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LUNG CANCER DEATH RATES IN ENGLAND AND WALES COMPARED WITH THOSE IN THE U.S.A.

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The large differences between reported lung cancer death rates in England and Wales and in the United States have not yet been explained satisfactorily. A study of these differences may well lead to a better understanding of the aetiology of this disease. While the data available at the present time are inadequate for the purpose, they are worth discussing as a basis for further investigations.

The lung cancer death rate reported by the Registrar General for England and Wales in 1955 was 69.3 per 100,000 population for males and 10.6 per 100,000 for females. Standardizing the lung cancer death rates reported by the National Office of Vital Statistics for the United States in 1955 to the age distribution of the population of England and Wales in 1955, the rates were only 33.0 per 100,000 population for males and 6.7 per 100,000 population for females. In other words, the lung cancer death rate in England and Wales for males was 2.1 times as high as in the United States and for females 1.6 times as high. These ratios did not vary greatly in different age groups. For example, among males the ratio of the rate in England and Wales to the rate in the United States was 1.9 in age group 25–34; 2.0 in age group 35–44, 2.0 in age group 45–54; 2.2 in age group 55–64; 2.1 in age group 65–74; and 1.8 in age group 75–84.

Fig. 1 shows reported lung cancer death rates for males and females in age group 45–54 for England and Wales and for the United States from 1931–5 to 1956. The rates for the United States are for the white population only. Fig. 2 is similar but for age group 65–74. For males in both countries and both age groups the rates increased rapidly during this period of time. Within each age group the trend lines (plotted on semi-log paper) are roughly parallel for the two countries, but at a much higher level for England and Wales than for the United States. After 1948 the rate of increase was less in age group 45–54 than in age group 65–74.

The picture is somewhat different for females. From 1931–5 to 1948 the female rates in each of the two groups were only slightly higher in England and Wales than in the United States and generally increased in both countries during this period of time. The female rates continued to increase after 1948 in England and Wales but not in the United States.

It should be noted that a small number of deaths from cancer of the respiratory system other than the lungs—for example, pleura, trachea, and mediastinum—are included in some of the figures quoted above. These inclusions are slightly different in figures from the two countries. However, the effect of this is trivial, since all but a very small percentage of the deaths are presumed to have been due to bronchogenic carcinoma.

Both the form of the death certificate and the rules for classifying deaths by cause were changed in the United States as from January 1, 1949. Changes in the rules for classification were also made in England and Wales in 1949, while the form of the death certificate had been changed at an earlier date.

The changes in reporting procedures in the United States may be responsible for the change in the trend lines for females which occurred after January 1, 1949. However, if this explanation is correct, it is hard to see why a change of similar magnitude did not occur in the trend lines for males.

Cigarette Smoking

There is evidence that, in both countries, lung cancer is highly associated with cigarette smoking (Doll and Hill, 1956; Hammond and Horn, 1958a, 1958b). Let us consider the hypothesis that differences in degree of exposure to cigarette smoke (or certain components of the smoke) account for the reported differences in lung cancer death rates between the two countries.

At least five different factors may be of importance in determining the degree to which the lungs of a cigarette smoker are exposed to important ingredients of the smoke. These are: (1) the average number of cigarettes smoked per day, (2) the number of years of smoking, (3) the degree to which the smoke is inhaled, (4) the proportion of each cigarette which is actually smoked, and (5) the amounts of various chemical ingredients in the main stream smoke of the cigarette. These are discussed in turn.

Average Daily Consumption

Cigarette smoking apparently became popular at an earlier date in the United Kingdom than in the United States. In 1935 the consumption per adult per annum of packeted cigarettes is reported to have been 1,589 in the United Kingdom and 1,410 in the United States (Todd, 1957). Cigarette consumption increased in both countries, but to a greater extent in the United States than in the United Kingdom. In 1956 the reported consumption per adult per annum of packeted cigarettes was 2,509 in the United Kingdom and 3,195 in the United States. The increase in total cigarette consumption was probably slightly less than these figures appear to indicate, since there was a decline in the use of hand-rolled cigarettes. It is also possible that more

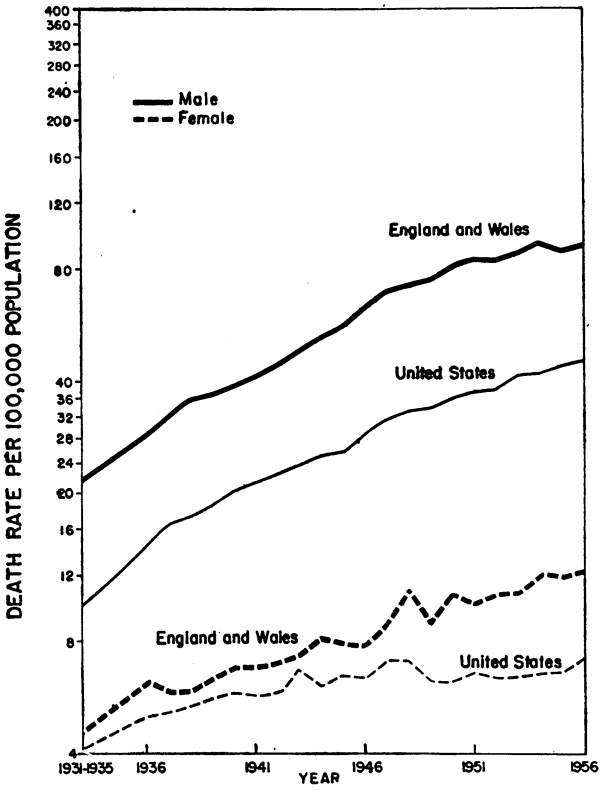

FIG. 1.—Lung cancer death rates, by sex, at age 45–54 for England and Wales and United States (white population) in 1931–5 to 1956. Source of data: Registrar-General of England and Wales and United States National Office of Vital Statistics.

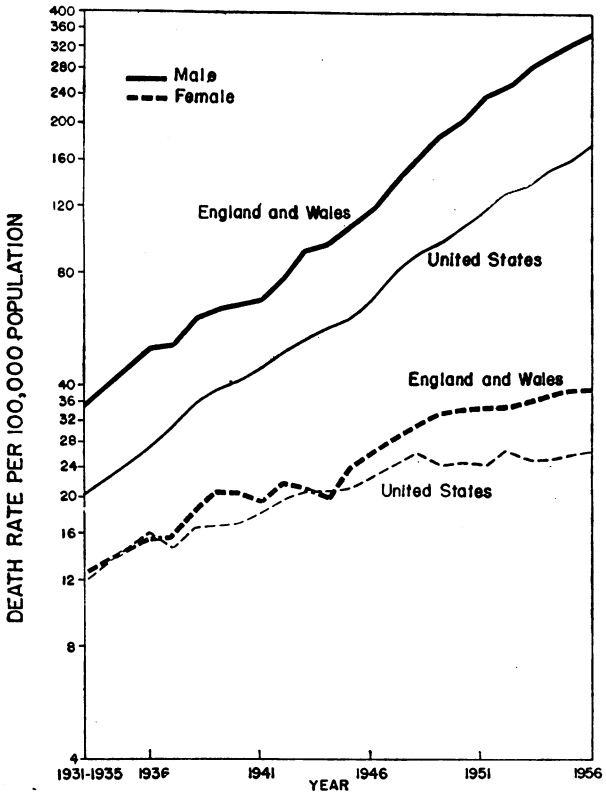

FIG. 2.—Lung cancer death rates, by sex, at age 65–74 for England and Wales and United States (white population) in 1931–5 to 1956. Source of data: Registrar-General of England and Wales and United States National Office of Vital Statistics.

hand-rolled cigarettes are now being smoked in the United Kingdom than in the United States. In the United Kingdom in 1956, 7.0% of all male cigarette smokers and 0.2% of all female cigarette smokers said that they smoked only the hand-rolled variety. However, 12.7% of male cigarette smokers in age group 60 and older still smoked only hand-rolled cigarettes. Information on this is not available for the United States.

For a proper comparison of cigarette consumption in the two countries one would need to know for each sex and for each five-year or ten-year age group the proportion of people who smoke cigarettes at each of several levels of number per day. This information is available for the United States for 1955 (Haenszel, Shimkin, and Miller, 1956) but is not available in such detail for the United Kingdom. However, some very useful data on the subject have been reported by the Tobacco Manufacturers' Standing Committee (Todd, 1957) for the United Kingdom in 1956. These are summarized in Tables I and II. Unfortunately, differences in age groupings and possible differences in definitions make comparisons between the two countries a bit difficult. About 4% of the people interviewed in the United States said that they smoked cigarettes "once in a while, not every day." These have been included as cigarette smokers in Tables I and II because the same procedure seems to have been used in the study in the United Kingdom.

TABLE I.—*Percentage of People Smoking Cigarettes by Age and Sex in the United Kingdom and in the United States of America*

United Kingdom, 1956		United States, 1955	
Age	% Smoking Cigarettes	Age	% Smoking Cigarettes
Males			
16–24	60·7	18–24	59·3
25–34	70·9	25–34	69·2
		35–44	68·0
35–59	71·0	45–54	63·5
		55–64	51·1
60 and over	52·6		
		65 and over	29·5
Total	66·0	Total	59·2
Females			
16–24	39·2	18–24	37·7
25–34	51·8	25–34	43·0
		35–44	38·9
35–59	44·7	45–54	29·0
		55–64	16·7
60 and over	28·8		
		65 and over	8·1
Total	41·6	Total	30·9

TABLE II.—*Percentage Distribution of Cigarette Smokers by Number Smoked Per Day for Males and Females in the United Kingdom in 1956 and the United States of America in 1955*

Cigarettes Per Day	Males		Females	
	U.K.	U.S.A.	U.K.	U.S.A.
<10	25	23	55	45
10–20	57	53	40	47
>20	18	24	5	8
Total	100	100	100	100

In age group 16–24 in the United Kingdom and age group 18–24 in the United States it appears that the proportion of people who smoke cigarettes is about the same in the two countries. The same is true of males in age group 25–34. In all other groups, particularly in the old-age group, it appears that a larger percentage of people smoke cigarettes in the United Kingdom than in the United States. The difference is most marked among women in age group 60 and older.

These figures suggest that the difference in reported lung cancer death rates between England and Wales and the United States may be partly due to the fact that there are

proportionally more cigarette smokers in the former than in the latter country (in age groups where lung cancer most frequently occurs). However, if this be true, it would seem that the ratio of the lung cancer death rate in the United Kingdom to the lung cancer death rate in the United States should increase with age and be highest in women in the old-age group. This does not appear to be the case.

For all age groups combined it appears that a somewhat larger percentage of cigarette smokers are in the over-20-cigarettes-a-day class in the United States than in the United Kingdom (see Table II). This should tend to nullify some of the effect (on lung cancer death rates) of the larger proportionate number of cigarette smokers in the United Kingdom than in the United States. Unfortunately, these figures are not available by age groups (which might perhaps alter the picture).

Number of Years of Smoking

There is reason to suppose that, other things being equal, the longer a person has smoked cigarettes the greater is the likelihood that he will develop lung cancer. Since smoking became popular at an earlier date in the United Kingdom than in the United States, it may be that there is a larger proportion of long-time cigarette smokers in the former country than in the latter. However, the great majority of men in the United States in age group 50–69 who are currently smoking cigarettes took up the habit before reaching the age of 25 (over half took it up before the age of 20) (Hammond and Horn, 1958a). This being the case, it seems unlikely that a difference, if any, in the number of years that cigarette smokers have been addicted to the habit could account for the large difference in lung cancer death rates between England and Wales and the United States.

Inhaling

A study by Schwartz and Denoix (1957) seems to indicate that, holding age, sex, type of smoking, and amount of smoking constant, smokers who inhale run a greater risk of lung cancer than do smokers who do not inhale. Data reported by the Tobacco Manufacturers' Standing Committee (Todd, 1957) indicate that the proportion of cigarette smokers who inhale: (*a*) increases with amount of smoking, (*b*) decreases with age, and (*c*) is greater among men than among women. We have recently made a study of inhalation in relation to age, type of smoking, and amount of smoking among men in the United States (Hammond, 1958). The findings of our study are in agreement with those of the British study.

In the British study the men were asked the simple question, "Do you inhale?" In our study the subjects were asked how much they inhale, given the choice between "do not inhale," "inhale slightly," "inhale moderately," and "inhale deeply." We are under the impression that the answers "inhale moderately" and "inhale deeply" taken together are roughly comparable to the answer "yes" in response to the question, "Do you inhale?" The following comparisons are valid only if this assumption is correct. Disregarding age, amount of cigarette smoking, and whether pipes and cigars were smoked as well as cigarettes, the proportion of male cigarette smokers who inhale is about 84% in the United Kingdom and about 82% in the United States. Among men under 60 years of age who smoke about a pack of cigarettes a day (or 15 to 24 cigarettes), about 91% inhale in the United Kingdom and 88% inhale in the United States. The comparable figures for age group 60 and older are 67% for the United Kingdom and 65% for the United States. These percentages for the two countries are remarkably close.

Proportion of Cigarette Smoked

Much of the tar and nicotine volatilized just behind the burning tip of a freshly lit cigarette is condensed as it is drawn through the cigarette towards the mouth of the smoker. This condensed material is largely revolatilized as smoking continues. As a result, the smoke from the last part of a cigarette which can be smoked is far richer in these ingredients than is the smoke from the portion first consumed. Some observers are under the impression that American smokers often discard a cigarette after taking only a few puffs, while this seldom happens in the United Kingdom. If true, this might make an appreciable difference in the degree to which smokers in the two countries are exposed to tobacco smoke.

Since casual observations can be very misleading, I have undertaken to collect some data on this subject in the United States, hoping that data for comparison will soon be available in the United Kingdom. There is no information on what factors influence the extent to which each cigarette is smoked, but it seems likely that the location and current activities of the smoker as well as individual idiosyncrasies play a part. With this in mind, I had 4,283 discarded cigarette butts collected from a variety of different locations, including business offices, private homes, restaurants, sidewalks of city streets, railroad and bus stations, and a public park. The collection was carried out in four large cities (Los Angeles, Chicago, Pittsburgh, and New York) and several smaller cities and towns (Harrisburg and Bradford, Pennsylvania; Oak Park, Wheaton, and Brookfield, Illinois; and Albany, New York). The butts were divided into those with filter-tips and those without filter-tips. Each butt was straightened out and the length of the remaining paper was measured. When the paper was burned farther down on one side than on another, the average length of the remaining paper was recorded. The results are shown on Table III.

The average length of all the butts was 30.9 mm., being 31.0 mm. for those with filter-tips and 30.7 mm. for those without filter-tips. Only 0.2% of the butts with filter-tips and 1.8% of those without filter-tips measured less than 15 mm., while 8.2% and 9.4% respectively measured less than 20 mm. Most filter-tip cigarettes are 85 or 80 mm. in total length, of which 17 or 18 mm. is taken up by the filter; but some are shorter in total length and some have shorter filters (the average length being about 82 mm.). About two-thirds of the cigarettes without filters sold in the United States in 1957 measured 70 mm. and most of the remainder measured 85 mm., the average length being about 75 mm. Since both filter-tip and non-filter-tip butts average about 31 mm. in length, it appears than on the average about

TABLE III.—*Lengths of Cigarette Butts Collected from Various Locations in the United States of America in* 1958

Location or Type of Cigarette	No. of Butts	Mean Length in mm.	Length of Butts in mm.								
			<15	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55+
			%	%	%	%	%	%	%	%	%	%
Total	4,283	30·9	0·8	7·9	19·7	19·9	20·9	12·8	8·9	4·4	2·7	2·0
Non-filter-tip	1,697	30·7	1·8	7·6	17·1	22·1	21·8	12·6	8·7	4·4	2·2	1·9
Filter-tip	2,586	31·0	0·2	8·0	21·3	18·4	20·4	13·0	9·1	4·3	2·9	2·2
Homes	1,563	30·1	1·1	8·2	19·6	22·4	21·9	12·0	7·8	3·6	2·4	1·0
Offices	1,117	30·3	1·1	7·6	21·5	19·5	20·9	13·6	7·6	3·8	2·4	1·9
Restaurants	496	34·5	0·6	4·0	11·1	16·9	19·4	18·7	15·3	7·1	2·8	4·0
Sidewalks	496	32·4	0·4	5·8	19·4	19·2	17·9	12·9	10·9	5·8	4·0	3·6
Stations	271	32·8	0·4	7·7	9·2	19·9	27·3	11·8	10·3	5·5	4·4	3·3
Park	340	26·7	0·3	15·9	35·3	14·7	18·2	5·9	5·0	2·1	1·8	0·9

38% of each filter-tip cigarette and about 41% of each non-filter tip cigarette is discarded.

At my request, Dr. Remmert Korteweg has collected and measured cigarette butts discarded by several different groups of people in the Netherlands and has kindly given me permission to publish his findings. Altogether, 545 butts were measured. The mean length was only 19.7 mm.; 19.6% were less than 15 mm. in length and 55.6% were less than 20 mm. in length. Dr. Korteweg warns that these are preliminary figures. Nevertheless, the very large difference between his findings in the Netherlands and my finding in the United States is suggestive. If an equally large difference of this kind exists between the United Kingdom and the United States, it may well account for the difference in reported lung cancer death rates.

There are some obvious difficulties in the method used in this study of cigarette butts. For one thing, the cigarette butts collected may not have been reasonably representative of all the cigarette butts discarded in the United States in the early part of 1958. More important, it is questionable whether the length of a discarded cigarette butt is a reliable index of the amount of smoke which was drawn into the mouth of the smoker. For example, lighted cigarettes are sometimes left to burn out in an ash-tray or on the ground. Furthermore, much of a cigarette may burn up while being held in the hand or left in an ash-tray between puffs. Thus a short butt does not necessarily indicate that most of the potential smoke from the cigarette was drawn into the mouth of a smoker. On the other hand, a long butt is sure proof that the smoker failed to avail himself of a large proportion of the potential smoke. In spite of these difficulties, I hope that the method is sufficiently reliable to reveal a large difference in this respect between Great Britain and the United States if a large difference in fact exists.

Chemical Composition of the Smoke Stream

Cigarettes were very much a standard product in the United States up until a few years ago. Now there are a great variety of types on the market, including "regular size" and "king size"; those without filter-tips and those with filter-tips of various degrees of effectiveness; some with the nicotine partly removed from the tobacco; and some with types of tobacco producing relatively low nicotine and tar in the main stream smoke. In addition, some brands with filter-tips began to contain more heavy burley-type tobacco and less light flue-cured tobacco in their blends. This probably nullified the benefit, if any, to be derived from the filter-tip.

In the middle of 1957 the amount of nicotine in the main stream smoke of the more popular brands of cigarettes in the United States varied from about 1.8 to 3.1 mg. and the amount of tar varied from about 25.6 to 42.8 mg. (Miller and Monahan, 1957a). If the number of cigarettes of each brand sold (Wooten, 1957) and the composition of the smoke are taken into account, the main stream smoke of the average cigarette had about 2.6 mg. of nicotine and 28.8 mg. of tar. Later that year a filter-tip cigarette with only 1.1 mg. of nicotine and 19.7 mg. of tar in the main stream smoke was put on the market (Miller and Monahan, 1957b). It immediately became popular, probably owing in part to an article on the subject which appeared in an influential magazine. To-day there are several additional low nicotine and low tar brands on the market. There have been no reports on the content of carbon monoxide and other gases in the main stream smoke of these cigarettes as compared with others. It appears that these new cigarettes are selling well. It remains to be seen whether they will eventually replace the old type and, if so, whether smokers will be benefited in terms of health.

Other Environmental Factors

Now let us consider the hypothesis that some environmental factor other than smoking entirely accounts for the difference in lung cancer death rates between the two countries.

It is well established that lung cancer can be caused by many years of heavy exposure to dusts of certain types—for example, radioactive minerals, chromates, and nickel (Hammond and Machle, 1956). Hueper (1955) has expressed the opinion that workers in various industries are exposed to a great many different substances (in the form of dust, gas, or vapour) that are of aetiological significance in lung cancer. This is difficult to prove one way or the other, because it is usually hard to find sufficiently large groups of workers who have had long exposure to known concentrations of specific dusts. Many of the dusts under suspicion in relation to lung cancer—for example, asbestos and beryllium—produce other serious effects upon the lungs. For this reason, intensive efforts have been made in the United States and elsewhere to protect workers from undue exposure. Presumably this would reduce or eliminate any potential lung cancer hazard.

General air pollution has long been under suspicion. The substances most often mentioned in this respect are: (*a*) fumes from motor vehicles and oil furnaces, (*b*) combustion products of coal, and (*c*) dust from asphalt roads. All of these contain small quantities of known carcinogenic substances. In addition, certain industrial plants discharge fumes which produce air pollution in the surrounding area. Some of these fumes may contain carcinogenic substances. The fact that these air pollutants contain carcinogenic substances does not necessarily prove that they cause lung cancer.

What concerns us here is whether a difference between England and Wales and the United States in respect to either occupational exposures or general air pollution could account for the differences in lung cancer death rates. Stocks and Campbell (1955) have studied lung cancer rates among men aged 45 to 74 in relation to type and amount of smoking in Liverpool compared with several small English cities and a rural area in Wales. There is considerable air pollution in Liverpool, and the Liverpool area has a high lung cancer death rate. There is almost no air pollution in the rural areas studied. In each of these areas the lung cancer death rate was found to be of the order of magnitude of 300 per 100,000 population per year higher for heavy cigarette smokers than for non-smokers. Among non-smokers and smokers alike, the lung cancer death rate was roughly 100 per 100,000 per year higher in Liverpool than in the rural area of Wales. The lung cancer death rate in the small cities was about the same as in the rural areas. Hammond and Horn (1958b) have studied lung cancer death rates in relation to smoking habits among men aged 50–69 in large cities, small cities, and rural areas of the United States. The rate was about 250 per 100,000 per year higher among heavy cigarette smokers than among men who never smoked. Both for smokers and non-smokers the lung cancer death rate was roughly 20 per 100,000 per year higher in large cities than in rural areas.

Since the data quoted above are almost the only information available on the subject for the moment, let us assume: (*a*) that air pollution, occupational exposure, or some other factor associated with urbanization produces an increase in the lung cancer death rate, and (*b*) that the force of this effect among males in age group 50–69 is 80 per 100,000 population per year greater in English and Welsh cities than in cities in the United States. Further, let us assume that this differential applies to three-fourths of the male population of both countries (people living in rural areas and cities such as Chester and Wrexham not being affected). Under these assumptions, the lung cancer death rates of males in age group 50–69 should be about 60 per 100,000 higher in England and Wales than in the United States.

In 1956 the reported lung cancer death rate among males in age group 50–69 was 233 per 100,000 in England and Wales and 115 per 100,000 in the United States, a difference of 118 per 100,000. This reported difference is about twice as large as might be expected on the basis of the hypothesis outlined above. Thus, even assuming that Liverpool is typical of all urban areas in England and Wales, it appears

that the difference in male lung cancer death rates between England and Wales and the United States cannot be attributed entirely to differences in air pollution or occupational exposures. Actually, Liverpool is far from typical. According to a report of the Registrar General (1957), the male lung cancer death rate in Merseyside (which includes Liverpool) is higher than in any other region of England and Wales and is 42% higher than for England and Wales as a whole. Furthermore, it is no criticism of the excellent work of Stocks and Campbell to say that it is difficult to obtain an accurate estimate of the lung cancer death rate of non-smokers and that their findings have not yet been verified by other investigators or in other cities with heavy air pollution.

Climate is another factor which cannot be ignored. In some heavily populated areas such as London and Los Angeles peculiar atmospheric conditions produce episodes of "smog" from time to time. From what little evidence is available, it appears that a far larger proportion of the population live in areas where this is a problem in England and Wales than in the United States. In addition, the climate of the British Isles is apparently such as to produce a higher incidence of bronchitis than in the United States. While it seems unlikely that bronchitis alone can result in lung cancer, it is not unreasonable to postulate that bronchitis increases the susceptibility of an individual to the carcinogenic effect of some other factor such as cigarette smoke or air pollutants.

Accuracy of Diagnosis

Finally, let us consider the hypothesis that differences in diagnosis and recording of deaths by cause entirely account for the difference in lung cancer death rates between the two countries.

The problem of accuracy of diagnosis plagues us whenever we attempt to compare death rates from cancer of specific sites in different periods of time, different countries, or different sections of the same country. For example, there is reason to suspect that lung cancer, when present, is somewhat more likely to be diagnosed in urban areas than in rural areas of the United States (doctors and medical facilities being concentrated in cities). This being the case, we are not at all sure that the small difference between urban and rural areas in lung cancer death rates among men with the same smoking habits is real or whether it is merely the result of differences in diagnosis. Likewise, it is reasonable to suppose that, owing to improvements in medical science, lung cancer is more likely to be correctly diagnosed to-day than it was thirty or forty years ago. It seems likely that some of the apparent rise in lung cancer death rates was due to the improvement in diagnosis (Dorn, 1954).

If the difference in lung cancer death rates between England and Wales and the United States is merely the result of a difference in the level of diagnosis, then (*a*) British physicians are making this diagnosis in about twice as many men as actually have the disease, or (*b*) American physicians are missing about half the cases that actually occur in men, or (*c*) British physicians tend to err in one direction and American physicians tend to err in the other direction.

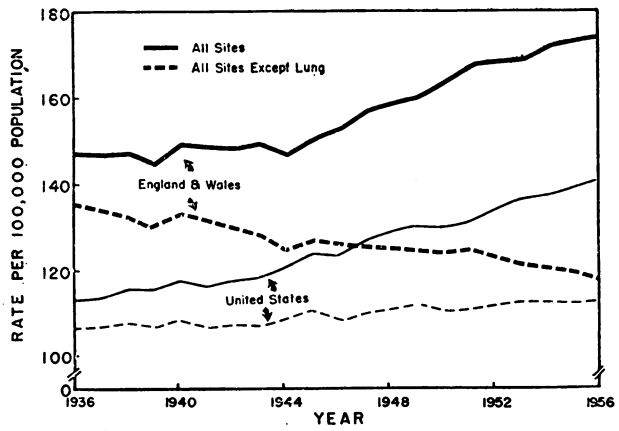

FIG. 3.—Male cancer death rates (standardized for age on 1940 U.S.A. population) for England and Wales and United States (U.S.A. figures for white males) in 1936–56.

Some other respiratory disease may sometimes be recorded as the cause of death when the patient actually died of lung cancer. However, among white males aged 50–64 in 1955 in the United States, 9,789 deaths were attributed to lung cancer and only 9,112 deaths were attributed to all other respiratory disease combined (including pulmonary tuberculosis, influenza, pneumonia, etc.). Even if half of the deaths attributed to other respiratory diseases were actually due to lung cancer, it would not account for the entire difference in lung cancer deaths between England and Wales and the United States.

Fig. 3 shows the death rates from cancer of all sites and cancer of all sites except the lung for males in the two countries for the period 1936 to 1956. For comparability, the rates have been standardized for age on the age distribution of the population of the United States in 1940. The figures for the United States are for white males only.

The reported total cancer death rate (age-standardized) increased in the United States during this entire period of 20 years and increased in England and Wales from 1944 onward. In all of these years the rate was far higher in England and Wales than in the United States. The interesting fact shown on this chart is that when lung cancer is *excluded* the rate went steadily down in England and Wales from 1936 to 1956 while it rose slightly in the United States during the same period of time. This may be a true picture of what actually occurred. On the other hand, it may be a clue to a part of our puzzle.

We have reason to believe that cure rates for cancer of some sites improved somewhat in the United States during this period of time (Hammond, 1957). We have no reason to believe that there was a real increase in incidence rates of cancer of sites other than lung. When cancer kills, it is usually widespread in the body at the time of death, and in many cases it is by no means easy to ascertain the site of origin of the disease. These facts suggest the following hypothesis. When cancer is present at the time of death both in the lungs and in other parts of the body and the primary site cannot be determined with accuracy, there is a tendency in England and Wales to record lung as the primary site and a tendency in the United States to record some other organ as the primary site.

This hypothesis, if true, would account for a part of the difference in lung cancer death rates between the two countries; but it would not explain why the total cancer death rate among males is far higher in England and Wales than in the United States. One would further have to assume that cancer (regardless of primary site) is either over-reported as a cause of death in England and Wales or under-reported in the United States, or both.

Conclusions

There must be some explanation for the fact that reported lung cancer death rates for men are about twice as high in England and Wales as in the United States and the rates for females are about one and a half times as high in England and Wales as in the United States.

Data at present available do not support the hypothesis that a substantial part of this difference can be attributed to differences in amount of cigarette smoking among males and females in various age groups in the two countries. However, more detailed information on smoking habits and on the chemical composition of smoke from cigarettes in the two countries is needed before this can be definitely established.

While it is possible that some of the difference in lung cancer death rates may be due to factors associated with urbanization—for example, air pollution or occupational

exposures—available evidence does not suggest that these factors can account for a large part of the difference.

Factors related to climate and to the incidence rates of bronchitis cannot be ruled out of consideration. There is too little evidence at present to draw any conclusions concerning this point.

It is within the realm of possibility that a part of the difference is due to under-reporting of lung cancer as a cause of death in the United States or to over-reporting of lung cancer as a cause of death in England and Wales, or both.

Clearly, the data at present available are insufficient for any definite conclusions to be drawn on why reported lung cancer death rates are so much higher in England and Wales than in the United States. However, it does not appear likely that any single one of the factors discussed above is sufficient in itself to account for all of the difference. This suggests that the difference may be due to an interaction of two or more of these factors. For example, bronchitis, which appears to be more common in England and Wales than in the United States, may increase the susceptibility of individuals to the carcinogenic effect of tobacco smoke or air pollution.

Summary

In 1955 the lung cancer death rate reported in England and Wales for males was 2.1 times as high as reported in the United States and for females 1.6 times as high. A difference of this order of magnitude has existed in male rates for several decades; while prior to 1949 there was only a small difference in the female rates.

Among both males and females in the middle- and old-age groups there are proportionately more cigarette smokers in the United Kingdom than in the United States. On the other hand, at the present time the number of cigarettes consumed per smoker per day is higher in the United States than in the United Kingdom. The proportion of male cigarette smokers who inhale appears to be approximately the same in the two countries. In the United States the average length of the remaining butt after a cigarette is discarded is about 31 mm.; about 5% are 45 mm. or longer and about 9% are under 20 mm. in length. In the United States in 1957 the main stream smoke of the average cigarette contained about 2.6 mg. of nicotine and 42.8 mg. of of tar. More recently, cigarettes with a relatively low content of nicotine and tar have become increasingly popular in the United States.

Data at present available do not support the hypothesis that a substantial proportion of the difference in lung cancer death rates between the two countries is attributable to differences in the use of cigarettes. However, more detailed information on smoking habits and on the chemical composition of cigarette smoke in the two countries is needed before this can be definitely established.

In both countries the lung cancer death rate of smokers, as well as the lung cancer death rate of non-smokers, is higher in urban areas than in rural areas. The difference in this respect is reported to be far greater between Liverpool and rural areas of Wales than between large cities and rural areas in the United States. However, Merseyside (which includes Liverpool) has a higher male lung cancer death rate than any other region in England and Wales, so it cannot be considered as typical of the country as a whole. While it is possible that some of the difference in lung cancer death rates may be due to factors associated with urbanization—for example, air pollution or occupational exposures—available evidence does not suggest that these factors can account for a large part of the difference.

The reported death rate from cancer, exclusive of lung cancer, declined steadily from 1931–5 to 1956 in England and Wales but rose slightly in the United States during the same period of time. It is possible that differences in the diagnosis and recording of causes of death may account for a part of the difference between reported lung cancer death rates in the two countries.

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PARAPLEGIA FOLLOWING EPIDURAL ANAESTHESIA

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We present a case of paraplegia that occurred after an epidural anaesthetic. So far as we can ascertain no similar case has been reported.

Case Report

A man aged 76 was admitted to hospital on March 14, 1957. He complained that for seven days before admission he had pain in his left-sided femoral hernia, with associated central abdominal intermittent pain. Two days before admission the pain in the rupture and the abdomen had become more severe and he started to vomit profusely. His bowels, usually regular, had been opened inadequately on the days before admission, and since the onset of the severe intermittent pain he had had no bowel movement nor had he passed flatus. The rupture appeared first six months before admission, but was small, and he had experienced no discomfort in it before.

In May, 1956, the patient was first seen at Ashford Hospital in congestive heart failure with pulmonary oedema. He was admitted to hospital and his cardiovascular condi-