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BIOLOGICAL ASPECTS OF A HIGH SOCIO-ECONOMIC GROUP

I. IQ, EDUCATION AND SOCIAL MOBILITY

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Summary. Data are presented on the social backgrounds and IQs of a sample of scientists, their male sibs and their fathers. The range of IQ in the scientists is similar to the range of scores expected of the higher 25% of a representative general population sample.

The IQs of the scientists showed a positive correlation with social class. Differences in IQ between the scientists and their fathers in each social class are related to the distance the scientists have moved up the social scale. In the twenty-two families in which the IQs of the father and two male sibs are known the upwardly mobile sibs tend to have higher IQs than the non-mobile or downwardly mobile sibs.

In Class II there is evidence that stabilizing selection operates on IQ to maintain the mean IQ level. The effect on social stratification of such selection, together with increased educational opportunity, is discussed.

Introduction

Few data are available, either in the United States or in the United Kingdom, that are suitable for detailed analyses of changes in family structure in relation to occupation or IQ in any social class. Demographic data obtained from the Census are not always suitable to answer many questions of socio-biological significance.

Previous studies (Gibson & Young, 1965) have related IQ to inter-generational mobility and fertility in small samples of the general population in which the representatives of any one socio-economic class were too few in number to provide detailed information about a particular class. Larger samples were required from single socio-economic groups and this and a subsequent paper will describe some of the factors of socio-biological significance in a non-manual socio-economic group.

The Registrar General's Class I, which includes all professional people, was chosen because of its particular socio-economic significance and because recent evidence (Bajema, 1963; Gibson & Young, 1965) had suggested that the mean family size in this class had been increasing during the last 10 years. A practical reason was that it is much easier to identify and obtain samples of professional people than of any other socio-economic group.

The sample and methods

To minimize geographical heterogeneity, the sample was restricted to male teaching officers and holders of posts in science departments of the University of Cambridge. In order to ensure that a reasonable proportion of the parents of the sample would be alive and amenable to IQ tests, the age range was restricted to exclude those scientists who were 35 years or older. This restriction produced a possible sample of 185. The actual sample for some observations was less than this but never below 80% of the possible sample. It is recognized that extreme caution must be exercised in extrapolating from these results to Class I generally as there are wide variations in many parameters over geographical regions.

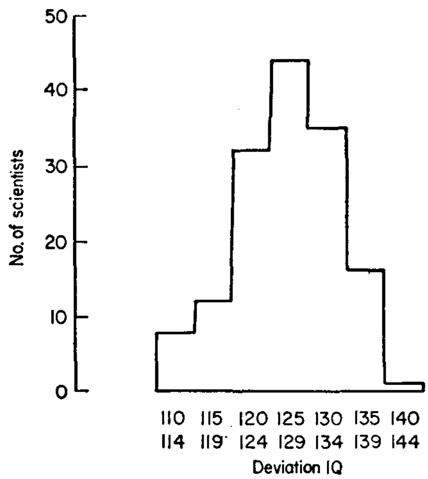
Table 1. Composition of the samples

Breakdown of sample	Scientists	Fathers	Brothers
Total in sample	185	116 (alive)	102 (alive)
Number interviewed	157	80	52
Reasons for omission			
Abroad	13	11	21
Indisposed	—	5	—
Refused	15	10	21
Addresses not available	—	10	8
% of possible sample	84·8	68·9	51·0

In addition to the index sample, data were also obtained by interview from the scientists' male sibs and their fathers. The total number of these relatives generated by the sample and the proportion of refusals for each group (Table 1) show that the data may be biased because of a varying response to the inquiry amongst the relatives. The directions of possible bias are difficult to estimate but it was noticed that the active professional fathers were less willing to co-operate in the work. However, the possible biases apply only to the IQ data, for much of the other information about relatives was obtained from the scientists themselves if relatives were not interviewed.

The overall response was high in view of the detailed information required from each member of the samples.

The intelligence test used was the Wechsler Adult Intelligence Scale (WAIS) (Wechsler, 1955). The WAIS was chosen because it was a general purpose test extensively used for measuring the IQ of adults. The test has verbal and performance components and is divided into eleven sub-tests. None of the sub-tests measure a particular quality but rather a wide spectrum of abilities that overlap to varying extents from one sub-test to another. It was, in fact, this diversity which rendered the WAIS particularly useful for the present study.



TEXT-FIG. 1. IQ distribution of scientists.

The scientists were within one of the standardized WAIS age ranges, but the IQ scores of some of the scientists' brothers and all their fathers were adjusted for age differences on the Wechsler scales.

Results

IQ levels amongst scientists

The scientists' IQ scores ranged from 110 to 141 with a mean of 126·5 and a standard deviation of 6·3 IQ points (Text-fig. 1). There were significant differences in mean IQ between scientists in different disciplines and between mean IQ and class of bachelor degree. These aspects of the data have been discussed in detail elsewhere (Gibson & Light, 1967).

Educational background of the scientists

Fifteen per cent of the scientists had IQs below the level of 118, usually considered to be the borderline between a pass or fail in the 11+ examination. Some of the sample had, in fact, fallen at this hurdle and later obtained university entrance qualifications by less orthodox routes. Some 64% of the sample had passed the 11+. Most of the remainder had received their secondary education at independent schools, although many of these had taken the Common Entrance Examination. Twenty-eight per cent of the scientists who were educated in the United Kingdom attended independent schools, 9% direct grant schools and 56% state maintained schools. In addition, 6·8% attended Scottish schools. The mean IQs did not differ significantly between any of these schools (Table 2). Sixteen scientists received part of their

Table 2. IQ and educational backgrounds of the scientists

Type of school	*n*	Mean IQ	
State	(a) 25	127·89	$0.01 > P > 0.001$
	(b) 47	123·96	
Failed 11+	2	119·5	
Independent	(a) 5	128·2	
	(b) 1	124·0	
Common entrance	(a) 28	128·96	
	(b) 3	121·66	
Grant-aided	(a) 6	129·0	
	(b) 6	128·16	
Scottish	(a) 3	131·0	
	(b) 6	127·0	
Educated abroad	16	120·38	

(a) Cambridge graduates 128·42 }
(b) Non-Cambridge graduates 124·60 } $P < 0.001$

education abroad and their mean IQ was significantly lower than the IQ of those educated entirely in this country. This probably reflects cultural bias in the WAIS.

Eighty-nine of the scientists had Cambridge bachelor degrees and the mean IQ of the Cambridge graduates was, at 128·4, significantly higher than the mean IQ of the non-Cambridge graduates, 124·6. Although, for each type of school background, the Cambridge graduates had a higher mean IQ than non-Cambridge graduates the difference was only significant for scientists from State schools. As the selection intensity for Cambridge entrance is greater than for most other universities this result is not surprising. It may be that the Cambridge selection systems give more weight than those of other universities to abilities represented in the WAIS.

IQ and class

The IQ of the scientists was related to the socio-economic class into which they were born (Table 3). The present or last full-time occupation of the scientist's father was taken as the scientist's initial occupational class. For the most part this was the occupational class into which the scientist was born. A similar convention has been adopted in determining the scientists' male sibs initial occupational class. Agricultural subdivisions of the Registrar General's Classifications (1966) have been ignored as the numbers in these subdivisions were very small.

The overall regression coefficient between the scientists' IQs and their initial occupational classes (b = 0·34) was positive and significant (0·01 > P > 0·001). The scientists whose fathers were in Class I had significantly higher mean IQs than

Table 3. IQs of scientists and their fathers in different socio-economic classes*

Occupational class of father (scientist's initial class)	n	Scientists' mean IQ	Standard deviation	Fathers' mean IQ	Standard deviation
Class I	18	129·7	4·24	130·16	8·00
Class II	36	128·6	6·25	122·6	10·90
Class III NM	12	125·66	5·97	121·58	9·08
Class III M	10	123·4	5·93	113·1	10·72

* Where IQ of scientist and his father are known.

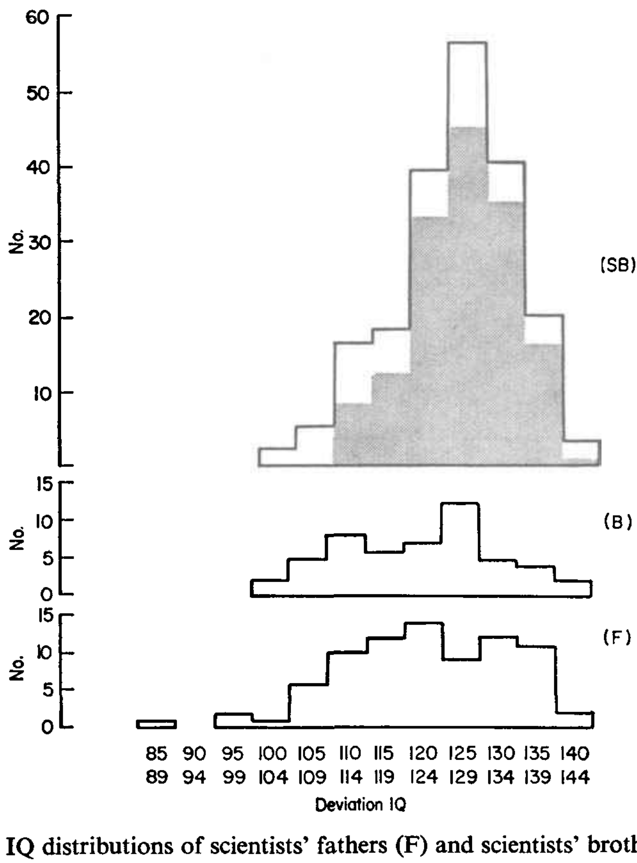
those whose fathers were in Class III non-manual or Class III manual occupations (0·002 < P < 0·01). Scientists from manual backgrounds had the lowest mean IQ. The relationship between social background and IQ is well known (Douglas, 1964; Floud, Halsey & Martin, 1956), so that it is not surprising that vestiges of the effect remain in this highly educated and selected sample.

The mean IQ of the scientists' fathers who were tested was 121·69 with a standard deviation of 10·9 IQ points. The fathers were not as homogeneous in age as the scientists and their IQ scores (Text-fig. 2) have been adjusted for age differences.

The fathers' mean IQ was significantly lower (0·02 > P > 0·01) than the mean value for the scientists and the fathers' scores had a significantly higher variance. However, as the fathers were in a greater variety of occupations in both manual and non-manual socio-economic groups than the scientists, this increased variance and lower mean was expected. The regression coefficient between fathers' IQ and social class (b = + 0·45, P < 0·001) was smaller than the values usually observed for this relationship in less selected samples (Burt, 1959; Anastasi, 1959). It was interesting that the variances of fathers' IQ scores were similar in each socio-economic class.

Parent–sib correlation

The overall correlation coefficient between the IQs of scientists and their fathers was lower ($r = 0{\cdot}37$, $P < 0{\cdot}001$) than the value often quoted for parent–child correlations for this trait (Erlenmeyer-Kimling & Jarvik, 1963). However, parent–sib correlations were not the same in each class (Table 4). In Class I the correlation was small and negative, whereas in Class III non-manual the correlation was



TEXT-FIG. 2. IQ distributions of scientists' fathers (F) and scientists' brothers (B). The combined distribution of the scientists and their brothers is shown in SB in which the shaded area represents the IQs of the scientists.

+0·47. In the manual Class III the correlation was also small but this is likely to be due to the biased sample of sons.

The data emphasize the variation that can occur in the relationship between parent and offspring IQ. Although the overall estimate of heritability of IQ in this sample is 0·74, the heritability is different in each of the four classes represented, varying from 0 to 0·94.

Table 4. Parent–sib correlation coefficients for IQ in different socio-economic classes

Socio-economic class	Correlation coefficient 'r'	Probability
Class I	−0·14	$0{\cdot}5 < P < 0{\cdot}7$
Class II	+0·31	$P < 0{\cdot}001$
Class III NM	+0·47	$0{\cdot}1 < P < 0{\cdot}2$
Class III M	+0·22	$0{\cdot}5 < P < 0{\cdot}7$

IQ of scientists' sibs

The scientists' sample generated fifty-two male sibs who were given the WAIS test. These brothers had a mean IQ of 121·7 with a standard deviation of 10·5 IQ points (Text-fig. 2). The brothers' mean IQ varied with their initial social class (Table 5) and the regression coefficient between IQ and class was +0·33.

The brothers' mean IQ was lower in each socio-economic class than the mean IQ of the scientists in the class, but the differences were not significant in Class I ($P > 0{\cdot}1$) or in Class III manual ($P > 0{\cdot}2$). These data suggest, therefore, that the scientists' sample was unrepresentative of the male children produced by their parents in terms of IQ but not as unrepresentative as might have been expected.

The combined distributions of the IQs of the scientists and their brothers (Text-fig. 2) shows that the relative proportion of scores between IQ 120 and IQ 134 is greater than for the fathers' distribution. However, the fathers' mean IQ (121·69) is not significantly different ($P > 0{\cdot}05$) from the joint mean IQ of the scientists and their brothers (124·1) and neither are the variances of scores significantly different. This result is surprising, for, as the fathers were born into a greater variety of socio-economic groups than the sons, the environmental component of the variance of their IQ scores might be expected to be larger than for their sons' scores.

Table 5. IQ of scientists' brothers by their initial socio-economic class

Occupational class of father (scientists' sibs initial class)	*n*	Mean IQ	Standard deviation
Class I	19	125·84	9·67
Class II	23	120·83	9·94
Class III NM	4	113·25	10·44
Class III M	5	116·8	12·09

Although the sons were selected from a highly educated population, the evidence suggests that the educational and economic factors favouring the sons has not altered their overall IQ level relative to their fathers. However, it must be remembered that the fathers are specially selected as fathers of scientists.

Social mobility

Over 87% of the scientists were born into non-manual social backgrounds, whereas 72% of the population reaching degree level of education have non-manual fathers (Robbins, 1963). Thus, the 27% of the population reaching degree level which originates from manual social classes is poorly represented in the scientists' sample (Table 6). When comparing these figures it must be borne in mind that approximately 64% of the population of the United Kingdom is classified as manual on the Registrar General's scale (1966). Only 1·3% of the scientists were born into the Classes IV and V and 11·45% into the manual Class III. However, there was a considerable amount of upward mobility in the scientists' generation because less than 30% of the scientists were born into Class I which is their present socio-economic class. The remainder, 70·5%, have moved into Class I from lower down the socio-economic scale (Table 6). The largest proportion of scientists originated in Class II containing the clerical, lesser managerial and semi-professional occupations. The data suggest that the differences in educational opportunities between the scientists and those of their fathers' generations have had little effect on upward social mobility. Of the scientists' fathers who were in Class I, 27·8% had been born into the class and 72·2% had moved up from lower strata (Table 7).

Table 6. Social mobility of scientists*

Occupational class of father (scientists' initial class)	Scientists by fathers' occupational class (%)		General population reaching degree level by their fathers' occupational class (%)
Class I	29·5		21·4
Class II	42·95	70·5	41·4
Class III NM	14·8		9·8
Class III M	11·45		21·4
Class IV and V	1·3		5·9

* Socio-economic classification of the scientists according to their fathers' occupational class compared to the classification of that part of the general population reaching degree level.

These values are remarkably similar to those found in the scientists' generation. It is clear that a considerable amount of social mobility occurred in the fathers' generation and it is particularly interesting to note how the mobility patterns vary from one class to another. Nearly half of the fathers in Class II were born into the class, whereas only 7·2% of the fathers in the non-manual Class III had moved neither up nor down relative to their fathers' class. Of all the fathers, only 32% had remained in the class into which they were born. These data agree with the high rates of social mobility found in numerous other studies in many different countries which have been shown to be very similar over space and time (Glass, 1954; Lipset & Bendix, 1960).

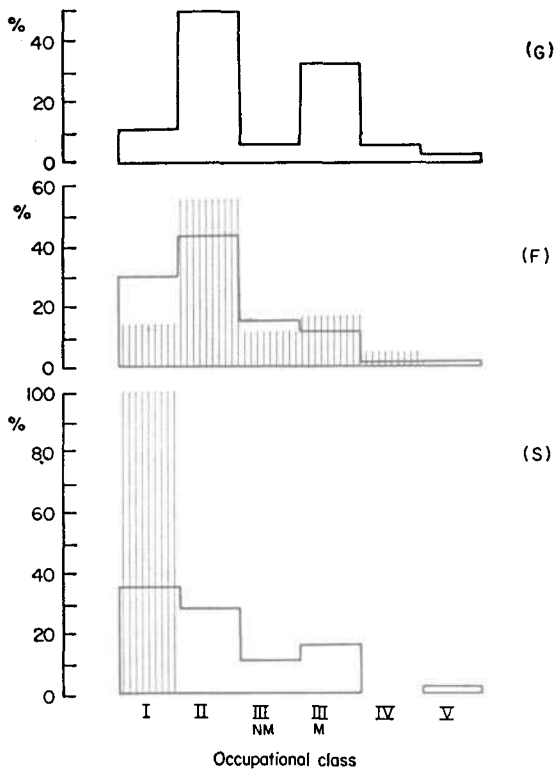
Table 7. Social mobility of scientists' fathers*

Occupational class of father	Social mobility (%)		
	Up	Down	Stationary
Class I	72·2	—	27·8
Class II	45·8	11·8	42·4
Class III NM	64·3	28·5	7·2
Class III M	18·8	56·2	25·0
Means	50·3	(32·2)	25·6

* The percentage of scientists' fathers in each occupational class that were born into the class, moved up or moved down relative to the scientists' paternal grandfathers' occupational class.

The sample of scientists is biased because all the members are in Class I and thus, unless they were born in Class I, the data represent only upward mobility. However, the scientists' brothers were also classified for occupational status together with the scientists' paternal uncles and grandfathers. Consequently, it is possible to compare the proportions of each of these three generations in each socio-economic class (Text-fig. 3). The distributions for the fathers' and grandfathers' generations are very similar and show that, in each case, 50% of the generation were in Class II and 11% were in Class I. In both samples the proportion of manual occupations is much less than would be expected on the basis of the national proportions. The non-manual occupations, with the interesting exception of Class III, are over-represented compared to the national figures. However, the social class distribution of the scientists' fathers is significantly different from that of the scientists' paternal uncles ($\chi^2_4 = 15{\cdot}35$, $0{\cdot}01 > P > 0{\cdot}001$) and thus the scientists' fathers are not a representative sample of the male children produced by the scientists' grandfathers. It is clear that in selecting a highly educated group the study has tapped a section of the population with a high rate of upward mobility over two generations.

Although insufficient data were available to compare the occupations of the scientists' male paternal cousins, it seemed that their mobility was nearly as striking as that of the scientists and their sibs. This mobility has led to the depletion of the manual representation of these families. Thus, whilst 42% of paternal grandfathers were in manual occupations, only 16% of their male children were in manual occupations.



TEXT-FIG. 3. The occupational class distributions of the scientists' paternal grandfathers (G) and the scientists' fathers and paternal uncles (shaded area), F. The lower figure, S, shows the present occupational class of the scientists (shaded area) and their male sibs.

IQ and social mobility

Although the combined social class distribution of the scientists and their brothers is very different from the social class distribution of their fathers (Text-fig. 3), it has been shown above that the means and variances of the IQ scores of the two groups are not significantly different. These comparisons would suggest that, overall, IQ has little significance for social mobility in this material. However, a more detailed analysis shows that the social mobility of the scientists is related to IQ.

Table 8. Mean difference in IQ between scientists and their fathers in each occupational class*

Occupational class of father (scientists' initial class)	Mean excess in IQ of scientists compared to their fathers
Class I	+0·16
Class II	+5·2
Class III NM	+5·8
Class III M	+8·0

* Excluding agricultural occupations.

A comparison of the IQ of each scientist and his father in each socio-economic class shows that the mean difference in IQ between the scientists and their fathers is related to the distance the scientists have moved up the socio-economic scale (Tables 8 and 9). The smallest mean difference in IQ is found for scientists born into Class I and the largest difference is for scientists who have moved from Class III manual. As the scientists are all in Class I and as there is a positive correlation between IQ and occupational class this relationship is expected. A similar relationship exists for the scientists' brothers.

However, a more precise examination of the relation of IQ to mobility can be made, for the material provides twenty-two families in which the IQ of the father and

Table 9. IQ and social mobility of scientists and their brothers in each occupational class

Occupational class of fathers	Fathers' mean IQ	Sons' mean IQ and subsequent mobility	
Class I	127·8	129·6	stable
		129·7	moved down
Class II	121·45	128·6	moved up
		120·8	stable
Class III NM	117·0	118·5	moved up
		—	stable
		99·0	moved down
Class III M	111·5	121·6	moved up
		101·0	stable
		—	moved down

the IQ of at least two sons is known. From these data it is possible to compare the IQs of the mobile and non-mobile sons with their fathers' IQ in each of these families. These data (Table 9) show that in each class the upwardly mobile sons have a higher mean IQ than the non-mobile or downwardly mobile sons. But the mean IQ of sons born into Class I who subsequently move down the socio-economic scale is not lower than the mean IQ of sons who remain in Class I. However, the majority of these sons have moved only down one class, to Class II, and might not be expected to have much lower IQs than their non-mobile sibs.

A more critical test of the significance of IQ for mobility is to compare the mobility and IQ of the scientists' sibs in relation to the scientists' IQ. Thus, within

Table 10. IQ and social mobility of scientists' brothers*

Social mobility	IQ level of scientists' brothers relative to scientists' IQ		
	Higher	Lower	Same
Moved up	11·3	6·8	—
Stable	13·6	12·0	2·3
Moved down	6·8	31·8	2·3

* Social mobility of scientists' brothers relative to their fathers' occupational class as a percentage of the total number of brothers.

each of twenty-two families, the mobility of brothers can be compared and related to their respective IQs. The results (Table 10) show that 31·8% of the scientists' sibs had lower IQs than the scientists and moved down the social scale compared to the class into which they were born. Of these brothers, 13·6% had higher IQs than their scientist brothers but were not socially mobile. But, again, the majority of these non-mobile sibs, in fact, stayed in Class I. Of the brothers who had lower IQs than their scientist brother, 25% remained in the same class. The relationship between mobility and IQ is far from being complete, as 6·8% of the brothers had higher IQs than the scientists but, nevertheless, were downwardly mobile.

The overall effect on the population of the relationship between IQ and mobility can be seen by comparing the sons' IQ distribution within any class before and after social mobility has occurred. By this means it is possible to obtain some idea of the kind of selection processes operating on IQ in the population. Mather (1943, 1953, 1955) and Thoday (1959) have discussed the phenotypic and genotypic consequences of various forms of natural selection on quantitative characters and Karn & Penrose (1952) have demonstrated the effect of stabilizing selection on birth weight in human populations. Stabilizing selection, which occurs when selection favours individuals near the mean in a population, will reduce the variance of a character in the population. Thus, in each generation of stabilizing selection, the individuals at the extremes of the distribution are selected against. Social mobility might operate as a stabilizing mechanism on IQ within a socio-economic class by removing the individuals with extreme IQs from the class. If this was happening then the variance of the IQs of sons within a class would be reduced by social mobility although the mean IQ of the class may not necessarily change. The data for all scientist–sib pairs in each socio-economic class were analysed in this way. The data (Table 11) show that in both Class I and Class II the variance of IQ scores was reduced by social mobility. In Class III, however, the IQ scores of the non-mobile sons had a larger variance

Table 11. Effect of social mobility on the variance of IQ of the scientists and their brothers

Occupational class of fathers	Variances				F	Probability
	Before mobility	df	After mobility	df		
Class I	60·17	34	50·08	24	1·2	$P > 0·05$
Class II	453·4	39	71·55	9	6·33	$0·01 > P > 0·001$
Class III NM + M	98·4	15	141·3	3	1·4	$P > 0·05$

than the IQ scores of all the sons born into the class. The only significant variance ratio is that for Class II which suggests that IQ in this class may be under stabilizing selection. Of course, the data are not ideal for this kind of analysis as upward mobility is probably over-represented in the sample of sons. In addition, any reduction in variance after mobility in Class I is dependent solely on downward mobility, and thus the reduction of variance in this class would not be expected to be as large as any change in Class II. All but one of the non-mobile sons in Class III had lower IQs than their upwardly mobile sibs and none of the sons born into Class III subsequently moved down. So, in this material, it is only for Class II that evidence for stabilizing selection was as expected. The variance comparison complements the mean IQ comparisons in confirming that IQ does affect social mobility.

Discussion

The results described in this paper are consonant with those Young & Gibson (1963) obtained in a small pilot survey of a general population sample. They found that the extent to which sons moved from the class into which they were born was related to the difference between their IQ and their fathers' IQ. Sons with higher IQs than their fathers tended to move up the socio-economic scale, sons with lower IQs generally moved down. However, the correlation between IQ and class in the general sample was larger than the same correlation in the present material. The range of IQs of the scientists was larger than expected for this highly educated sample and, in contrast to popular belief, was similar to the IQ range of the top 25 % of a general population sample. With such a range of scores within the highest socio-economic class it was surprising that the results showed a marked relationship between IQ and mobility. Only a relatively small proportion of the mobility in the scientists' generation was inconsistent with IQ, although, of course, IQ is not an adequate measure of all the abilities required for social promotion.

As far as I know this is the only study in which social mobilities and IQs have been compared for more than one son in a family. Such comparisons introduce further difficulties because it is clear that birth order is implicated in social mobility as the scientist sons were the first born much more often than would be expected by chance alone. This aspect of the problem will be considered in detail in a later paper.

Further difficulties arise because the scientists' mobility is complete, whereas that of most of their brothers may not be. Hence, some of the present non-mobile brothers may change occupations and move up or down the socio-economic scale. Similarly, mobile brothers may also change their social class in either direction and all these subsequent changes may not be as consistent with IQ as their earlier mobility. Only long-term follow-up studies would answer these questions, and even then changes in social structure would seriously affect the results.

In spite of these problems there is now a considerable body of evidence for a fairly close relationship between IQ and social mobility. Because of the biased sample of sons it is not possible from the present data to estimate the proportion of social mobility that occurs due to differences in IQ. Anderson, Brown & Bowman (1952) estimated that at least a third of the mobility of sons out of the class into which they were born was due to differences in IQ between sons and fathers. Such estimates are made by comparing the regression coefficient of IQ on occupation for a sample of fathers with the coefficients obtained for their sons before and after mobility has occurred. The ideal situation is envisaged as one in which the relationship between IQ and occupation is restored to the level of the fathers' generation after the mobility of sons. Much of the discussion of this type of analysis is concerned with the so-called optimal use of intelligence in the population in which the ideal correlation between IQ and occupation approaches unity. It is clear that the closer the relationship between IQ and occupation the greater must be the inter-generational mobility to maintain the position with a parent–child correlation for IQ less than unity. The regression analyses have usually been carried out on representative samples of the general population and have assumed that parent–child correlations will be the same in each socio-economic class. The present data suggest this assumption is invalid for there are striking differences between the social classes in

IQ correlations. The relationship between IQ and mobility may vary from one class to another and it is unrealistic to suppose that IQ will have the same significance in each class.

Increased educational opportinity in the lower classes will tend to increase inequalities of ability between classes and thus the stratification of society into ability levels will be more marked (Dobzhansky, 1962). The evidence that stabilizing selection for IQ is operating in Class II is particularly interesting for it implies that social mobility may lead to the maintenance of mean IQ within a class rather than a directional tendency to increase the mean. This situation is similar to the models proposed by Hirsch (1958) and Young & Gibson (1963) in which social mobility was envisaged as a mechanism for maintaining stability of social structure.

In conclusion, it must be re-emphasized that this material was biased due to the initial sample, and only further studies on Class I and other groups will indicate the extent to which these conclusions apply to the general population.

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