

A Speaker: There has been some work done of the changes in the bronchus between smokers, non-smokers, and ex-smokers, and also changes in the alveolar walls. Changes in the alveolar walls were found which persisted in people who had given up smoking, but there was also some reversal in the alteration of the bronchial line. There was some improvement in people who have given up. However, experimental studies on the alteration are very slow. In rats that have been exposed to large doses of sulphur dioxide, it was found that the recovery was extremely slow.

Dr S. Carne: I go back to the problem of sex. One speaker raised the question of the general practitioner's studies. I think we are bogged down by statistical significance. The number of women who smoke in the relevant age-groups is so few that I do not think that any study has been able to show any statistical similarity, but certainly in the air pollution study the women who smoked got as much chronic bronchitis and exacerbation in fog as the men; the women who did not, of course, did not get the complications. However, the number of women smokers was so few that we could not draw significant conclusions.

AFTERNOON SESSION

THE RECOGNITION OF EARLY CHRONIC BRONCHITIS

Dr Ian Gregg, B.M., M.C.G.P. (*General Practitioner, Roehampton: Clinical Assistant, Brompton and Westminster Hospitals*)

By the time it causes disability chronic bronchitis is virtually an incurable disease, for the pathological changes which are found in its later stages are destructive and irreversible. Therefore, the only logical approach to treatment is to identify the disease in its early stages, before a serious amount of structural damage has been incurred, and then to make every effort to prevent further deterioration. No one has a better opportunity than a general practitioner to seek out patients with early chronic bronchitis: the problem is—How are they to be identified?

Professor Scadding has suggested that this could be achieved simply by questioning every patient, as a routine, about the presence

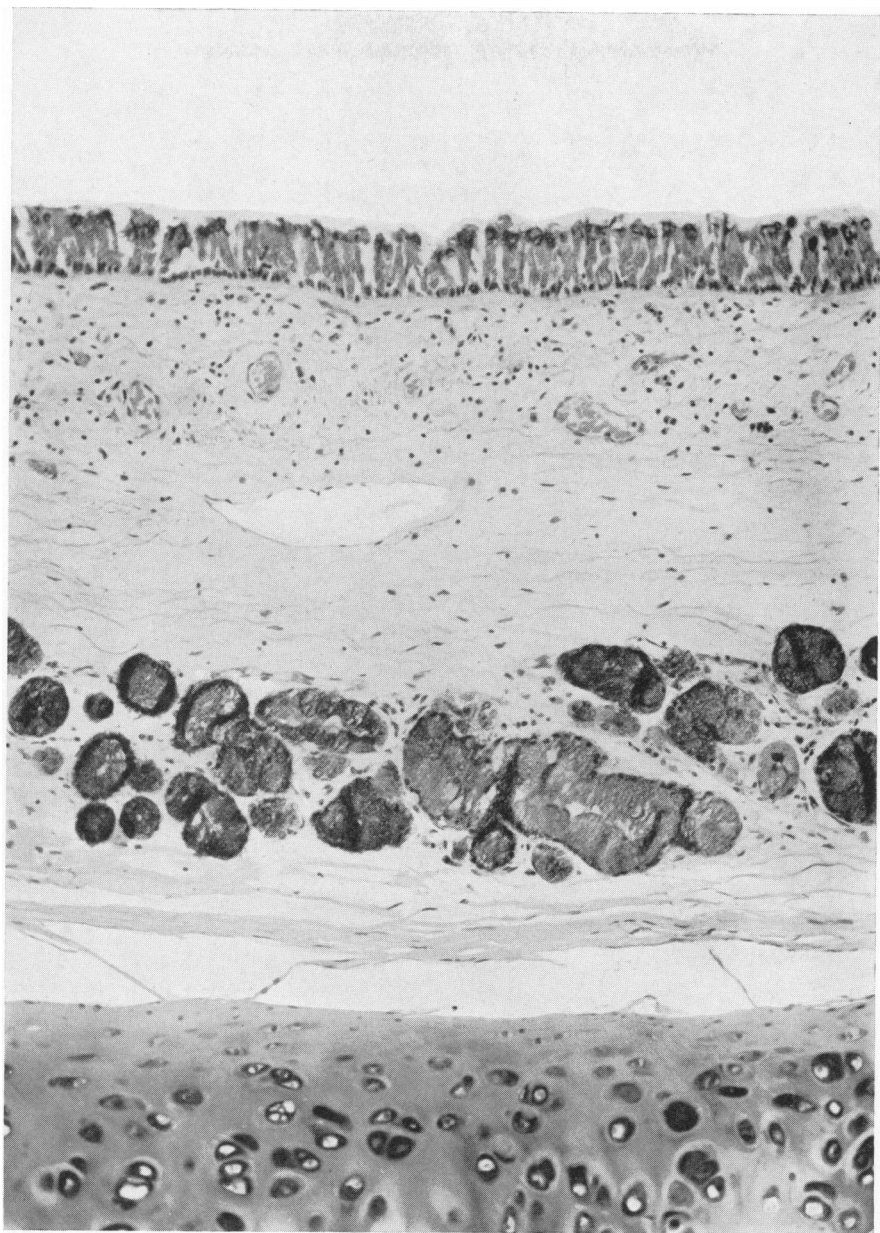


Figure 17
Normal bronchus

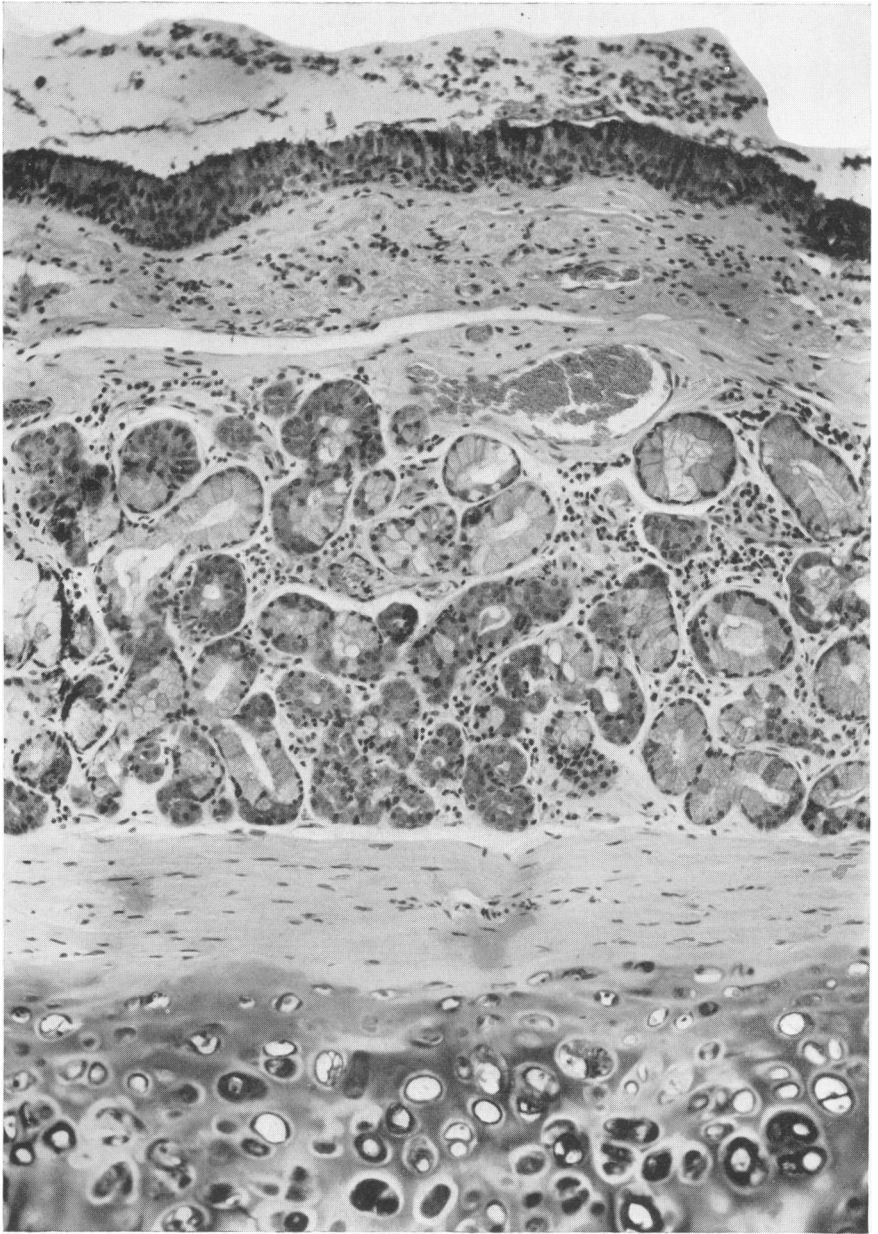


Figure 18
Bronchus from a chronic bronchitic

of productive cough. Such an approach would be in accord with the generally accepted view that hypersecretion of mucus is the cardinal disorder which characterizes the disease. For the most widely accepted definition of chronic bronchitis is that which was proposed by the World Health Organization (1961). According to this definition any person with a productive cough for the specified duration of time is deemed to have chronic bronchitis (provided that localized broncho-pulmonary disease has been excluded).

In a survey of my practice, which is in a smokeless zone of south west London, I found that no less than 26 per cent of men over the age of 20 had chronic bronchitis according to the World Health Organization's definition. This figure does not include any man who was known to have asthma or who gave a history of tuberculosis or other major chest disease. Furthermore, only men who admitted actual expectoration of phlegm are included in this figure. However, there were many patients whom I encountered in the course of my study who were difficult to classify according to the Medical Research Council's questionnaire. These patients denied expectoration, except perhaps for short periods following colds, yet they admitted to a 'smoker's cough' or morning catarrh: often they referred to clearing of the throat.

I am convinced that this symptom is caused by mucous hypersecretion in the lower respiratory tract, though it is true that it may be accompanied by upper respiratory catarrh and sometimes there is a postnasal drip from the nasal cavities. In a recent report of the Medical Research Council's Committee on the aetiology of chronic bronchitis (1965), it was recommended that patients with a regular, non-productive cough should be regarded as having sputum which is swallowed and that they should be counted as having chronic bronchitis. If the men with 'throat-clearing' are added to those with expectoration, the proportion of men in my practice who, by definition, have chronic bronchitis rises to the startling figure of 42 per cent.

A high prevalence of symptoms due to mucous hypersecretion has been found in other surveys. Holland and Reid (1965) found that 42.5 per cent of London G.P.O. workers between the ages of 40 and 59 were subject to regular expectoration of phlegm in the morning. Their findings are compared with my own in a similar age-group in table V. Also shown are my findings for two other age-groups. It should be noted that there is little difference in the prevalence of symptoms between the three age-groups.

Figure 20 shows that among smokers, expectoration and throat-clearing appear to be related to the quantity smoked. In this figure life-long average smoking habits have been used rather than the

TABLE V
A COMPARISON BETWEEN MALE POST OFFICE WORKERS AND MEN FROM A SOUTH-WEST LONDON GENERAL PRACTICE

SUBJECT	PLACE	AGE-RANGE	PERCENTAGE WITH MORNING PHELM	PERCENTAGE WITH PHELM INCLUDING THROAT-CLEARERS	AUTHOR
293	MALE G.P.O. WORKERS	CENTRAL LONDON	40 - 59	42.5	HOLLAND & REID - 1965
364	MEN SURVEYED IN GENERAL PRACTICE	S.W. LONDON	40 - 59	27.5	} GREGG 1965
186	MEN SURVEYED IN GENERAL PRACTICE	S.W. LONDON	20 - 39	21.4	
91	MEN SURVEYED IN GENERAL PRACTICE	S.W. LONDON	60 AND OVER	34.1	

current quantity smoked. One ounce of tobacco smoked in pipes or in hand-rolled cigarettes is regarded as equivalent to 30 manufactured cigarettes.

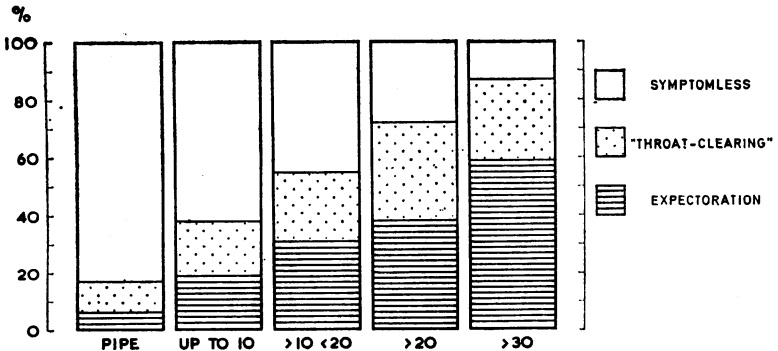


Figure 20
Prevalence of symptoms according to smoking habits

Though throat-clearing and expectoration become more common with advancing age, it will be seen in figure 21 that these symptoms of mucous hypersecretion are already present in 50 per cent of smokers aged 20-30. In this figure the men shown as having chronic bronchitis were those in whom I should have made this diagnosis on customary clinical grounds—primarily based on the fact that they had consulted my partner or myself at least twice on account of chest symptoms.

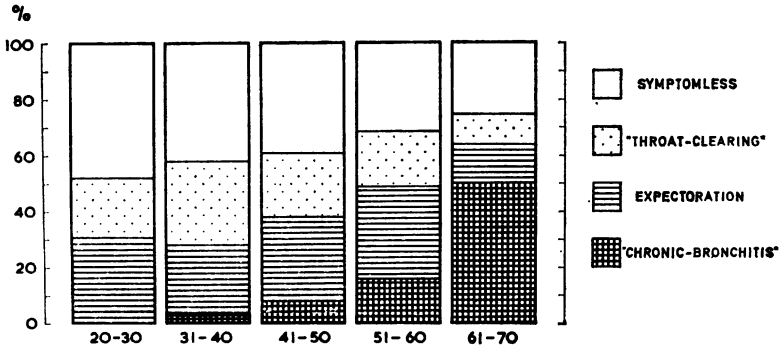


Figure 21
Prevalence of mucous hypersecretion in 411 male smokers aged 20-70

Mucous hypersecretion is unquestionably the primary abnormality in chronic bronchitis. However, figures 20 and 21 show that the symptoms of throat-clearing and expectoration are so common, even in the comparatively good climate and atmosphere of southern England, that by themselves they are of very limited value for identifying patients who are at special risk of becoming disabled by the disease.

The most important disorder which occurs in chronic bronchitis is progressive, structural damage of the bronchial airways. This causes an increased resistance to air flow. Only when there is a severe degree of damage and increased airways resistance, is a patient conscious of shortness of breath.

Three possible ways in which structural damage might cause progressive impairment of ventilatory function are illustrated diagrammatically in figure 22. All three lead to a state of severe disability around the age of 55-60. The vertical axis represents any

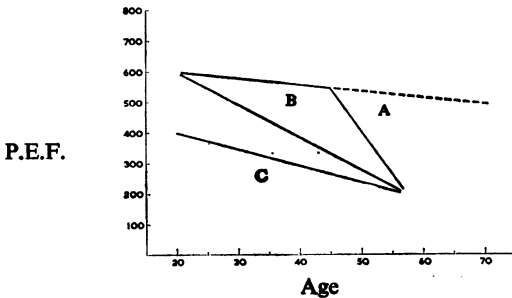


Figure 22
Three possible ways in which chronic bronchitis may develop, with progressive ventilatory impairment leading to incapacity at age 50-60 (see text)

parameter of ventilatory function—in this case peak expiratory flow. First, the disease might run a relatively rapid course (A), in which case ventilatory capacity would be normal until middle-age. Secondly, there might be progressive ventilatory impairment throughout adult life (B). Thirdly, the disease might be the continuation of a process which had already begun in childhood (C)—ventilatory impairment being present at the start of adult life, due to structural damage sustained while a child.

It seems likely that chronic bronchitis can develop in any of these three ways. In any event, one should be able to detect impairment of ventilatory function long before it is sufficiently severe to cause symptoms of breathlessness. By use of simple tests of ventilatory function, such as those which Dr Gomez has described, the general practitioner should be able to identify patients who are in the early stages of the disease.

My own study, which I began three and a half years ago, has been based on measurement of peak expiratory flow (PEF) using the Wright meter, which I consider has overwhelming advantages over other instruments so far as the general practitioner is concerned (Gregg 1963: 1964, *a, b*). The greater part of the survey was carried out in the course of ordinary surgery consultations. Every man who came to consult me, regardless of the nature of the complaint which had brought him, was closely questioned about his smoking habits and the presence of any symptoms of mucous hypersecretion and their duration. His PEF was measured with very careful attention to the proper performance of the test.

Once a man is admitted to the survey he automatically becomes part of a prospective study. On subsequent occasions when he comes to the surgery, the details of his smoking habits and symptoms are

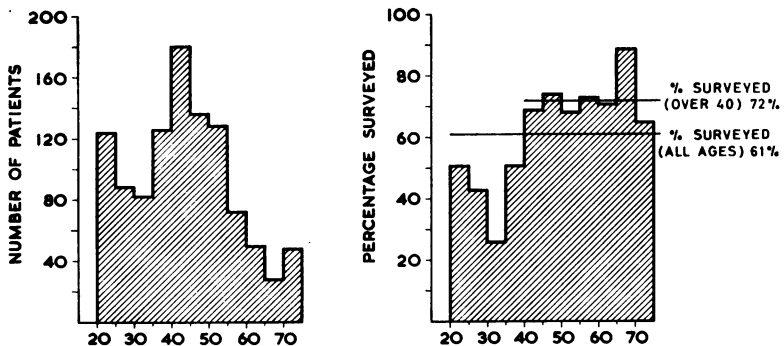


Figure 23

A. Age structure of males in practice August, 1965 (total 1,058)

B. Percentage of males surveyed by August, 1965 (total 641)

checked. His PEF is measured and he is persuaded to improve, if possible, on his previous performance. Many patients have been specially followed up by appointment or by visits to their homes.

Up to date 641 men (and 350 women) in the practice have been surveyed. In figure 23 it will be seen that the practice, which is largely composed of people living on three housing estates, contains relatively few men over the age of 60. The proportion of men of all ages who have been surveyed to date is 61 per cent: 72 per cent of those over 40 have been surveyed.

One of the first difficulties which I encountered was uncertainty about the normal values of PEF. For various reasons none of the series of normal values which have been published is entirely satisfactory. Therefore I set out to find the range of PEF in subjects whom I defined as normal on the grounds that they had never smoked, they could not recall having had any significant chest disease, and they were not subject to cough or expectoration.

Figure 24 shows the PEFs of these normal men, plotted against age. The wide scatter at all ages is probably due in part to differences of body-size and musculature. However, it is also possible that some men who satisfied the criteria which I chose may nevertheless have not been strictly normal. Five men (represented by circles) had low PEFs and were suspect for other reasons. Nevertheless,

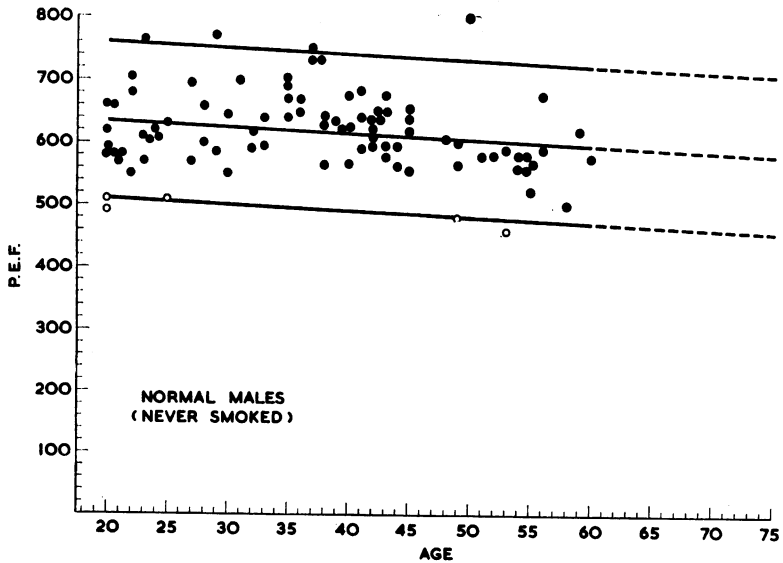


Figure 24
Scattergram of P.E.F.s of 90 'normal' men. Five represented by circles were 'suspect'

they were included for the purpose of calculating the regression between age and PEF and the 95 per cent 'confidence limits' (two standard deviations on either side of the regression line).

Considering the factors which are believed to be of importance in the aetiology of chronic bronchitis, it should be noted that the principal difference between the men comprising the normal group and those in other groups which were studied was that the former had never smoked. However, the non-smokers may have been equally exposed to atmospheric pollution, and some may have had infections in childhood which they had forgotten.

In figure 25 (centre), it will be seen that the PEFs of two of these presumably normal subjects fell considerably in the course of three years. Had their original PEFs not been known, there would have been no reason to suppose that a PEF found on a later occasion was not a normal value for the individual concerned. In most normal subjects, figure 25 (left) PEF remained remarkably constant, whether measured in summer or winter. On the other hand, in men who were subject to expectoration there was a marked tendency for PEF to be lower in the winter months: two typical examples are shown in figure 25 (right).

In the case of both the normal subjects (figure 24) and the other groups shown in figures 26 to 31, the values of PEF which are plotted are the highest which was achieved by each individual when tested on at least two occasions. To facilitate comparison, the regression

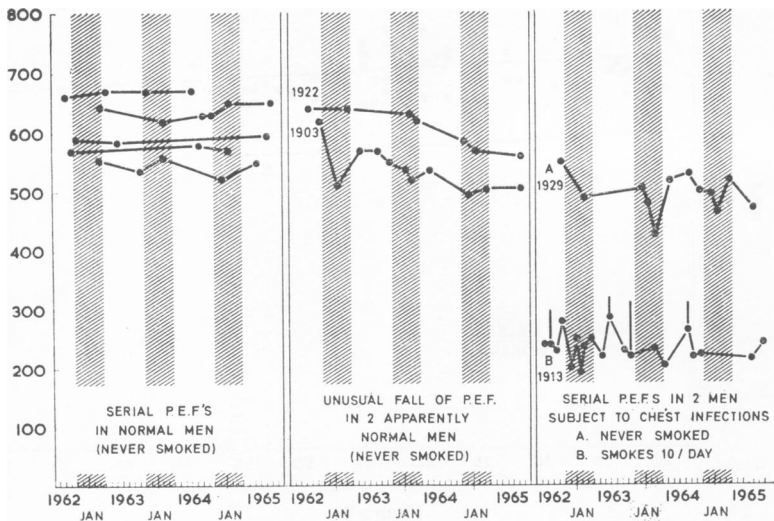


Figure 25
Serial PEFs in individual subjects

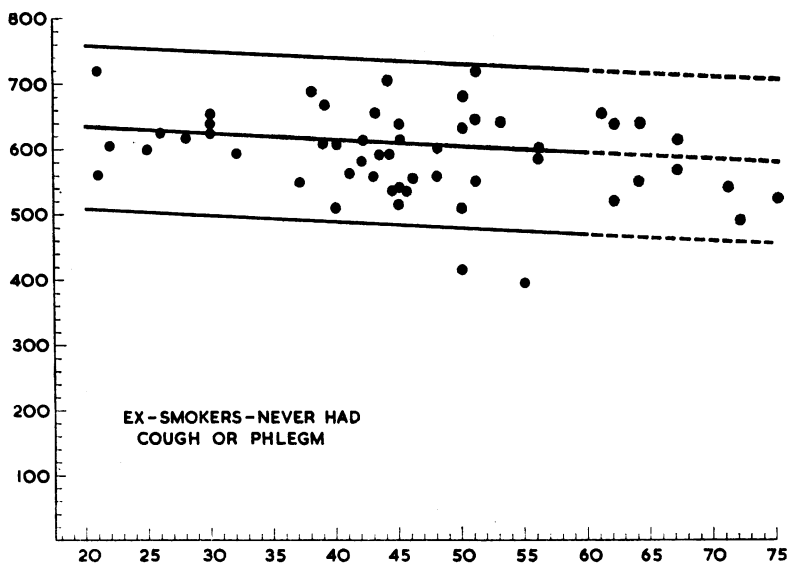


Figure 26

PEFs of 54 men who had given up smoking at least a year previously, none of whom had ever been subject to cough or sputum

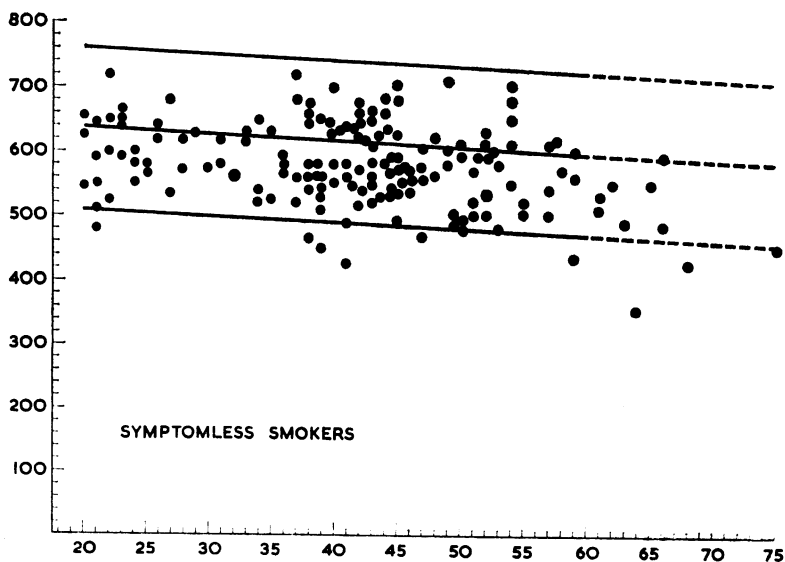


Figure 27

PEFs of 104 smokers who denied any cough or phlegm

line and 95 per cent confidence limits of the normal group are reproduced in figures 26 to 31.

In figure 26 are shown the PEFs of men who had given up smoking at least a year previously and who denied that they had ever had any cough or sputum when they were smokers. It will be seen that nearly all have PEFs well within the normal range.

Figure 27 shows the PEFs of current cigarette and pipe smokers, regardless of the amount they smoked, all of whom denied any symptoms of mucous hypersecretion. As a group they compare favourably with the normal subjects, though after the age of 40 a trend becomes apparent for the majority to have PEFs on the lower side of the regression line.

In figure 28 are seen the PEFs of smokers who were subject to throat-clearing but who seldom expectorated. Several men over 40 have a significantly low PEF. It seems likely that the difference between throat-clearing and expectoration is a quantitative one. Dr Heard in his paper referred to the fact that secretion of mucus occurs in normal persons but is of such small amount that it is swallowed without being perceptible. Recently, I had a bronchogram performed on myself, in the course of which 30 ml. of Dionosil were tipped down my right bronchial tree. I was interested to observe that after it was finished I expectorated only about a teaspoonful of

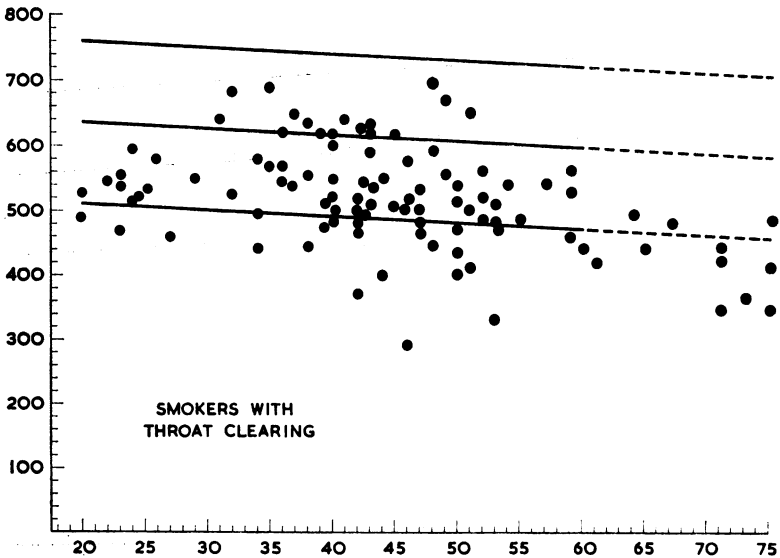


Figure 28
PEFs of 102 smokers subject to throat clearing

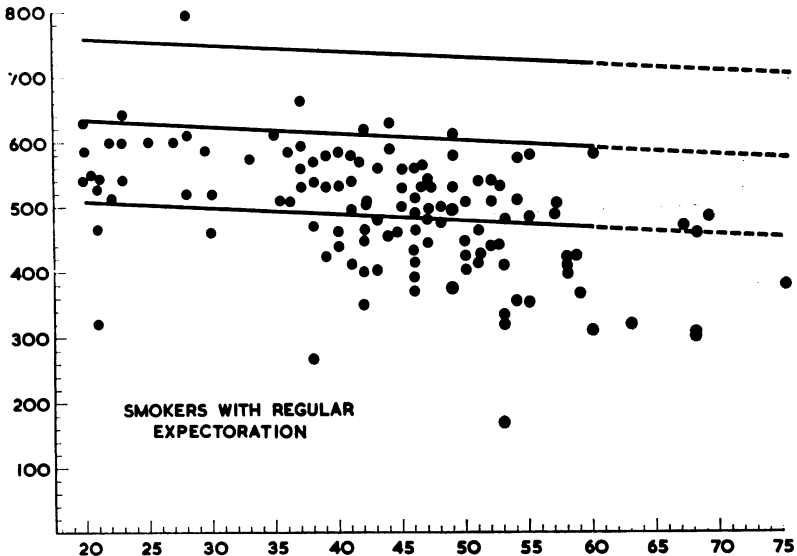


Figure 29
PEFs of 128 smokers with regular expectoration

the dionosil; however, for about 24 hours afterwards I kept having to clear my throat and I could identify the dionosil by a metallic taste.

Figure 29 shows the PEFs of smokers with regular expectoration, all of whom would have fulfilled the criteria of the WHO definition. However, none thought of himself as being chesty and I would not have regarded any of them as having chronic bronchitis unless I had cross-questioned them because of my interest in this disease. It will be seen that roughly half have PEFs within normal limits but there is now a clear trend for impairment of PEF to be found after the age of 40.

In figure 30 are shown the PEFs of men whom I should have regarded as having chronic bronchitis, whether or not I had been able to measure their PEFs. All of them, in addition to having regular cough and sputum, had consulted my partner or myself on at least two occasions for chest infections. It will be seen that some had surprisingly little impairment of PEF. Most of those whose PEF was less than 300 were conscious of shortness of breath.

It will be seen from figures 26 to 30 that serious impairment of PEF was found only in the groups of men who had symptoms of mucous hypersecretion, although within these groups there were many *individuals* whose PEFs were normal. It is now necessary to

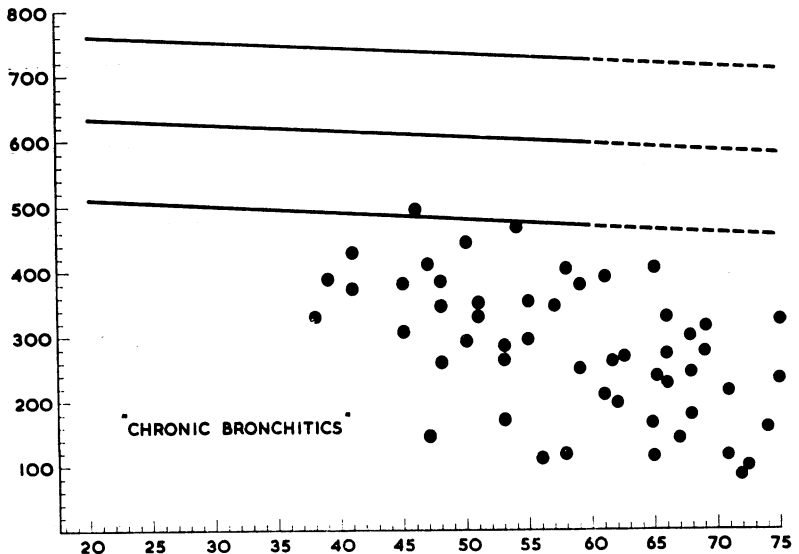


Figure 30
PEFs of 53 'chronic bronchitics' (see text)

consider the possible causes of the airways obstruction which was disclosed by the finding of an abnormal PEF. It is helpful if we try to do so in terms of the pathological changes which Reid (1960) has shown to occur in chronic bronchitis.

Minor degrees of airways obstruction could result from reduction of the bronchial lumen caused by the hypertrophy of mucous glands. Secondly, mucus itself may be a direct cause of obstruction, especially if it is secreted by goblet cells at the periphery of the bronchial tree where the airways are of small calibre. On theoretical grounds, airways obstruction from both these causes should be reversible if the factors which provoke mucous hypersecretion no longer operate. Thirdly, obstruction may be the result of structural damage, particularly when this has occurred in the more delicate bronchioles or in the lung parenchyma, giving rise to destructive emphysema. These changes, due to structural damage, are irreversible and permanent, and I believe they are fundamental to an understanding of the natural history of chronic bronchitis.

Clearly it is necessary to distinguish airways obstruction, due to potentially reversible causes, from permanent airways obstruction caused by structural damage. Some information regarding this can be derived from studying what happens when patients with expectoration give up smoking.

Figure 31 shows the PEFs of men who had given up smoking

at least a year previously, all of whom had had a persistent productive cough when they were smokers. In the majority of cases this had ceased within a few months of giving up. Many men in this group were still subject to cough and sputum for short periods, but in none would a diagnosis of chronic bronchitis have been made. It will be seen that nearly all the men below the age of 45 have a normal PEF. In only four of the older men is there a significant reduction of PEF. This suggests that if smokers who have expectoration give up smoking and, as a result mucous hypersecretion is reduced, their PEF will improve. In figure 29 it was seen that a large number of smokers with expectoration had significant impairment of PEF. Presumably, in many such cases, the airways obstruction was at least partially reversible and therefore not wholly due to structural damage.

Figure 32 is a diagrammatic representation of the relative contributions which are made by reversible causes and irreversible structural damage to the airways obstruction which becomes progressively greater in the course of the disease. Provided that no structural damage has been sustained, a smoker's PEF should return to normal on giving up. Permanent damage is represented as occurring in a stepwise fashion (probably in relation to episodes of infection). Though improvement may still occur on giving up smoking, PEF will not return to normal.

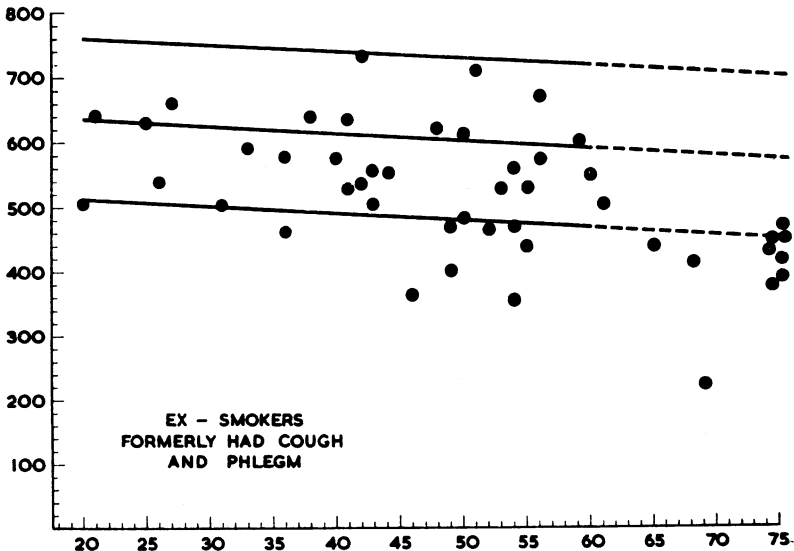


Figure 31
PEFs of 48 ex-smokers who had had regular cough and phlegm when they were smokers

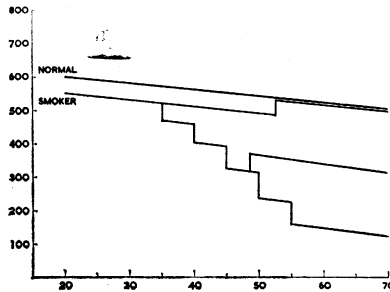


Figure 32

Diagrammatic representation of the natural history of chronic bronchitis, showing the contributions of reversible and irreversible airways obstruction

Serial measurements of PEF in men who gave up smoking (figures 33 and 34) confirm that little or no improvement occurs in those with low PEFs and who therefore may be presumed to have considerable bronchial damage. In two men (O.M. in figure 33 and H.S. in figure 34) marked improvement of PEF did occur, though in neither patient did it return to normal.

It is not yet known how closely either the clinical features or the functional disturbances of chronic bronchitis correlate with the morbid anatomical findings. During life the only practical method of investigating this is by means of bronchography. A certain number of carefully selected patients, whom I considered to have the early stages of the disease, have had bronchograms performed by Dr Trapnell. In general we found a good correlation between impairment of PEF and certain bronchographic changes which we believe are caused by structural damage.

In figure 35 are shown serial PEF measurements in three men with chronic productive cough. In the two younger men (211 and 311), whose PEFs were not seriously impaired, bronchograms were performed. These revealed poor peripheral filling and other changes which Dr Trapnell will be discussing and which we believe are caused by structural damage. This suggests that a considerable amount of structural damage may be necessary to cause serious disturbance of ventilatory function.

Though the subject of this symposium is *early* chronic bronchitis, none of the previous speakers has attempted to define it. Perhaps this is not surprising, for there is still no general agreement about the definition of the disease itself. So long as it is defined on a symptomatic basis, it is meaningless to refer to an early stage. We have seen that quite severe ventilatory impairment may be accom-

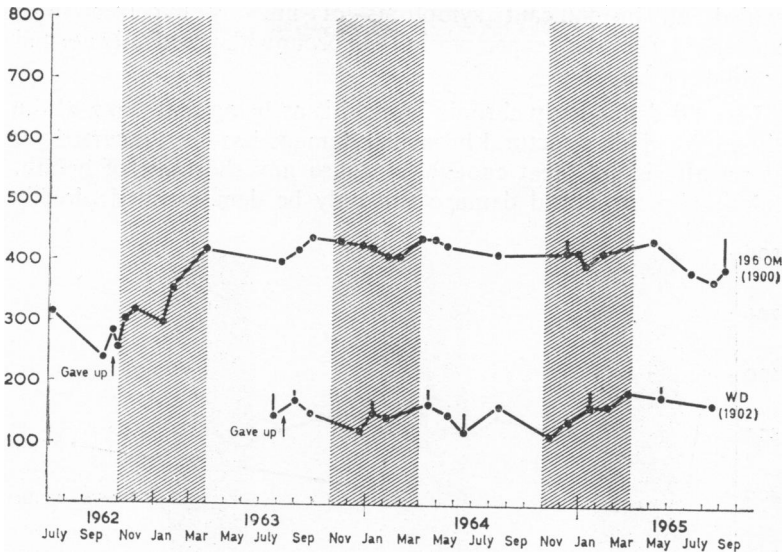


Figure 33
Effect of giving up smoking on PEF

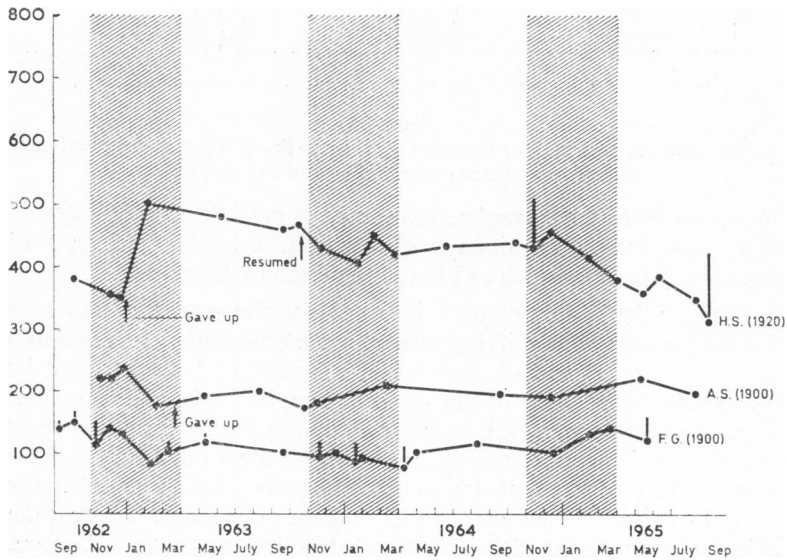


Figure 34
Effect of giving up smoking on PEF

panied by insignificant symptoms of mucous hypersecretion; conversely, persistent expectoration can occur with practically normal ventilatory function.

I would define early chronic bronchitis as being that stage of the disease in which structural bronchial damage has been incurred yet its severity is not great enough to cause any shortness of breath. Admittedly, structural damage can only be demonstrated directly

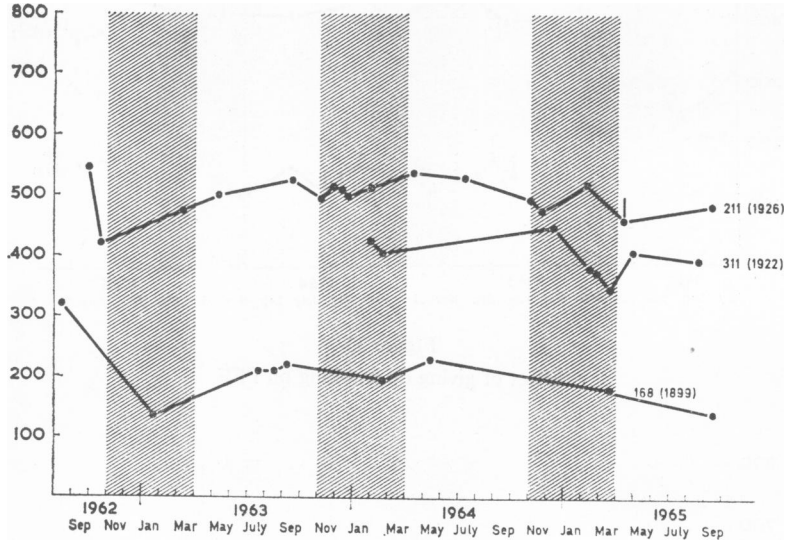


Figure 35

Serial measurements in three chronic bronchitics. Bronchograms were performed in the two younger patients, 211 and 311 (see text)

by means of bronchography. However, its presence can be inferred from the finding of airways obstruction, using simple tests of ventilatory function such as I have attempted to describe.

I believe the Wright meter is invaluable to the general practitioner for the purpose of identifying early chronic bronchitis. It is essential to ensure that the test is properly performed and results must be interpreted in the light of the subject's age, body-size and musculature. For instance, a PEF of 500 may be normal for a small man of 50, whereas it would certainly be abnormal for a tall man of 30. I regard a PEF of less than 450 as being abnormal for a man whatever his age or size. The lower the PEF, the more probable it is that the principal component of the airways obstruction is structural damage.

Acknowledgements

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RADIOLOGICAL ASSESSMENT OF EARLY BRONCHITIS

Dr D. H. Trapnell, M.D., M.R.C.P., F.F.R. (Consulting Radiologist, Westminster Hospital)

Two speakers today already have reminded us that a patient may die of chronic bronchitis and yet have a normal chest radiograph. I think you will agree, therefore, that my subject, the radiological assessment of early chronic bronchitis, poses some obvious problems. It may be that there are some here who would question the right of a radiologist to attend and speak at a symposium on a subject such as this. They would say, and with very good reason, that the radiologist should really play no part in the management or diagnosis of early chronic bronchitis.

I should like to make three propositions for your consideration. Because radiographs do not normally show bronchi, the chest radiographs of patients with uncomplicated or early chronic bronchitis are normal. Obviously, if abnormalities such as emphysema,