

According to the correct estimates of  $p$  and  $q$ , the expected frequencies of disomic, monosomic and nullisomic presented in Table 2 in our communication<sup>1</sup> will be as follows:

Types Chromosome No. (42)	Disomic (41)	Monosomic (40)	Nullisomic (40)	Total	$\chi^2$ (d.f. 1)
Obs.	13	43	58	114	
Exp.	9.66	48.28	56.06	114.00	1.80

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<sup>1</sup> Bhowal, J. G., and Roy Choudhury, A. K., *Nature*, **206**, 1067 (1965).

<sup>2</sup> Bhowal, J. G., *Canad. J. Bot.*, **42**, 1321 (1964).

with the stored trace. These findings, therefore, suggest that age-related impairment of long-term memory may be confined to situations which involve the retrieval of acquired material from storage.

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<sup>1</sup> Welford, A. T., *Aging and Human Skill* (Oxford Univ. Press, 1958).

<sup>2</sup> Jerome, E. A., in *Handbook of Aging and the Individual*, edit. by Birren, J. E. (Univ. Chicago Press, 1954).

<sup>3</sup> Inglis, J., *Nature*, **204**, 103 (1964).

## PSYCHOLOGY

### Memory Changes with Age

MANY studies have shown that increasing age results in a deficiency in ability to acquire new skills and information. However, the commonly held view that older people manifest an impairment in the retention of acquired material has received equivocal support from laboratory investigations<sup>1,2</sup>. Even Inglis's recent demonstration<sup>3</sup> of a loss with age in short-term memory is confined to an hypothesized storage system with a limit of approximately 4 sec. I wish to direct attention to the results of an experiment which suggests that the aged show special defects in the remembering of acquired material stored over longer periods of time. These defects seem to be due to a loss in ability to retrieve memories from storage rather than a deficiency in the storage system itself.

The material for the experiment consisted of two lists of 24 words. The words were presented on a screen at intervals of 4 sec. Memory was tested by the voluntary recall method on one list and the recognition method on the other list immediately after the last word on a list was exposed. For the recognition method, subjects were shown the 24 learning words, each in a group of four other words, and asked to underline those previously seen on the screen. One hundred and thirty-four subjects, aged between twenty and seventy-five, participated in the experiment, with approximately half the group performing the recognition test first, the others beginning with the recall test.

The scores showed no significant differences between results on the recognition test when this preceded or followed the recall test on the alternate list. Similarly, there was no difference between recall scores when these were obtained before or after a recognition test. The results on the two lists have, therefore, been combined.

Table 1 shows that there is no deterioration with age in the recognition scores, while there is a consistent drop in the recall scores. The differences between recognition and recall scores shown in the final column have a  $\rho$  correlation with age groups of +1.00. The Pearson product moment correlation between individual recognition minus recall scores and age is +0.66 ( $P < 0.001$ ).

The age disparity between recognition and recall scores cannot be due to a difference at the acquisition stage since this should affect both types of memory tests. The disparity must, therefore, be the result of the different demands of the two testing procedures. The psychological distinction between voluntary recall and recognition seems to be that the former requires retrieval from storage while the latter does not. In the recognition test, a response is provided and the subject needs only to match a stimulus

Table 1. MEAN RECOGNITION, RECALL, AND RECOGNITION MINUS RECALL SCORES BY AGE

Age range	No.	Recognition	Recall	Recognition minus recall
20-29	36	20.01	13.78	6.42
30-39	23	19.48	12.30	7.17
40-49	32	19.53	10.01	9.47
50-59	21	19.90	9.57	10.24
60+	22	20.09	7.50	12.59

## MISCELLANEOUS

### Ethology and the 'Baconian' Method

AMONG the many stimulating ideas elaborated by Sir Peter Medawar in his Presidential Address<sup>1</sup> to Section D of the British Association for the Advancement of Science is the claim that the foundation and subsequent development of what has come to be known as 'ethology' have "demonstrated the sterility of the old experimental approach" of test-stimulus and response, and illustrate "the danger of doing experiments in the Baconian style; that is to say, the danger of contriving 'experiences' intended merely to enlarge our general store of empirical knowledge rather than to sustain or confute a specific hypothesis or pre-supposition".

This rejection, by one with Sir Peter's authority, of the notion of a unique 'scientific method' applicable to all natural enquiry will fall gratefully on the ears of many. Nor can it be denied that the 'older experimental method' exemplified the weaker aspect of Bacon's incompletely worked out 'inductive method'. But does not Sir Peter imply a contrast that is in fact absent? For, in describing the 'new' and, in his view, effective ethological method, he says, "They [the pioneers of ethology] studied natural behaviour instead of contrived behaviour, and were thus able for the first time to discern natural behaviour structures or episodes—a style of analysis helped very greatly by the comparative approach." In the *Distributio Operis* prefixed to the *Instauratio magna* Bacon says, "all depends on keeping the eye steadily fixed upon the facts of nature and so receiving their images simply as they are. For God forbid that we should give out a dream of our own imagination for a pattern of the world."

That this ideal did not suffice to effect the so-called 'scientific revolution' is now abundantly clear; nor is it the method by which sciences greatly advanced by reason of their simplifying assumptions can be further enlarged. But, where an almost infinite number of possible variables leads to an almost limitless possibility of complexity, there is no alternative but to "sit down before facts like a little child" (Faraday)—but all the facts, in as great a variety of natural circumstances as possible. "Then, and only then", Sir Peter concludes, "was it possible to start to obtain significant information from the study of contrived behaviour . . . for it is not informative to study variations of behaviour unless we know beforehand the norm from which the variants depart." Being more interested in the "mastery of Nature for the relief of Man's estate", Bacon applied the method of comprehensive observation to the wrong data. But, so far from giving support to the now fashionable use of the term 'Baconian' as a wholesale term of disparagement, Sir Peter has shown how fertile, even indispensable, the 'Baconian' method may be in the appropriate context.

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<sup>1</sup> *Nature*, **207**, 1327 (1965).