lives lost in every country each year from cancer of the respiratory tract demands that we expedite our efforts. It is hoped that with the evidence already at hand a practical solution may be within our reach. It is toward this end that laboratory studies involving the smoking-cancer problem must now be directed.

REFERENCES

- ¹ Auerbach, O., Gere, J. B., Forman, J. B., Petrick, T. G., Smolin, H. J., Muehsam, G. E., Kassouny, D. Y., and Stout, A. P., *New Engl. J. Med.*, 1957, **256**, 97.
- ² Badger, G. M., Buttery, R. G., Kimber, R. W. L., Lewis, G. E., Moritz, A. G., and Napier, I. M., *J. chem. Soc.* In press.
- ³ Van Duren, B. L., and Nelson, N., *Proc. Amer. Ass. Cancer Res.*, 1958, **2**, 353.
- ⁴ Blacklock, J. W. S., *Brit. J. Cancer*, 1957, **11**, 181.
- ⁵ Bock, F. G., *Proc. Amer. Ass. Cancer Res.*, 1958, **2**, 282.
- ⁶ Bonnet, J., and Neukomm, S., *Helv. chim. Acta*, 1956, **39**, 1724.
- ⁷ Campbell, J. A., *Brit. J. exp. Path.*, 1936, **17**, 146.
- ⁸ ——— *Brit. med. J.*, 1942, **1**, 217.
- ⁹ Campbell, J. M., and Lindsey, A. J., *Brit. J. Cancer*, 1957, **11**, 192.
- ¹⁰ ——— *ibid.*, 1956, **10**, 649.
- ¹¹ Cardon, S. Z., Alvord, E. T., Rand, H. J., and Hitchcock, R., *ibid.*, 1956, **10**, 485.
- ¹² Chang, S. C., *Cancer*, 1957, **10**, 1246.
- ¹³ Cooper, R. L., and Lindsey, A. J., *Brit. J. Cancer*, 1955, **9**, 304.
- ¹⁴ Croninger, A. B., Graham, E. A., and Wynder, E. L., *Cancer Res.* In press.
- ¹⁵ Engelbreth-Holm, J., and Ahlmann, J., *Acta path. microbiol. scand.*, 1957, **41**, 267.
- ¹⁶ Essenberg, J. M., Horowitz, M., and Gaffney, E., *West J. Surg.*, 1955, **63**, 265.
- ¹⁷ Gilbert, J. A. S., and Lindsey, A. J., *Brit. J. Cancer*, 1956, **10**, 642.
- ¹⁸ ——— *ibid.*, 1956, **10**, 646.
- ¹⁹ ——— *ibid.*, 1957, **11**, 398.
- ²⁰ Graham, E. A., Croninger, A. B., and Wynder, E. L., *Cancer Res.*, 1957, **17**, 1058.
- ²¹ Hamer, D., and Woodhouse, D. L., *Brit. J. Cancer*, 1956, **10**, 49.
- ²² Hamilton, J. D., Sepp, A., Brown, T. C., and Macdonald, F. W., *Canad. med. Ass. J.*, 1957, **77**, 177.
- ²³ Hoffmann, D., and Wynder, E. L., "A Study of Tobacco Carcinogenesis. VII. The Higher Aromatic Polycyclics." In preparation.
- ²⁴ Kuschner, M., personal communication.
- ²⁵ Lacassagne, A., Zajdel, F., Buu-Hoi, N. P., and Chalvet, H., *C.R. Acad. Sci. (Paris)*, 1957, **244**, 273.
- ²⁶ Lam, J., *Acta path. microbiol. scand.*, 1955, **36**, 503.
- ²⁷ ——— *ibid.*, 1955, **37**, 421.
- ²⁸ ——— *ibid.*, 1957, **40**, 369.
- ²⁹ Latarjet, R., Cusin, J.-L., Hubert-Habart, M., Muel, B., and Royer, R., *Bull. Ass. franç. Cancer*, 1956, **43**, 180.
- ³⁰ Lettré, H., Jahn, A., and Hausbeck, C., *Angew. Chem.*, 1956, **68**, 212.
- ³¹ Leuchtenberger, C., Leuchtenberger, R., and Doolin, P. F., *Cancer*, 1958, **11**, 490.
- ³² Lorenz, E., Stewart, H. L., Daniel, J. H., and Nelson, C. V., *Cancer Res.*, 1943, **3**, 123.
- ³³ Lyons, M. J., *Nature (Lond.)*, 1956, **177**, 630.
- ³⁴ ——— and Johnston, H., *Brit. J. Cancer*, 1957, **11**, 554.
- ³⁵ Magnus, H. A., *J. Path. Bact.*, 1939, **49**, 21.
- ³⁶ Miller, L. M., and Monahan, J., *Reader's Digest*, July, 1958.
- ³⁷ Neukomm, S., *Oncologia (Basel)*, 1957, **10**, 137.
- ³⁸ Orris, L., Van Duuren, B. L., Kosak, A. I., Nelson, N., and Schmitt, F. L., *J. nat. Cancer Inst.*, in press.
- ³⁹ Passey, R. D., Roe, E. M. F., Middleton, F. C., Bergel, F., Everett, J. L., Lewis, G. E., Martin, J. B., Boyland, E., and Sims, P., *A. R. Brit. Emp. Cancer Campgn.*, 1954, **32**, 60.
- ⁴⁰ Rockey, E. E., Kuschner, M., Kosak, A. I., and Mayer, E., *Cancer*, 1958, **11**, 466.
- ⁴¹ Roffo, A. H., *Dtsch. med. Wschr.*, 1937, **63**, 1267.
- ⁴² ——— *Krebsforsch.*, 1939, **49**, 588.
- ⁴³ Seelkopf, C., *Z. Lebensmitt. Untersuch.*, 1955, **100**, 218.
- ⁴⁴ Sugiura, K., *Gann*, 1956, **47**, 243.
- ⁴⁵ Touey, G. P., and Mumpower, R. C. II, *Tobacco Science*, 1957, **1**, 33.
- ⁴⁶ Wynder, E. L., Graham, E. A., and Croninger, A. B., *Cancer Res.*, 1953, **13**, 855.
- ⁴⁷ ——— *ibid.*, 1955, **15**, 445.
- ⁴⁸ ——— Lupberger, A., and Grener, C., *Brit. J. Cancer*, 1956, **10**, 507.
- ⁴⁹ ——— and Wright, G., *Cancer*, 1957, **10**, 255.
- ⁵⁰ ——— Kopf, P., and Ziegler, H., *ibid.*, 1957, **10**, 1193.
- ⁵¹ ——— and Mann, J., *ibid.*, 1957, **10**, 1201.
- ⁵² ——— Gottlieb, S., and Wright, G., *ibid.*, 1957, **10**, 1206.
- ⁵³ ——— Wright, G., and Lam, J., *ibid.*, in press.
- ⁵⁴ ——— in preparation.
- ⁵⁵ ——— unpublished data.

LUNG CANCER MORTALITY AND THE LENGTH OF CIGARETTE ENDS

AN INTERNATIONAL COMPARISON

BY

R. DOLL, M.D., D.Sc., F.R.C.P.

A. BRADFORD HILL, C.B.E., F.R.S.

Statistical Research Unit of the Medical Research Council

P. G. GRAY, B.Sc.

AND

E. A. PARR, B.A.

Social Survey Division of the Central Office of Information

Study of the recorded death rates from lung cancer in different parts of the world shows that there is a fairly close relationship between the present national mortality from the disease and the national consumption of cigarettes 20 to 25 years ago. Data for 16 countries are given in Table I and illustrated in the Chart, in which for each country the standardized mortality of men in 1952-4 is set against the consumption of cigarettes per adult (of both sexes) in 1930. The latter

TABLE I.—Mortality from Lung Cancer and the Consumption of Cigarettes in 16 Countries*

Standardized Mortality of Men from Cancer of Lung in Years 1952-4. Rate per Million			Cigarette Consumption in Year 1930 (per adult)	Mean Cigarette Consumption (Unweighted)
Mortality Group	Country	Rate		
Over 300	England and Wales	461	1,378	1,330
	Finland	433	1,662	
	Austria	380	960	
200-299	Netherlands	276	632	840
	Belgium	254‡	1,066	
	Switzerland	236†	706	
	New Zealand	216	478	
	U.S.A.	202‡	1,296	
100-199	Denmark	179	465	550
	Australia	177	504	
	Canada	176	760	
	France	140	585§	
	Italy	110†	455	
Under 100	Sweden	89†	388	490
	Norway	77	359	
	Japan	40	723	

* The standardized mortality rates were calculated by Segi (1957). Rate for cigarette consumption were given by Todd (1957) or were derived from data for Finland and Norway published by Nielsen and Clemmesen (1954), for Switzerland published by Gsell (1951), and for New Zealand kindly provided by the New Zealand Government, Department of Statistics.

† 1951-3. ‡ 1954. § 1951.

Relationship between lung cancer mortality and previous cigarette consumption in 16 countries. The regression line is given by $y = 0.24x + 28$; the correlation coefficient is 0.76.

date was chosen to allow for a reasonably long induction period for the lung cancer; it is not possible to test the effects of lengthening this period still more, since there is insufficient information about cigarette consumption in previous years. For the same reason it is not possible to use the cigarette consumption of males only, but as long ago as 1930 the consumption by women was probably only a small part of the total. In addition to these defects in the data we must note the great hazards of all such international comparisons.

Firstly, the standard of death certification is likely to vary from one country to another, so that the numbers of deaths attributed to lung cancer in 1952-4 will not necessarily be a true measure of its occurrence in those years, and the degree of error will doubtless vary. Secondly, the average consumption of cigarettes per adult in 1930 is likely to be an inadequate measure of the extent to which a population has been exposed to risk from smoking. For example, (1) the spread of cigarette smoking is unlikely to have been the same in all countries; it may well have affected different sex and age groups at different periods; (2) hand-rolled cigarettes are excluded from the estimates of the number of cigarettes smoked, and the frequency of their use will vary from country to country; (3) no allowance is made for any possible carcinogenic effect associated with the smoking of tobacco in cigars or in pipes; and (4) there may be substantial differences in the methods of smoking, in the kinds of tobacco used, and in the quality of the smoke reaching the bronchial mucosa. Moreover, even if exact information was available about all these factors, it would still be difficult to be sure of making a valid comparison between consumption and mortality, since so little is known about the mechanism of carcinogenesis and the relationship between the duration and intensity of exposure and the incidence of the resulting disease.

In spite of these various limitations to the data there is, nevertheless, a distinct relationship in these 16 countries between their cigarette smoking of 1930 and their lung cancer death rates of 1952-4. The principal exceptions are the U.S.A. and Japan, in both of which the mortality is substantially lower than would be expected from their apparent level of cigarette consumption (Table I). For the U.S.A. it has, however, often been suggested that the habit of throwing away a large unsmoked butt may contribute to the relatively low mortality. This possibility was particularly stressed by Sir Ernest Kennaway (1957), who made some preliminary measurements in this country. Factual data for the size of discarded butts on a large scale have, however, been lacking until the recent report by Hammond (1958).

Cigarette Ends

U.S.A.

In Hammond's study of the habits of the U.S.A. 4,283 butts were collected from ashtrays in homes, offices, and restaurants or picked up from sidewalks, stations, and parks in four large cities and several smaller cities and towns scattered throughout the country. The average length of all the butts was 30.9 mm., or some 40% of the length of the average cigarette. It did not differ appreciably between cigarettes with filter-tips (31.0 mm.) and those without (30.7 mm.), nor did it vary greatly between the butts collected in the different localities, save that it was somewhat longer in restaurants (34.5 mm.) and shorter in parks (26.7 mm.).

It seems likely, therefore, that the average figure for the whole series may be a reasonable estimate of the true average for butts found by these means in urban areas of the U.S.A. On the other hand, since the butts were collected some time after they had been thrown away it is likely that sometimes a substantial amount of the cigarette will have burnt *after* the cigarette was discarded (a factor which might contribute to the relatively low average length of butts picked up in the open in parks). The average given by these data is therefore likely to be an underestimate of the length of the butt at the time it was actually put out or thrown away by the smoker.

England and Wales

Corresponding data for the length of the butt discarded in Britain have now been obtained in the study here reported, which was carried out by the Social Survey Division of the Central Office of Information (Gray and Parr, in the press). In this study a different technique was adopted. A letter was sent to a small randomly selected sample of the civilian population of England and Wales, aged 21 years and over (picked from the 1958-9 Electoral Register by choosing the first number under 150,000 at random and then taking every successive 150,000th electoral number). The recipient was asked in reply to give particulars of his (or her) usual smoking habits and, if a cigarette smoker, to collect, in a tin enclosed with the letter, the butts of all the cigarettes smoked the day after the letter was received. To avoid any change of habits the specific object of the inquiry was not mentioned or even hinted, the wording of the request being as follows:

"We are carrying out an inquiry for the Medical Research Council. As you may know, they are studying the effects of smoking on people's health. They want to collect for examination a sample of cigarette ends which have just been smoked in the normal way. You have been picked purely by chance for this inquiry. Please will you help us?"

It is a tribute to the co-operativeness of the British public that, of the 200 thus written to, 180 (90%) responded (with the same proportion in each sex).

Of the 81 men who replied, 38 said that they smoked cigarettes only and 4 that they smoked cigarettes and a pipe; 6 said that they smoked a pipe only and 33 that they were not then smoking. Of the 99 women who replied, 29 said that they smoked cigarettes and 70 that they were not smoking. The proportion of current smokers is unexpectedly small. This may have been due partly to a tendency for smokers to have replied less readily than non-smokers, but a few irregular smokers may have regarded themselves as non-smokers for the sake of simplicity.

The butts returned by the cigarette smokers amounted to approximately 80% of the declared number usually smoked. They were straightened out and their length was measured. Mean values for different groups of interest are given in Table II.

It will be seen that the average length for all 772 butts was 18.7 mm.,* or a little over a quarter of the ordinary 70-mm. cigarette. The various subdivisions of the table are more remarkable for their similarity than dissimilarity, and the only formally significant difference is between men and women, where the latter show a slightly shorter mean length. This is due in part to the

*The sampling standard error allowing for the within-person correlation is 0.4 mm.

TABLE II.—*Mean Length of Cigarette Ends Provided by a Sample of Adult Population of England and Wales*

Group	No. of Smokers Sending in Butts	No. of Butts Sent in	Average Length of Butt in mm.
All cigarette smokers	71	772	18.7
Sex { Male	42	540	19.3
Female	29	232	17.3
Age of males { 21-35	12	184	19.8
36-55	17	158	20.0
56 and over ..	13	198	18.3
Usual No. of cigarettes smoked per day { 1-4	8	16	19.1
5-14	28	228	18.9
15-24	30	428	18.5
25+	5	100	19.0
Type of cigarette { Filter-tip	11*	99	17.6
Ordinary tip ..	66*	673	18.9

* 6 persons sent in both.

fact that 27% of the butts returned by women were filter-tipped, against only 7% of those returned by men. There is no trend apparent either with age or with the usual amount of smoking. (If the usual amount for each individual be used to recalculate the overall average a figure of 18.5 mm. is reached, which differs negligibly from the 18.7 mm. for the butts actually returned. But we do not, of course, know whether the missing butts were, in fact, different from those sent in.) This lack of difference between the subgroups allows us with more confidence to contrast our total figures with those from the U.S.A., where such subdivisions of the data are, owing to the method of collection, impossible.

England and Wales Compared with the U.S.A.

The frequency distributions of the lengths of butts measured in the British and the U.S. inquiries are contrasted in Table III. The differences are very large.

TABLE III.—*Comparison of Cigarette Ends Measured in England and Wales and the U.S.A.*

Length in mm.	England and Wales (%)	U.S.A. (%)
Up to 9.5	1.2	} 0.8
10-14.5	17.5	
15-19.5	46.7	
20-24.5	25.4	
25-29.5	6.9	
30-34.5	1.4	19.9
35-39.5	0.6	20.9
40+	0.3	12.8
Total No. of butts measured	772 (100%)	4,283 (100%)
Average length (mm.) ..	18.7	30.9

In total the average length of the U.S. butts (30.9 mm.) is 65% greater than the British average (18.7 mm.). More striking still is the fact that 2 out of every 3 British butts (65.4%) were less than 20 mm. in length and less than 1 in 10 of the American were smoked down to this level (8.7%). At the other end of the scale only 1 in approximately 40 of the British butts were 30 mm. or longer (2.3%), while as many as half the American ends were discarded at such lengths (51.7%). Though in both countries the filter-tipped butts did not differ greatly from the ordinary tipped, we may note that only 13% of the English butts were filter-tipped, compared with 60% in the American sample.

Discussion

The statistics on cigarette ends reported here for this country are admittedly on a small scale. Those obtained by Hammond previously for the U.S.A. are based upon larger numbers but form a less clear sample

of the whole population. The great contrast between them, however, strongly supports the general impressions of any careful observer of the two countries; there can be no doubt that in substance it is true. Such a very great difference in the British and American habits at the present time makes it at least possible that the greater butt length in the U.S.A. can account for much of the relative deficiency in its lung cancer mortality. If carcinogenic substances are associated with the polycyclic hydrocarbons in cigarette smoke, it must be anticipated that they would be produced by combustion, condensed further along the cigarette and redistilled as the cigarette burns shorter (Gilbert and Lindsey, 1957). Quite a small difference in butt length might therefore result in a substantial difference in the amount of carcinogen inspired. On the other hand, we must note that the present data may not be a good indication of the relative lengths of the butts which were discarded in the U.S.A. and Britain 20 to 30 years ago. Substantial changes are known to have taken place in smoking habits in the U.S.A. in the last few years; the proportion of filter-tipped cigarettes has increased greatly and the proportion of extra large cigarettes has also risen—that is, cigarettes 80 to 85 mm. long against the standard 70 mm. We know of no evidence to show whether or not the average length of butt has altered; personal impressions suggest that the difference between the two countries is of long standing.

We do not suggest that this difference in butt length is the only factor that might account for the relatively low mortality from lung cancer in the U.S.A. Many other factors may have contributed to it, and, in so far as they concern the difference between the mortality in England and Wales and in the U.S.A., they have been discussed in detail by Hammond (1958). We are concerned to emphasize that such an exception to the broad geographical association between present-day lung cancer mortality and past national smoking habits, as shown in Table I, may have many explanations. It cannot be lightly taken at its face value and accepted as wholly incompatible with the general evidence on cigarette smoking.

The only other extensive data on cigarette ends of which we are aware were obtained by Korteweg for Holland (referred to by Hammond, 1958). These gave an average length of 19.7 mm. for 545 butts, a figure akin to the one we have found for England and Wales.

Summary

In spite of the well-known difficulties of international statistical comparisons there is a distinct relationship in 16 countries between their reported cigarette consumption in 1930 and their lung cancer death rate in 1952-4. Striking exceptions are Japan and the U.S.A., which had a relatively high cigarette consumption but a relatively low incidence of cancer of the lung. In the U.S.A. one explanation may lie in the larger cigarette end that the citizen discards. A comparison of cigarette ends, specially collected and measured in Britain, with similar data recently reported from the U.S.A., gives an average length of 30.9 mm. in the latter country against 18.7 mm. in the former. Two out of three cigarette ends in the British sample were less than 20 mm. in length; only 1 in 40 was as long as 30 mm. In the American sample less than 1 in 10 were smoked down to 20 mm. and half were discarded with 30 mm. or more still unsmoked. Such a large national difference in

habits might considerably influence the national exposure to any carcinogen in cigarette smoke.

We are most grateful to Mr. Louis Moss, Director of the Social Survey, for his advice and for the facilities which enabled the British data to be collected.

REFERENCES

- Gilbert, J. A. S., and Lindsey, A. J. (1957). *Brit. J. Cancer*, **11**, 398.
 Gsell, O. (1951). *Schweiz. med. Wschr.*, **81**, 662.
 Hammond, E. C. (1958). *Brit. med. J.*, **2**, 649.
 Kennaway, E. (1957). *Ibid.*, **1**, 299.
 Nielsen, A., and Clemmesen, J. (1954). *Dan. med. Bull.*, **1**, 194.
 Segi, M. (1957). "Cancer Mortality Statistics in Japan." Department of Public Health, Tohoku University, Japan.
 Todd, G. F. (1957). *Statistics of Smoking. Tobacco Manufacturers' Standing Committee, Research Papers, No. 1.*

TOBACCO SMOKING, RESPIRATORY SYMPTOMS, AND VENTILATORY CAPACITY

STUDIES IN RANDOM SAMPLES OF THE POPULATION

BY

I. T. T. HIGGINS, M.D., M.R.C.P.

*Member of Scientific Staff, Pneumoconiosis Research Unit
of the Medical Research Council, Llandough
Hospital, Penarth, Glamorgan*

Evidence is accumulating that tobacco smoking is an important factor in the aetiology of chronic bronchitis and emphysema. In a prospective study of mortality of medical practitioners Doll and Hill (1956) found a statistically significant gradient from non-smokers to heavy smokers in the mortality rates due to chronic bronchitis. Investigations of bronchitis morbidity in hospital patients, working groups, and representative samples of the general community support the hypothesis. Abbott *et al.* (1953) presented their findings in 294 patients suffering from various types of emphysema. They noted an almost constant history of protracted cough or so-called "chronic bronchitis" in these cases and considered that tobacco irritability was an important aetiological factor in 214.

Palmer (1954), in a study of 422 male hospital patients, found that chronic bronchitis was significantly commoner in smokers than in non-smokers. Greene and Berkowitz (1954) recorded a very high prevalence of "smokers' bronchitis" in patients smoking 20 cigarettes or more daily. These findings were supported by Leese (1956), who compared 100 patients with bronchitis with 100 controls and showed that the controls smoked less. Lowell *et al.* (1956) studied 34 patients (28 males and 6 females) aged 50–81 years and concluded that in New England smoking was the major cause of emphysema in this age group. Oswald and Medvei (1955) investigated the records of 6,245 clerical Civil Service employees and compared smokers with non-smokers. They found a higher prevalence of bronchitis in both sexes among the smokers. Clifton (1956) compared respiratory symptoms in a group of workers in heavy industry in Sheffield with those recorded in males in a rural general practice and noted a close association between tobacco smoking and persistent cough and sputum.

Phillips *et al.* (1956) observed a close correlation between cigarette smoking and chronic cough, and

stressed the importance of standardizing for smoking habits in assessing the other factors considered important in the aetiology of chronic bronchitis. Ogilvie and Newell (1957) carried out an investigation of bronchitis in a sample of 3,866 inhabitants of Newcastle upon Tyne. They compared 464 bronchitics with 485 non-bronchitic controls and showed that in both sexes the bronchitics were the heavier smokers, and among the men included a higher proportion of cigarette smokers. There was, however, no significant association between the number of cigarettes smoked and the disease. In a recent investigation of 1,062 men aged 60–69 living in Birmingham (Brown *et al.*, 1957) chronic bronchitis was found to be more frequent in cigarette smokers than in non-smokers.

Our own investigations at the Pneumoconiosis Research Unit of random samples of geographically defined communities have supported these findings. Thus in men aged 55–64 studied in Leigh (Lancs) tobacco smokers had significantly more "chronic bronchitis," defined as persistent sputum and a history of one bronchitic chest illness during the past three years, than non-smokers (Higgins *et al.*, 1956). In the Vale of Glamorgan, in South Wales, the prevalence of persistent cough and sputum was significantly higher in smokers than non-smokers, and smokers also appeared more liable to chest illness, breathlessness, and "chronic bronchitis" as previously defined, though for none of these symptoms did the difference reach the conventional level of statistical significance (Higgins, 1957). Finally, in Annandale, in South-west Scotland, a similar trend was observed in a sample of men and women aged 55–64 (Higgins and Cochran, 1958).

Surprisingly few attempts have been made to correlate smoking with changes in lung function. Whitfield *et al.* (1951) studied the effect of tobacco smoking on lung volume in 58 healthy men, and concluded that smoking produced a slight diminution in the vital capacity and a more pronounced increase in the ratio of residual air to total lung volume. These conclusions were criticized by Oldham (1951), who pointed out that they could not be drawn with certainty from the results presented.

Bickerman and Barach (1954) studied the acute effects of smoking three cigarettes in 91 patients with emphysema and 27 normal subjects. Although they observed no consistent trend, they noted a fall in the maximum breathing capacity in 10 subjects and suggested that this might have indicated increased bronchospasm. More recently Eich *et al.* (1957) investigated the acute effects of smoking on the mechanics of respiration in chronic obstructive emphysema. They showed an immediate statistically significant increase in the airway's resistance in 14 out of 15 emphysematous patients after smoking one cigarette, but no change in a control group. Franklin (1958) has reported the results of an investigation of the effect of smoking habits on lung function in a working population aged 40–65. Analysing kymographic tracings of the maximal forced expiration, he found that the flow rate was significantly lower in heavy smokers compared with light smokers or non-smokers. There is clearly a need for further studies assessing the long-term effect of smoking habits on lung function, using an objective physiological test. Our investigations of bronchitis in different communities have always included detailed smoking histories and also an assessment of the ventilatory capacity. The purpose of this paper is to consider the relation of smoking to