel scientists have been university professors rather than schoolteachers or even non-professorial academic staff. A possible factor may therefore be related to 'modelling' or 'level of aspiration' based on parental achievement, and it is notable that a large proportion (about 30 per cent) of laureates' fathers were themselves distinguished in some way. Some stimulus to achievement may also be provided by culturally mixed backgrounds in childhood, which about a quarter of the Science laureates have experienced.

As Zuckerman[12] has shown, the recruitment of the élite in American science is a strongly meritocratic process, in which the initially less 'privileged' gain steadily on those with greater social and financial advantages. By this process, future laureates typically gain access to one of about a dozen élite institutions (Harvard, Columbia, etc.), more often at the graduate school or post-doctoral phase than at undergraduate level. European Nobel Prize scientists have a similar history of association with élite universities. These 'élite' associations extend in some cases to schooling, e.g. in the case of English public schools, outstanding *Realgymnasien* in Munich and Hamburg, and to a handful of science-oriented public high schools in New York City.

It is not clear what the successful systems have in common, but educational practices such as scholarship provision and early promotion probably play a role. It may be significant that the American laureates both come predominantly from these regions where early school promotion has long been practised and are distinguished from the generality of their colleagues in the National Academy of Science by their precocity at every stage in their academic progress.

Although the private secondary school system provides a mechanism of social privilege in the UK, there is, even with incomplete data, an obvious over-representation of protestant (i.e. low church and non-conformist) backgrounds, reflecting the pattern noted by Hagen[13] among the leading innovators of the British Industrial Revolution. Thus if social privilege plays a role, it does so rather selectively, in ways which it seems we should relate to 'cultural advantage' – a concept that needs to be enlarged upon in developing a 'psychology of achievement'.

In line with this notion, the evidence on family cultural factors in scientific achievement in the present data points strongly to the great importance of religious 'core values' discussed by McClelland in his

'psychologising' of the Protestant Ethic notion. These cultural values include stress on the value of education and knowledge for their own sakes, and have little to do with religious belief or observance as such, surviving secularization over generations. A model figure may again be an important element in transmitting such values.

If the interpretations drawn from the data are substantially correct, the pattern of social origins of eminent scientists should be unlikely to change radically with the spread of opportunity in education and general rise in living standards. A comparison of distribution of fathers' occupations for those laureates born before 1914 and those born between 1914 and 1935 in the UK and the USA (the only countries with a substantial number of post-1914 winners) gives no indication of change (Table IV) except among American Jewish laureates, who show an *increasing* socio-economic

TABLE IV *Changes in social origins of Nobel Scientists: percentage breakdown of fathers' occupational class for laureates born before and after 1914. (a) Gentiles (USA and UK); (b) Jewish Laureates (USA only)*

	(a)		*(b)*	
	Pre-1914	*Post 1914*	*Pre-1914*	*Post 1914*
Professional	58.2	58.1	7.6	38.5
Business	26.4	22.6	57.1	53.8
Employees	9.1	9.7	14.3	7.6
Land	4.5	3.2	0.0	0.0
Others	1.8	6.5	14.3	0.0

In contrast to Table III, fathers dying during future laureate's childhood are included in the appropriate occupational categories.

status of the fathers between these periods. Although it may be argued that the impact of the extension of educational opportunity has been too recent to be reflected in this data, the rigidity of the pattern and the absence of differences between the USA and other countries is consistent with the 'caste' flavour of the data, and the fact that the son's performance is related to particular parental religious and occupational backgrounds.

The main change that has occurred over the years has been the demise of a number of countries as contributors to the ranks of the Nobel Scientists. Once-fruitful European regional sources such as Paris, Berlin, Silesia and Vienna have proved notably vulnerable to social and historical change. The distribution of years of birth of the laureates provides a picture which is discouraging for every major country except the USA. Compared with 17 Nobel scientists born since 1920 in the USA, the UK has so far had 3, and Germany 2.

Post-1930, the corresponding figures are 10, 1 and 0. Even in the USA the output remains dependent on two geographically and culturally circumscribed sources; Jewish New York and the small-town protestant Mid-West. Hence, both scientific theories of achievement and national planning in science should take account of the very narrow cultural base on which major contributions to science rest.

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NOTES

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