

# INTELLIGENCE AND FERTILITY

## The Scottish 1947 Survey \*

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WHEN this lecture was written for delivery to a Members' Meeting of the *Eugenics Society* I was unaware that it was the custom to publish such lectures in the REVIEW. Before consenting to its publication I have obtained the consent of the Scottish Mental Survey Committee, and of the principal co-workers whose results are mentioned. But I have asked that the diagrams shown at the meeting should not be reproduced, for they should be accompanied by much more detail than I could give in a talk. Their general nature is easily grasped from the context.

I had some hesitation in accepting the invitation to address you on the Scottish Survey to-night, and that for two reasons: One meeting of Section J of the British Association at Newcastle dealt with this matter, and I feared that another meeting might be superfluous. And secondly, I am only the chairman and leader of a band of people whose work enables me to give this lecture whatever interest it may possess, and I do not wish to usurp their claims in any way, or to anticipate the publication of their full papers. However, I felt that courtesy and gratitude to the *Eugenics Society* demanded my personal report, and so here I am.

I would like to speak for a comparatively brief period and thereafter answer questions and hear, I hope, criticism and advice.

### The Scottish Mental Surveys

May I first remind you briefly of the main results of the repetition in 1947 of the Scottish Mental Survey of 1932, results already published in my article in *The Times* of November 17th, 1948, and with

full details in the Survey Committee's first report, *The Trend of Scottish Intelligence*.\*

Both in 1932 and in 1947 we tested a complete age-group of Scottish eleven-year-olds. In 1947 the Registrar-General's estimate of their number was 80,300. Of these, the Survey schedules were completed for about 95 per cent, and the group test score was recorded for 70,200, those missing being mainly the absentees on the days of the test. This was about the same proportion as in the early Survey, or a trifle better. The group test was exactly the same in both Surveys.

Two random samples of the children were chosen to give further details: the 36-day sample and the 6-day sample—the latter being part of the former. The 36-day sample was composed of all the children born on the first, second, or third day of any month in 1936, who were visited in their homes; the 6-day sample was those born on the first day of the even months. Most of the extra information I have to give you now, over and above what has already appeared in print, will concern the 36-day sample of over 7,000 children.

### Group and Individual Testing

The steep descent of average score in the group test with larger and larger families was fully confirmed, both in the group testing of the 70,200 children and in the individual testing, by the Terman-Merrill test, of the 6-day sample of about 1,200 carried out by Mr. Kennedy Fraser and numerous helpers. The graph showing the group test scores for different sizes of family is shown on several of the diagrams which have been distributed.† May I, in passing,

\* University of London Press, published on August 19th, 1949.

† It is shown on p. 108 of the published *Report*.

\* A paper read before the *Eugenics Society* on October 25th, 1949.

ask for *all* these diagrams to be returned at the end of this meeting, partly because I want to use them again, and partly because I do not want any premature publication of the details shown on them.

In spite of this apparent multiplication of the less intelligent, there was no evidence, in the average scores of all children in 1947 compared with 1932, of any general decline of intelligence. Indeed, the group test score in 1947 was actually higher than in 1932, 36.7 points against 34.5, out of a possible 76. The individual test scores were somewhat inconclusive because of the different forms used, the Stanford in 1932 and the Terman-Merrill in 1947; but a very careful statistical comparison which Dr. Fraser Roberts has carried out gives no reason for assuming any change in I.Q. either way.

### Intelligence and Family Size

We are left, therefore, with the apparent paradox that although the less intelligent seem to be multiplying more rapidly than the intelligent, yet the average intelligence does *not* seem to be sinking. Various hypotheses have been advanced to account for this, and one is already answered in the *Report*. It was the surmise that later born children in a family are progressively less intelligent, or tend to be. With our large numbers we could investigate this separately for each size of family, and found it unconfirmed. We are still enquiring into the reason for a *very slight* superiority of the first-born *and* last-born in each size of family, but this small difference is quite insufficient to account for the general drop in I.Q. as families of larger and larger size are considered.

### Influence of Environment

One obvious hypothesis is, of course, that the whole phenomenon is environmental in origin and that no selection is, in fact, going on. The suggestion in this hypothesis is that the large families are not unintelligent because they are in so many cases the families of unintelligent and thoughtless parents, but because their very size con-

stitutes a handicap. Other things being equal—for instance wages being equal in the two cases—the father of one or two children can give them better schooling, buy them more books, give them more room for private study, and supply better food, clothing and holidays than can the father of six. It seems indeed very probable, on general grounds, that these influences may explain at least part of the phenomenon, and a general improvement in welfare between 1932 and 1947 could explain the improvement in the group test score.

### Test Sophistication

There remains in the mind, however, an uneasy fear that environmental improvement may be only masking a hidden selection going on behind, a steady selection which might in the long run defeat any temporary environmental improvement. Especially is this fear increased by the possibility that the children of 1947, though perhaps less intelligent in reality than those of 1932, were more accustomed to tests and were thus able to make a better score. In short, were the 1932 children handicapped by unfamiliarity with test-procedure, and the 1947 children helped by being used to such questions? Tests have been widely used in the intervening years; and, moreover, newspapers, children's journals, school reading books, and the B.B.C. have all used freely the type of item which appears in a group test such as we used.

Some further as yet unpublished results lend some support to the view that test sophistication may explain the rise. Nine of the Scottish Education Authorities had used tests very little, while fourteen of them had used them a great deal, previous to 1947. Among the former, the 1932 and 1947 scores were 35.0 and 35.4, a very small difference. Among those where tests had been much used the rise was from 35.9 to 39.1, a significant improvement.

Mr. Maxwell has also examined the performance in the 1947 test of those boys and girls who had been subjected to a somewhat similar test earlier in the year, or in the previous year, by their Education Authority,

and finds that they get better scores than the others. But there is a serious snag here. For these pupils had been tested a year earlier than routine demands for reasons connected with their intelligence, either because they were put forward as precocious by their teachers, or because they were, on the contrary, backward and needed diagnosing. They were a selected group, and not a random sample of the whole.

We find such difficulties on every hand when we try to probe further into environmental influences. So often there is also conscious or unconscious selection.

### **The English Survey**

At this point I would like to interpolate some remarks about the English Survey, somewhat similar to the Scottish one, which has been carried out from Moray House by Mr. W. G. Emmett. The results of this Survey have not yet been published, but a paper by Mr. Emmett will appear soon.

The English Survey differed from the Scottish in several respects. It concerned only ten districts, and not the whole of England, and, furthermore, the time between the two tests was only about ten years and not fifteen as in Scotland. Also different tests were used in the different districts. 31,728 children were tested on the first occasion, and 28,505 on the second. The numbers were therefore about forty per cent of the Scottish numbers.

In one respect, which concerns what I was saying about test sophistication, the English Survey had the advantage over the Scottish one, for in England there is little or no reason to think that the children of 1947 were any more familiar with tests than their predecessors of a decade earlier had been. All the ten English areas had already used tests before the first of our Survey tests, in some cases for many years.

The general result from England is that the boys show a fall and the girls a rise, while both together show no change. As far as this evidence goes, therefore, it does not appear that a change in test sophistication explains the absence of a decline.

Let me now return to the Scottish investigation.

### **Intelligence and Social Class**

Another line of enquiry is to ask whether the negative association between family size and I.Q. is found within each social class, or whether it is only due to differences in test performance between social classes. There have been in the past enquiries which suggested even a positive connection among graduates of Harvard and Yale. But that was before intelligence testing was available. Where tests have been given to socially homogeneous groups, the negative association has usually, and as far as I know always, been found to persist. This is now fully confirmed by our Scottish data.

Mr. James Maxwell, one of the chief workers engaged on the analysis of the Survey data, who has already at the British Association quoted the figures I gave for the more and less sophisticated areas of Scotland—sophisticated I mean in the sense of familiarity with tests—has supplied me with preliminary figures for each occupational level of the 36-day sample, from some of which I have made the graphs on the sheets which have been passed round. It will be seen at a glance that in every case—with the possible exception of farmers, where the curve is irregular at its two ends—in every other case, I say, the graph descends at much the same slope as it does for all the 70,200 children. The numbers of cases are of course much smaller, for they refer only to the 36-day sample, and to separate occupations within that sample, so that zigzagging of some of the graphs is only to be expected.

The occupations of the fathers were ascertained by visitors to each home, some of them in very remote parts of Scotland. Very careful instructions were given to the visitors, and very few of the families declined to co-operate. These instructions were based on previous experience in other Surveys, and the questions aimed at ascertaining not only the generic name of the occupation, but the father's status in it. For example, an answer "engineer" is

insufficient, and the visitor asked further what kind of engineer, whether professionally qualified, and (if an employee) whether paid weekly or at longer intervals? The visitors were warned to make no enquiry about the actual salary or wage. The coding of the answers was done by Professor D. V. Glass, who has wide experience of such.

There is, of course, a general decline in average score from professional and salaried classes, through skilled manual workers, down to unskilled. The curves are at different levels on the diagrams in your hands, but the slope is everywhere similar. The general decline in the 70,200 children, while partly due to differences between occupational classes, is also clearly due in part to a decline in I.Q. with size of family *within* each class. The bearing of this on the environment *versus* heredity problem is not clear, but it seems at least to be consistent with the assumption of a genetic cause, the assumption that at least some selection is going on.

### Age of Mother

Among the facts ascertained about the 36-day sample was also the date of birth of the mother, and it was hoped that this might throw light on some aspects of the enquiry. There were 766 mothers born before 1900, 659 born after 1914, and over 5,000 born in between. Comparison of the two extreme groups showed that the children of the older mothers did better than those of the younger, 35.9 to 34.1. This superiority was found in each separate size of family, as one of the diagrams before you shows—and it also shows the usual decline in I.Q. with family size in both groups.

But it is unsafe to draw the naïve conclusion that the children of older mothers do better in tests, and wrong to take the inferiority of the younger mothers' children as evidence of a decline in the successive generations. For in the first place, the families of the younger mothers are quite likely to be incomplete, whereas those of the older mothers are almost certainly finished. The former families are possibly, therefore,

really large families not yet finished, potentially large families, one might say. The younger mother curve perhaps ought to be moved a place or two to the right, which would abolish the difference between the two curves. If this is the explanation, heredity rather than environment is supported. For the younger mother families are less intelligent, although *not yet* large.

### Occupational Status of Father

But other snags come to light when we examine the occupational status of the husbands. The higher occupational and social grades are much more represented among the husbands of the older group, in part, perhaps, because the young husbands had not yet had time to rise into salaried positions or to become employers rather than employees. But in part because the professional classes, who marry later, are simply not represented among these young parents. These young mothers had borne the child whom we tested at the age of twenty-two or earlier, and that is unusual in the higher occupational groups. The one cause suggests environmental, the other hereditary explanations. The whole comparison warns us how careful we must be not to jump to conclusions.\*

### Twins

We have not been able, or have not *yet* been able, to do anything towards separating fraternal from identical twins, except by considering the two groups of like-sexed and unlike-sexed twins, the latter being of course only fraternal, not identical. My present remarks, however, apply to the whole group of twins, of whatever sex.

In each size of family it will be seen that twins are inferior to the whole group of 70,200. This may be a fundamental fact due either to the setback of twinning, the greater nutritional handicap in the prenatal period, or some other cause. But it is

\* And later calculations, since I wrote the above, show that the mean score is higher in the groups between these extremes, the highest average being achieved by the children of mothers born in the years 1905-9, who were therefore from 27 to 31 when the tested child was born.

possibly fictitious, for there is definite statistical evidence in our data that the birth of twins tends to stop the growth of a family. Twins are often the last-born, no further pregnancies being adventured upon. Being the last-born ought not in itself to be a handicap, for I explained earlier that the last-born seems to share with the first-born a slight advantage, only very slight, but undoubted.

But if the twin birth puts an end to the family, which is, as it were, a "might-have-been-larger" family than it actually is, then possibly our family size in our diagrams is, for the twins, less than it *was* going to be; just as, in the case of the younger mothers, the size of family is in many cases no doubt less than it *is* going to be. So perhaps our twin curve needs also shifting to the right. I only labour this rather subtle and, you may say, very unreal point, in order to show what difficulties stand in the way of sharp and clearcut conclusions.

I have given the scores of the twins separately for each size of family, because the fact that their inferiority persists in each size disposes of another surmise, namely, that their inferiority in general average was due to the greater frequency of twins in large families. Clearly the chances of a twin birth are proportionately large in large families. But evidently, as the curves show, this is not the cause of the twins' lower scores.

Mr. Barclay, another member of our group, has analysed further this apparent defect of twins in the test score. He finds that it persists in every grade of occupation, at every age of mother, and whatever the density of the home may be (the ratio, that is, of persons to rooms).

He has, however, called attention to an apparent deficiency in ascertainment of twins in our enquiry. Assisted by officials of the Registrar-General's department, and beginning with the recorded number of twin births in 1936, he finds, on making allowance for mortality, etc., that we should expect many more twin pairs than

the 525 we have records for. This is being looked into.

### Physique and Family Size

Leaving now the twins, I turn to the connection, if any, between physique and size of family. Here Mr. Maxwell's sorting and calculating has barely begun. We have the weight of each child in the 36-day sample and have sorted out weight against size of family for the girls. There is a drop over the sizes of family 1, 2, 3 and 4, the mean weights being 72.0, 70.0, 69.0, and 68.2 lb. Thereafter, there is no steady change and for families of ten the weight is still 68.2 lb. There is a hint of nutritional influence in the first four numbers.

Again, we have information about the number of rooms and the number of residents in each home, and the differences in weight are in the direction we would expect. The average weights are, for the girls of the 36-day sample:

	Number	Mean Weight*
Less than 1 person per room	293	73.13 lb.
1 but less than 2    "   "	1,434	70.16   "
2       "       "    3       "   "	1,106	67.37   "
3 or more           "   "	654	65.93   "
	<hr/>	
	3,487	

It is sad to think that 654 of these 3,487 girls live in such overcrowded homes, and are, possibly in consequence, half a stone lighter in weight, on the average, than the 293 who have abundant space, and probably other advantages.

### Differential Birth-rate and Intelligence

One of the theories put forward to explain the absence of a decline of intelligence despite a differential birth-rate is not environmental, but purely genetic. Professor Penrose has illustrated this possibility by constructing a highly simplified model of a population in which these phenomena could coexist. Fundamentally, such theories depend on postulating a very low birth-rate for parents of the very lowest intelligence,

\* I must emphasize that these are preliminary figures and that checking and counter-checking, still going on, may lead to some changes, but not probably to large changes.

and they arrange the proportions of each level of intelligence so that equilibrium continues from generation to generation. It is a fact that human beings of the very lowest levels of intelligence leave few or no offspring. In many cases they are physically incapable, in many cases they are confined in institutions, in most cases they are extremely unattractive in appearance; and in other instances they do not come to maturity, are possibly even still-born. Whether their numbers are sufficient to balance the differential shown by our curves I do not know. It would be an interesting and useful task for someone to estimate their numbers, and to consider whether this reversal of the differential birth-rate at the low end of the scale of intelligence can in fact cause the average to remain constant.

### Position in Family

Perhaps, since time permits, I may at this point return to the question of the association, if any, of intelligence with position in family. In our *Report* there are given the mean intelligence scores for each position in each size of family, and to illustrate what I am going to say I have had these figures passed round for families of four and of seven:

Position	Number	Mean
1	2,612	36.15
2	2,855	34.63
3	2,908	34.40
4	2,567	36.31
	<hr/> 10,942	<hr/> 35.32

Position	Number	Mean
1	154	31.48
2	293	30.40
3	517	27.79
4	570	29.81
5	617	27.61
6	584	28.81
7	607	32.04
	<hr/> 3,342	<hr/> 29.45

You will see in these figures the phenomenon I mentioned earlier in passing, namely, that in each size of family the *first-born and also the last-born* scores rather more than the children in between. This is found in

every size of family except size eight, where the first-born is not so good. For the first four families the advantage of the first-born and the last-born is definitely highly significant in the statistical sense. For larger families, where it is still found, there comes in a difficulty of selection of the sort I have already said queers so many of our calculations. It will be remembered that all our children are aged eleven. The early positions in very large families are therefore impossible, and even in the families of size seven you will see that the first and second positions are insufficiently represented. The 154 in the first position, being eleven years of age and having six younger brothers and sisters, are members of families where the children have come very close on each other's heels. Yet these 154 get a better average score than the average member of a family of seven. It is all very puzzling. Furthermore, there is a certain selection in the mothers of these children as we go from first-born to last-born. A mother whose son aged eleven is the last-born of a family of seven cannot be very young, whereas if he is the first-born she may be. The age of the mothers, in the family of seven in our table, probably increases steadily on the average as we pass from the first to the seventh position in the family.

All this makes the drawing of definite conclusions difficult, and I do not draw any at this stage. We are, however, very interested in the phenomenon and are keeping it in mind as we go on with our analyses. It is my experience in scientific work that when one comes across phenomena which puzzle, one is often on the verge of a discovery, and I hope it may be so in this case.

### Further Experiment

I would like, finally, to say something of our plans for further experiment. We hope in the first place that our Survey will be repeated, with improvements, in another fifteen or twenty years. And secondly, in addition to going on with the analysis of our existing data, we want to follow up the 1,215 children of the 6-day sample throughout

their whole lives, to see what a cross-section of the children of Scotland make of their careers. Terman\* of California has followed up about a thousand Californians from school to middle age, and a very interesting book his report makes. But his were all gifted children of high I.Q. Ours, on the contrary, are a fair sample of the whole range of intelligence from the lowest (except for the very mentally defective) to the highest. Their Terman-Merrill I.Q.s range from 173 down to 58. They are dotted over the whole of Scotland, in cities and on remote crofts and distant islands, and their parents are of all classes and many occupations. It will be a hard task to keep touch with them after the compulsory school age, but we intend to try to lose as few as possible. The Nuffield Trust has already given us a grant which will enable us to do the absolute minimum necessary to keep hold of them during the next five years. We could, however, make good use of more financial help, and if any of my hearers are in possession of great wealth, it would give me much pleasure to relieve them of some of it for this purpose.

#### DISCUSSION

Mr. JAMES MAXWELL said that he would like to comment on points that had occurred to him whilst handling the Scottish Mental Survey data. Sir Godfrey Thomson had referred to the paradox of a rise in the intelligence test score having been accompanied by a decline in average test score with increasing size of family. He appeared to favour the interpretation of this as a decline in the average intellectual level of the population which was being masked by an improvement in environmental conditions.

One thing that had impressed him, Mr. Maxwell continued, was the strong influence of environmental effects upon test scores. The children in 1947, for instance, had had more experience of mental tests than those in 1932; and it

was quite probable that this "test sophistication" would have been itself sufficient to account for most of the difference between the scores in the two surveys. Further, the relationship between test score and the socio-economic status of the home was very marked. Again, it was probable that the improvement in social conditions over the last few decades had had the effect of raising the national I.Q., as measured by tests.

It did not follow, of course, that this was necessarily counteracted by a corresponding decline due to the negative correlation between intelligence and size of family. There was evidence in the Report of the Royal Commission on Population that this differential fertility had existed since the middle of the last century, and probably earlier. Also, this tendency persisted in a remarkable manner through such environmental influences as parent's occupation, degree of overcrowding, and so on. It appeared likely that this might be a natural phenomenon not necessarily associated with declining intelligence. In the U.S.A., Tryon had divided white rats into two groups on the basis of their ability to learn a maze. Over some generations it had been observed that the "intelligent" group of rats had fewer offspring than the "dull" group. Unless we were willing to conclude that the intelligence of the white rat population was declining, we could not easily argue that the intelligence of a human population was declining.

PROFESSOR P. E. VERNON said that, to his regret, he had been associated only with some of the earliest stages of the Scottish Research Council's investigation. He could therefore, as an outsider, sincerely congratulate Professor Thomson and his collaborators on the brilliant work that had been described. In particular, it was a privilege for those present at to-day's meeting to hear of some of the results which might not reach publication for many months. As others would be better qualified to comment on the social and eugenic implications of Professor Thomson's paper, he would prefer to draw attention to some of the important advances in research

\* *Genetic Studies of Genius: IV. The Gifted Child Grows Up*. Stanford University Press, 1947.

techniques made by the Mental Survey investigators, advances which would be of the greatest value for further studies in this field. For example, proof had been provided of the effects of familiarity on group test scores. Professor Vernon pleaded guilty to having invented the term "test sophistication" in 1938. Members of the *Society* should certainly study the chapter by Dr. Fraser Roberts in *The Trend of Scottish Intelligence*. The way in which he bridged

the gap between the 1932 and 1947 group tests, via Stanford-Binet and Terman-Merrill individual tests, was a beautiful technical achievement. He had also established the important point that when the intelligence of two populations was to be compared, any group tests which correlated fairly highly with an individual test could be used, provided that the same individual test was given to samples of both populations.

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