not stated whether the cases of familial hypercholesterolaemic xanthomatosis had also been previously treated by a low-fat diet, and it remains possible that the peculiar response to the treatment in the case of essential hyperlipaemia may have been the result of the malady itself.

Much further investigation, both clinical and biochemical, will be needed before the correct nosological position of these two syndromes becomes apparent.

The significance of the hyperlipaemia is also obscure. Its presence in a gross form is usually associated with other signs of essential hyperlipaemia, although these may appear singly or in combination. That they do not depend on any particular critical level of plasma neutral fat is shown by the cases in the present series in regard to the abdominal symptomatology and by Harslöf's (1948) case in regard to the skin. This patient had a total plasma lipid level of 7,767 mg. per 100 ml. without any cutaneous lesions.

Eruptive xanthomata occur only in the presence of hyperlipaemia, whereas plane and tuberous xanthomata appear to bear no relationship to the plasma neutral fat level (see Table). However, the clinical characteristics of the cutaneous lesions seem to be less significant than their chemical content. Although polariscopic examination is an extremely crude method of determining the type of lipid present in these deposits, it does help to give some indication. Thus cholesterol can be found in eruptive xanthomata (Cases 2 and 8), while neutral fat may occur in tuberous xanthomata (Cases 4 and 8). If, therefore, the duration and level of hyperlipaemia bear any direct relationship to the skin deposits, it is to the amount of neutral fat present and not to the type of lesion in which the fat occurs (see Table). This is best exemplified in Case 8, where a recent skin lesion, in the presence of both gross hyperlipaemia and hypercholesterolaemia, contained approximately equal amounts of neutral fat and cholesterol. The lesion was clinically an eruptive xanthoma. Six and a half years later, when the hyperlipaemia was much greater than the hypercholesterolaemia, the cutaneous deposits, then in the form of tuberous xanthomata, consisted almost entirely of neutral fat. Why this lesion, however, was unaffected by the dietary treatment, when all the others disappeared in a few months, remains unexplained. Other factors are thus clearly involved, and these probably have to do with the form in which the fat is transported. For instance, Lever *et al.* (1954) have shown by ultracentrifugation that the strength of the chylomicron-protein bond varies irrespective of the degree of hyperlipaemia; and Gofman *et al.* (1954), by similar means, have demonstrated that the chylomicrons vary in size in the same way.

Final understanding of the true significance of hyperlipaemia must await further detailed investigations of this type regarding the form the lipid takes in both the plasma and the tissues.

Summary

Eight cases of cutaneous xanthomatosis are reported, seven being associated with an increase in plasma neutral fat.

On clinical grounds, two cases were diagnosed as essential hyperlipaemia, four as idiopathic hypercholesterolaemic xanthomatosis, and two appeared to represent mixed types.

It is considered that the diagnosis of essential hyperlipaemia does not depend solely on the presence of an increase in plasma neutral fat.

The differences between this condition and idiopathic hypercholesterolaemic xanthomatosis, and the significance of the hyperlipaemia, are discussed.

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ACCIDENTAL COAL-GAS POISONING LOSS OF SENSE OF SMELL AS A POSSIBLE CONTRIBUTORY FACTOR WITH OLD PEOPLE

BY

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During recent years there has been a progressive increase in the number of accidental deaths from coal-gas poisoning in this country. In 1955, out of a total of 8,000 fatal home accidents, 892 were due to domestic gas and three-quarters of these occurred in persons over 60 years of age. As shown in Tables I and II, which refer to Great Britain, the increase is not accounted for by the greater number of consumers of gas. The figures quoted are taken from the Report on Accidental Coal-gas Poisoning issued by the British Medical Association in 1956 after a careful investigation by a committee appointed by that body for the purpose.

It is clear that impairment or loss of the sense of smell may be one of the factors contributing to the prevalence of accidental poisoning among older persons. With this in view a small pilot survey was initiated in Camberwell by one of us (H. D. C.), and the findings were considered by the B.M.A. Committee. This survey showed that in the case of many of the people tested the sense of smell was negligible and would therefore give no protection. The work was, however, of a preliminary

TABLE I.—Accidental Deaths from Gas Poisoning

Year	No. of Fatalities	Fatalities per 10 Million Consumers (Domestic)
1931	175	No figures available
1935	203	" " "
1938	224	" " "
War years	No records	
1946	441	41.0
1949	497	44.5
1951	589	51.8
1953	751	64.2
1955	892	74.2

TABLE II.—*Classification of Deaths from Gas-poisoning Accidents According to Age*

Year	Proportion of All Fatalities	
	0-59 Years	60 Years and Over
	%	%
1931	49.2	50.8
1935	42.3	57.7
1938	50.5	49.5
War years	No records	
1946	28.8	71.2
1949	28.9	71.1
1951	29.4	70.6
1953	32.4	67.6
1955	25.2	74.8

nature, and in its report the Committee pointed out that before definite conclusions could be reached it would be necessary to carry out further work on this problem. The present paper gives the results obtained in a more detailed examination of a further 60 persons over the age of 65—hospital out-patients and in-patients, and residents in an old people's home. Control tests on a limited number of younger persons were carried out at the same time, and these are directly comparable with the results obtained earlier with a total of 160 persons of all ages representative of the working population.

Preliminary Tests

In carrying out tests of this nature with old people it is important to maintain their confidence, and it was therefore thought at first that complicated apparatus must be avoided. The simplest technique appeared to be that normally employed in assessing the sense of smell—a number of bottles containing substances of different odour. It was found that medicinal paraffin will take up the typical odour of town gas when a slow current of gas is passed through it for a short period. The level of odour, or odourosity, may be controlled, within limits, by the time of passage of the gas.

Accordingly, two bottles were prepared containing oil odorized to the equivalent of 5 and 15 parts of gas per 10,000 parts of air, and these were submitted to a number of persons together with a selection of other odours, as indicated in Table III. The subjects were asked if they could detect the odours and if they could identify them.

The results obtained were not satisfactory; very few people, whether old or young, succeeded in recognizing the "coal gas." It was concluded that the unexpectedness of "gas" in a glass bottle was confusing, and the technique was modified. The odorized oil was placed in a pair of aspirators connected by a oil-resisting plastic tube and fitted each with a glass filter funnel through which air in the one aspirator could be expelled by raising the other and allowing the oil to flow through the tube. This technique was more satisfactory, nearly 50% of old people readily recognizing the smell of the issuing air as that of gas. Table III sets out the results obtained in one series of tests with 19 old people. The "gas" was equivalent to about 30 to 40 parts of town gas per 10,000 parts of air.

TABLE III.—*Ability to Detect and Identify Odours (All Subjects Over 65 Years)*

Odour	No. of Subjects		
	Able to Identify the Odour	Able to Detect the Odour but Not Identify It	Unable to Detect the Odour
Clove ..	3	16	0
Lavender ..	8	11	0
Onion ..	8	10	1
Peardrops ..	3	16	0
Wintergreen ..	3	14	2
Peppermint ..	1	18	1
Town gas ..	8	1	10
All odours but gas ..	0	17	2
.. seven odours ..	0	9	10

Determination of the Threshold of Recognition

While this work was going on, a method had been developed in the laboratory for readily determining the lowest concentration of gas which a normal subject could recognize. Experience with this apparatus suggested that it might be possible to use it with old people without imposing upon them the strain of a lengthy test procedure. Preliminary trials confirmed this view, and tests have been completed with a number of old persons in hospitals and in an old people's home.

The apparatus is shown in the accompanying illustration. It consists of two 1-in. (2.5-cm.) brass tubes, 20 in. (50 cm.) long, connected at intervals along their length by a number of smaller tubes containing calibrated capillaries of stainless steel and carrying each its own stopcock. These capillaries have been selected to pass a small known amount of gas when the differential pressure across the capillary is 0.50 in.

Odorimeter for determination of the threshold of recognition of the odour of town gas. Gas from the further wide tube passes in determined quantity through one or more of the cross-tubes into a measured stream of air in the near wide tube, and, emerging from the glass vessel on the right, is smelled by the subject.

(1.25 cm.) of water. Air, purified by active carbon, is blown through the nearer 1-in. (2.5-cm.) tube at 100 c.ft. (2.83 cubic metres) per hour, and emerges from the glass vessel on the right. The diameter of this is about 6 in. (15 cm.), so that the linear velocity of the issuing air is approximately 10 ft. (3.05 metres)/min. Town gas is passed through the other wide tube and its pressure is adjusted to be 0.50 in. (1.25 cm.) of water above that of the air, as indicated by the gauge on the right. When one of the stopcocks is opened gas passes into the air stream at the predetermined rate giving the corresponding concentration. With the apparatus used for the bulk of this work the concentrations given by the capillaries were 1, 2, 3, 0, 6, 10, and 16 parts of gas per 10,000 parts of air. As more than one capillary could be used at a time, this permitted concentrations up to 38 parts per 10,000 without modification of the pressure. Higher concentrations were obtained by increasing the differential pressure, but only a very few tests were made with concentrations above 50 parts—taken as the maximum for this report. The blank tube, passing no gas, served as a useful check on reliability.

In carrying out a test the subject smelled first the air with no added gas. Unfortunately, this was not completely odourless, but the level was low and did not seem to affect the results. A selected amount of gas was then added, and the subject was asked if he could detect coal gas. The concentration was then altered and the question repeated. By varying the concentration both up and down it was possible to obtain a reasonably accurate estimate of the "threshold of recognition," or, in the case of "unreliable" subjects, to be certain that they were in fact not detecting the smell at all.

Results Obtained

Four series of tests have been made with a total of 61 persons over the age of 65, and with a few younger persons to act as controls. The results are summarized in Table IV.

It is believed that the values are reliable, but in a few cases the answers were suspect, because, as was to be expected, some subjects were too overawed or too anxious to please. It seems probable that these could not reliably

recognize the odour, and they have been included among those who could not recognize 50 parts per 10,000 parts of air. In Table IV the term "reliable" has been used to indicate those whose threshold was under 50 parts and could therefore be determined. In calculating the means and the standard deviations, only the "reliable" results were utilized.

The control tests with younger persons carried out at the time of the main tests gave the results indicated in the table. They are directly comparable with those obtained with samples of the normal working population drawn from the office staff at two of the Gas Board's establishments and included in the table under "Other Tests."

TABLE IV.—*Threshold of Recognition of Odour of Town Gas (Parts of Gas per 10,000 Parts of Air)*

	Threshold of Recognition		Unable to Recognize 50 Parts
	Mean "Reliable"	Standard Deviation	
1. <i>Old persons (over 65):</i>			
A. Hospital in-patients. 9 tested; 6 reliable ..	24	11	27%
B. Hospital out-patients. 7 tested; 5 reliable ..	25	9	29%
C. Home X. Convalescents. 26 tested; 17 reliable ..	29	7	35%
D. Home Y. Inmates. 19 tested; 13 reliable ..	22	10	31%
All four tests. 61 tested; 41 reliable ..	24	10	33%
2. <i>Younger persons (under 65):</i>			
A. 6 tested; 6 reliable ..	7	3	0
B. 4 tested; 4 reliable ..	9	2	0
C. Observer only ..	10	—	—
D. 19 tested; 17 reliable* ..	9	6	10%
All four tests. 30 tested; 28 reliable* ..	8	5	7%
3. <i>Other tests (under 65):</i>			
61 tested; 61 reliable ..	6	3	0
49 " 49 " ..	6	3	0
51 " 51 " ..	7	4	0

*The two persons who could not detect 50 parts in 10,000 were inmates and not staff.

Discussion

These results indicate that it is probable that approximately 30% of old persons cannot reliably recognize the odour of town gas at concentrations below 50 parts per 10,000 (and perhaps not at all). While of those old persons who can smell town gas, 95% will recognize 45 parts and 50% will recognize 25 parts of gas per 10,000 parts of air.

For younger persons (under 65) the proportion who cannot smell town gas is lower, since over 95% may be expected to recognize 20 parts, and 50% should recognize 8 to 10 parts per 10,000.

The "other tests," with the Gas Board's staff, indicated that neither age below 65 nor sex, nor the practice of smoking, has any significant effect upon the threshold of recognition of town gas.

Conclusions

These results confirm the earlier findings referred to in the B.M.A. report and indicate that the subject is one of importance. Investigation of the sensitivity of old people to other odours might also be of value, since there would appear to be a case for the addition of odorants to town gas to increase the threshold of recognition. Ways and means of doing this are being investigated as part of the research programme of the Gas Council, which has been acquainted with the results of the surveys mentioned in this paper and is actively interested in methods of odorization.

The use of odour as a danger signal for accidental escapes of unburnt gas is clearly unreliable for old people living alone. In this country there are 1½ million one-person households; nearly two-thirds of them are occupied by persons over 60, but the proportion varies widely throughout the country. The carbon monoxide content of domestic gas also varies, and it is possible that the level of odour of the gas is different in different areas. It is suggested, therefore, that further information should be sought in other parts of the country on this ability of older persons to detect and recognize the smell of gas. The results would be of value

for purposes of comparison in relation to local conditions. They would also help to throw further light on the whole question of loss of sense of smell with advancing years. If, as a result of these surveys, the loss of sense of smell is confirmed, it must have considerable bearing on the problem of poisoning by coal gas in the home.

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REFERENCE

British Medical Association. Council's Report on Accidental Coal-gas Poisoning. November, 1956.

FURTHER CONSIDERATIONS ON CEREBROSPINAL FLUID DYNAMICS

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In an earlier paper (Bowsher, 1953) apparent changes of cerebrospinal fluid (C.S.F.) pressure due to change in venous volume were considered in the case in which the fluid was in communication with an open manometer. It was pointed out that the volume of fluid displaced into a manometer, over and above the resting pressure level, when venous compression is applied, is equal to the increase in volume of the subarachnoid blood vessels, and therefore dependent, in height, upon the calibre of the manometer tube. In any such case there will, of course, be a slight rise of true pressure, measured by the increase in height of the column of liquid in the manometer. But this height varies with the calibre of the manometer, whereas the volume of fluid displaced does not, at least within the limits imposed by the increased pressure.

It was considered necessary to study these conditions in the physiological state—that is, when the system is not open to the atmosphere. To this end, two sets of experiments were performed.

Experiments with a Model

A model was constructed consisting of an outer glass cylinder, representing the craniospinal theca. Running through this was a semi-permeable tube of plastic sausage-skin, representing the subarachnoid vasculature. Although this plastic tubing is analogous to blood vessels in that it is permeable to water and is deformable, it is not elastic, and this factor was provided by hard rubber bungs at each end of the glass cylinder (Fig. 1, A).

A flow of water was set up in the inner tubing such that it did not fully fill it, and at the same time the outer tube was filled with water containing sodium thiocyanate. The whole system was then closed.

FIG. 1.—Semi-permeable tube running through a rigid water-jacket, in side (A) and end (B) elevations. Dotted lines indicate position of tube in semi-collapsed and solid line in circular cross-sectional areas, the circumference being the same in both cases. The area between the dotted and solid lines indicates the increase of volume which occurs in change of area.