LETTERS TO THE EDITORS

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Lung Cancer and Cigarettes?

The association observable between the practice of cigarette smoking and the incidence of cancer of the lung, to which attention has been actively, or even vehemently, directed by the Medical Research Council Statistical Unit, has been interpreted, by that Unit, almost as though it demonstrated a causal connexion between these variables.

The suggestion[1], among others that might be made on the present evidence, that without any direct causation being involved, both characteristics might be largely influenced by a common cause, in this case the individual genotype, was indeed rejected with some contempt by one writer[2], although I believe that no one doubts the importance of the genotype in predisposing to cancers of all types.

It seemed to me that although the importance of this factor had been overlooked by the Unit in question, it was well within the capacity of human genetics, in its current state, to examine whether the smoking classes to which human beings assign themselves, such as non-smokers, cigarette smokers, pipe smokers, cigar smokers, etc., were in fact genotypically differentiated, to a demonstrable extent, or whether, on the contrary, they appeared to be genotypically homogeneous, for only on the latter view could causation, either of the disease by the influence of the products of combustion or of the smoking habit by the subconscious irritation of the postulated pre-cancerous condition, be confidently inferred from the association observed.

The method of inquiry by which such differentiation can be recognized is the same as that by which the congenital factor has been demonstrated for several types of disease[3], namely, the comparison of the similarities between monozygotic (one-egg) and dizygotic (two-egg) twins respectively; for any recognizably greater resemblance of the former may be confidently ascribed to the identity of the genotypes in these cases.

I owe to the generous co-operation of Prof. F. von Verschuer and of the Institute of Human Genetics of the University of Münster the results of an inquiry into the smoking habits of adult male twin pairs on their lists.

The data so far assembled relate to 51 monozygotic and 31 dizygotic pairs, from Tübingen, Frankfurt and Berlin. Of the first, thirty-three pairs are wholly alike qualitatively, namely, nine pairs both non-smokers, twenty-two pairs both cigarette smokers and two pairs both cigar smokers. Six pairs, though closely alike, show some differences in the record, as in a pair of whom one smokes cigars only, whereas the other smokes cigars and sometimes a pipe. Twelve pairs, less than one-quarter of the whole, show distinct differences, such as a cigarette smoker and a non-smoker, or a cigar smoker and a cigarette smoker.

By contrast, of the dizygotic pairs only eleven can be classed as wholly alike, while sixteen out of thirty-one are distinctly different, this being 51 per cent against 24 per cent among the monozygotics.

The data can be rearranged in several ways according to the extent to which attention is given to minor variations in the smoking habit. In all cases, however, the monozygotic twins show closer similarity and fewer divergencies than the dizygotic.

There can therefore be little doubt that the genotype exercises a considerable influence on smoking, and on the particular habit of smoking adopted, and that a study of twins on a comparatively small scale is competent to demonstrate the rather considerable differences which must exist between the different groups who classify themselves as non-smokers, or the different classes of smokers. Such genotypically different groups would be expected to differ in cancer incidence; and their existence helps to explain such oddities as that pipe and cigar smokers should show much less lung cancer than cigarette smokers, while among the latter, the practice of inhaling is associated with less rather than with more cancer of the lung.

Dr. Bradford Hill, while admitting that the evidence of association found by his Unit did not amount to proof of causation, has emphasized that he does not know what else it can be due to. The facts here reported do show, however, that the choice is not so narrow as has been thought.

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May 17.

[1] Fisher, R. A., *Brit. Med. J.*, ii, 43, 297 (1957).
[2] McCurdy, R. N. C., *Brit. Med. J.*, ii, 158 (1957).
[3] Von Verschuer, F., *Proc. Roy. Soc.*, B, **128**, 62 (1939).

Measurement of Toughness in Cold-stored Fish

Luijpen recently noticed[1] that the proportion of fish muscle protein that would dissolve in 5 per cent sodium chloride solution was not correlated with the development of toughness during cold-storage at or below −20° C. The discovery was of great significance to the study of cold-storage phenomena, because it implied that the soluble protein nitrogen (usually expressed as a percentage of the total protein nitrogen) could not now be used as an objective standard for the quality of cold-stored fish. This was contrary to former belief.

It seems likely, therefore, that future investigations of freezing and cold-storage of fish will require the direct estimation of toughness as a measure of quality change. A satisfactory method for measuring toughness does not, however, exist at present. Assessment by a taste panel is time-consuming and inaccurate, and can only deal with a few samples at a time. Machines such as penetrometers, various types of shear apparatus, etc., which successfully estimate the toughness of beef muscle, are not as a rule adaptable to fish because the fibres in the latter case are extremely short and interspersed with sheets of connective tissue (myocommata) which are tougher than the muscle itself.

The following method, which requires only a small piece of fish muscle, was therefore devised. It has so far been tried out only on uncooked cod (*Gadus callarias* L.).

A handle was made to hold two Swann–Morton No. 24 scalpel blades 3 mm. apart and parallel. By means of a gentle sawing action, the blades were sunk into a wide myotome (muscle segment) on the 'bone' side of the fillet, at right angles to the long