cases, the newly isolated heart continued to beat in one direction during the first few hours, but eventually reversal started, at first at long intervals but with increasing frequency. The duration, in minutes, of alternate phases in two typical isolated hearts is given, both series being taken about eight hours after isolation. The figures in italic type are for the abvisceral phase, and those in roman type for the advisceral phase.

Specimen 1. *5 6 2 2 4 3 4 3 3½ 3 3 3½ 1½ 3 4½ 3½ 3 3½ 4*
Specimen 2. *1½* 6 *6* 13 *5* 16 *3* 14 *5* 10½ *5* 12 *1½* 14 *12½* 18½ *12* 8 *4½* 10½ *7*

In some of the preparations the wall of the heart was cut open to ensure that the pressures of liquid inside and outside were equal; in others the ends sealed themselves so that a constant pressure was maintained within the heart. In each kind of preparation periodic reversals were made.

The sequence of events during reversal of a weak and slowly beating isolated heart also shows that it is not back-pressure which stops the heart. There is a distinct pause between beats, and very little movement of liquid is produced. Nevertheless, such hearts still reverse, and it can be seen that, immediately before reversal, the hitherto quiescent end starts to beat in opposition to the dominant end, but only takes over control from the latter when, owing to its increasing rate of beat, it initiates a beat before the hitherto dominant end.

I conclude from these experiments that the back-pressure theory is untenable, and that there exists some internal controlling mechanism of the kind described by von Skramlik[2]. Periodic pressure changes may, of course, influence the behaviour of the heart in the intact animal, and may have some effect on the periodicity of reversal; but any such effect is superimposed on the pattern of reversal inherent in the heart.

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## Level of National Intelligence

The results of the Scottish Mental Survey[1] presented a paradox which has been difficult to resolve. These results showed a small rise in mean intelligence test score in the eleven-year-old population over a period of fifteen years; but they also established the existence of a negative correlation between intelligence test score and family size—a tendency for intelligent children to be found in small families—which implies the danger of a possible decline in national intelligence, in so far as intelligence is inherited. Though the existence of this negative correlation has now been established, its cause is the subject of considerable controversy, and predictions of the future level of national intelligence depend on how far it can be attributed to a limiting of families by intelligent parents or to the depressive effect of a poor environment on the test scores of children from large families.

The former cause is suggested by the results of previous investigations in which attempts to hold constant such factors as parental occupation or overcrowding in the home have failed to dispel the negative correlation; but such methods are not adequate if the actual size of family is itself an environmental factor—if the lack of adult contact and consequent retardation in verbal development suffered by a child from a large family depress the environmental component of his test score. Such a hypothesis has been shown to be tenable in a survey I have carried out of some 7,600 Aberdeen children; it is consistent with findings in other fields, for example, in the comparison of orphanage children and only children, in studies of bilinguals, deaf children and twins; and model populations can be constructed to show how, on such a hypothesis, the paradox of the Mental Survey results may be resolved, the observed rise being due to improved conditions or to a greater proportion of small families.

While the practice of previous investigators has been to apply one intelligence test to as large a group of children as possible, the method I followed in the Aberdeen survey was to apply several tests with different verbal loadings to the same children. In two groups each of some 2,500 children, aged eleven, the partial correlation between size of family and score in a test of English attainment (with intelligence test score held constant) was negative (about − 0·1) and significant in both groups at the 0·05 level. In a random sample of two hundred children aged eleven, the correlation between size of family and score in the non-verbal Matrices Test was − 0·20, while the correlation between size of family and score in a verbal Moray House Test was − 0·30, the difference being significant at the 0·05 level.

These results support the hypothesis that the environment of the large family constitutes a handicap to verbal development, and that this verbal retardation affects general mental development. If this were so, one would expect the negative correlation between intelligence test score and size of family to be more marked at later ages when the cumulative effect of environment begins to show itself; and this prediction was confirmed with tests applied at different ages. The correlation between intelligence test score and size of family in an age-group of 1,236 children aged seven was − 0·26; in a similar age-group of 1,270 children aged nine it was − 0·29; and in four such age-groups totalling 5,168 children aged eleven it was − 0·33. The difference between the correlation at age seven and at age eleven was significant at the 0·01 level, and was not attributable merely to incomplete families. In a group of 178 children who were tested at ages seven, nine and eleven, confirmatory results were obtained, though the difference between the correlations in this group was not significant because of the small numbers.

The results suggest that part of (but not all) the negative correlation of size of family and intelligence test score, such as was found in the Mental Survey among children aged eleven, may be attributed to the environmental influence of the size of family on verbal ability and through it on general mental development. Fuller details of the results and their analysis will be published elsewhere.

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[1] "The Trend of Scottish Intelligence" (London, 1949).