

that these subjects were primarily insulation workers. While all of them were occupationally exposed to asbestos dust, their degree of exposure was light as compared with the degree of exposure of asbestos miners, processors, and weavers in earlier times.

Bronchogenic Carcinoma.—Bronchogenic carcinoma accounted for 24 deaths while only about 2.3 were expected on the basis of general United States mortality data for white males. However, as previously mentioned, evidence at hand suggests that there were proportionally somewhat more cigarette smokers among the 370 subjects than among white males in the United States as a whole, age being taken into consideration. This might have partially accounted for the high bronchogenic carcinoma death rate of the subjects. For this and other reasons we made estimates of the expected number of bronchogenic carcinoma deaths, the smoking habits of the men being taken into consideration. This was done as follows:

Data are available on lung cancer deaths in relation to the smoking habits of 440,000 men enrolled by American Cancer Society volunteers in a prospective epidemiological study between October 1959 and March 1960 and traced through Sept 30, 1964. Causes of death were ascertained from death certificates, but whenever cancer was mentioned on a death certificate inquiry was made of the physician who signed the certificate. In case of disagreement between the two sources of information, the physician's statement was accepted. For the purpose at hand, we only made use of data covering the 52-month period beginning on June 1, 1960, and ending on Sept 30, 1964. The number of lung cancer deaths occurring during the 52-month period was divided by the number of men alive at the beginning of the period. This was done by five-year age groups for men in each of the following smoking categories: (1) never smoked regularly (nonsmokers and occasional smokers being combined); (2) history of regular pipe or cigar smoking, past or present, but never smoked cigarettes regularly; (3) excigarette smokers (including those who had smoked or currently smoked pipes or cigars); and (4) current regular cigarette smokers (including those who also had smoked or currently smoked pipes or cigars). The last of these categories was further divided by current number of cigarettes smoked per day: (4a) one to nine cigarettes a day; (4b) 10 to 19 cigarettes a day; (4c) 20 to 39 cigarettes a day; and (4d) 40 or more cigarettes a day. Since the men were divided into seven groups by smoking habits and further sub-

Table 4.—Estimated Number of Lung Cancer Deaths Expected to Occur During a Period of 52 Months per 10,000 Men Living at the Start of Period; by Age and by Smoking Habits*

Age, Yr (Jan 1, 1963)	Never Smoked Regularly	Pipe, Cigar Only	Excigarette Smokers†	Current Cigarette Smokers‡			
				1-9 a Day	10-19 a Day	20-39 a Day	40+ a Day
35-39	0	...	5	...	...	...	...
40-44	2	...	75	...	...	15	15
45-49	2	2	10	...	...	39	46
50-54	7	12	22	28	44	69	90
55-59	6	15	53	...	91	117	185
60-64	16	31	71	80	...	190	256
65-69	14	32	97	...	157	305	350*
70-74	12	52	100	103	206	288	450*
75-79	28	53	100	...	185	341	329
80-84	25	32	148	...	...	...	...

*Based upon data from a prospective study with adjustment for US mortality experience.

†Ellipses indicate rates omitted for categories with no subjects in this study. See Table 2.

‡Includes cigarette smokers who also smoked pipe or cigar. Men with a history of only cigarette smoking have higher lung cancer rates than shown here.

§Rates obtained by smoothing the data.

divided into many five-year age groups, some of the subgroups contained only a small number of men. In consequence, the lung cancer death rate was statistically unstable in some of the very small subgroups. In three instances where the observed rate in a small subgroup appeared to be badly out of line, we arbitrarily made an adjustment to bring it more into line with adjacent figures in the table. These adjusted figures which are indicated with symbols in Table 4 carry very little weight in the final calculation. All of the rates were then adjusted as follows:

Lung cancer death rates in the United States have risen steadily year by year and were higher in 1964 than during the period 1960 to 1964 as a whole. Furthermore, in the study described above, we avoided enrolling seriously ill people and, as of the cut-off date for preparing the computer tape, we had not yet received death certificates for all of the men now known to have died during the specified period of time. For these reasons, lung cancer death rates in the study population were appreciably lower than those reported for white males in the United States in 1964. To compensate for this, we raised the rate of each individual smoking category so that the total lung cancer death rate (disregarding smoking habits) in each five-year age group would be the same as that of all United States white males (based upon the 1964 life table and the 1964 distribution of deaths by causes of death). The results of these computations are shown in Table 4. (It should be noted that Table 4 shows only such rates as were required for further calculations.)

The rates shown in Table 4 were then applied to the number of asbestos workers shown in each of the corresponding internal cells of Table 2. This yielded an estimate of the number of lung cancer deaths expected to occur during a 52-month period among the 370 asbestos workers classified by their smoking habits. By "expected" number, we here mean an estimate of the number of lung cancer deaths which would have occurred under the null hypothesis that asbestos workers do not differ from other men in respect to their lung cancer death rates, both age and smoking habits being taken