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PANEL ON EPIDEMIOLOGY, INCLUDING ENVIRONMENTAL AND OCCUPATIONAL CANCER. W. C. HUEPER and others, Proc. Nat. Cancer Conf., 1949, p. 244.

The following forms of occupational cancer are discussed: bladder tumors from β naphthylamine and benzidine; skin cancer from petroleum fractions, shale oil, arsenicals, and radiation; lung cancer from chromates, asbestos, and nickel carbonyl; bone cancer from radium. The possibility is being investigated that cancer may be produced by bars containing radium used to prevent accumulation of static electricity in textile and printing plants. Beryllium compounds are reported to have produced tumors in animals and pulmonary disease but thus far no tumors in man.

MARION HORN PESKIN [CHEM. ABST.].

A STUDY OF THE EFFICIENCY OF GROUPS OF EX-MINERS DISABLED BY PNEUMOCONIOSIS EMPLOYED IN LIGHT INDUSTRIES IN SOUTH WALES. J. A. P. TREASURE, Brit. J. Social Med. **3**:127 (July) 1949.

For the purposes of the investigation reported, certification by the Silicosis Medical Board was taken as defining "disabled by pneumoconiosis" and absence for sickness as the measure of efficiency. Certified and uncertified sickness were considered separately. The statistical inquiry was supplemented by collecting opinions from the employers. It was found that the difference between the disabled men and a control group of fit men (matched for age distribution) was not sufficiently distinct, in either class of absence, to be statistically significant. The subjective opinions collected confirmed the fact that employers were not conscious of any difference. In each of three successive years the disabled men had slightly more uncertified sickness than the fit men, and slightly less certified sickness; but this trend was again found to be statistically nonsignificant. No difference in industrial behavior could be detected between men in receipt of weekly compensation and those who had compounded for a lump sum.

The study is confined to a small number of small groups, all employed in light factory work. Such evidence as is available, however, gives no reason to regard the factories studied as exceptional.

ALICE M. STEWART [BULL. HYG.].

PNEUMONOKONIOSIS IN QUEENSLAND FOUNDRIES. D. GORDON, M. J. Australia **2**:217 (Aug. 5) 1950.

Gordon says that all Queensland foundries, 76 in all, were investigated with regard to the pneumonoconiosis hazard. Among a working population of 1,118 there were 388 who had worked sufficiently long in foundries to make the development of pneumonoconiosis a possibility. Of the 388 foundry workers eligible for the survey, 359 agreed to cooperate. From these, occupational and medical histories were obtained; the patients were examined, and large roentgenograms of their chests were taken. At the same time all foundries were inspected, and dust surveys were carried out in approximately 15 of them. Thirteen cases of silicosis were discovered; in addition, eight workers were eventually considered to present "doubtful" involvement. Ten of the silicotics were considered to have "early" lesions. The great majority of subjects whose silicotic involvement was "positive" were elderly, and were foundry dressers or furnace men. Thus it seems that steel dressers and furnace men are exposed to the severest dust hazards.

Comparing his observations with those reported in other surveys, the author concludes that in Queensland foundries the incidence of pneumonoconiosis is not high. Furthermore, he thinks that it is wrong to regard the man with early silicosis as an invalid.

PREVENTION OF SILICOSIS. D. EVANS and W. SCHWEISHEIMER, South African Mining Engin. J. **60** (II):807, 1950.

The problem of pneumonoconiosis in the wider sense is discussed and the status of diagnosis, treatment, and prevention compared between England, the United States, and South Africa. Prevention of silicosis should principally consist in removal of all harmful dust concentrations, i. e., with more than 15-20% silicon dioxide, exceeding 5 million particles per cubic feet of air.

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ETIOLOGIC FACTORS IN BRONCHIOGENIC CARCINOMA WITH SPECIAL REFERENCE TO INDUSTRIAL EXPOSURES

Report of Eight Hundred Fifty-Seven Proved Cases

ERNEST L. WYNDER, M.D.
NEW YORK
AND
EVARTS A. GRAHAM, M.D.
ST. LOUIS

IN A PREVIOUS paper we [1] brought forth evidence directing attention to tobacco smoking as a factor in the causation of primary cancer of the lung. During the past year similar conclusions have been drawn by others in this country (Schrek and associates,[2] Levin and associates,[3] and Mills and Porter [4]). Indirect evidence has been supplied from Iceland by Dungal,[5] who has demonstrated through his autopsy records a low incidence of bronchiogenic carcinoma in that country, noting at the same time that the annual consumption of tobacco in Iceland did not reach 1 lb. (0.5 kg.) per capita until 1945, an amount reached in Great Britain, which has a high incidence of lung cancer, as early as 1920. Recently a large-scale statistical study of this subject has been published in Great Britain by the well known statisticians Doll and Bradford Hill.[6] That survey involves 709 lung-cancer patients and is based, as is our own survey, on cases collected only through personal interviews. It presents results remarkably similar to those shown in our own investigation. Among 649 male patients with primary carcinoma of the lungs the British workers found two nonsmokers. Doll and Bradford Hill concluded that "smoking is a factor, and an important factor, in the production of carcinoma of the lungs." They emphasized, furthermore, that "the risk of developing carcinoma of the lungs increases steadily as the amount smoked increases."

From the Department of Medicine, Georgetown University School of Medicine, Washington, D. C., and the Department of Surgery, Washington University School of Medicine, St. Louis.

1. Wynder, E. L., and Graham, E. A.: Tobacco Smoking as a Possible Etiologic Factor in Bronchiogenic Carcinoma, J. A. M. A. **143**:329-336 (May 27) 1950.

2. Schrek, R.; Baker, L. A.; Ballard, G. P., and Dolgoff, S.: Tobacco Smoking as an Etiologic Factor in Disease: I. Cancer, Cancer Res. **10**:49-58 (Jan.) 1950.

3. Levin, M. L.; Goldstein, H., and Gerhardt, P. R.: Cancer and Tobacco Smoking, J. A. M. A. **143**:336-338 (May 27) 1950.

4. Mills, C. A., and Porter, M. M.: Tobacco Smoking Habits and Cancer of the Mouth and Respiratory System, Cancer Res. **10**:539-542 (Sept.) 1950.

5. Dungal, N.: Lung Cancer in Iceland, Lancet **259**:245-247 (Aug. 12) 1950.

6. Doll, R., and Hill, A. B.: Smoking and Carcinoma of the Lung, Brit. M. J. **2**:739-748 (Sept. 30) 1950. R. Doll, M.D., M. R. C. P., is a member of the Statistical Research Unit of the Medical Research Council; A. Bradford Hill, Ph.D. D.Sc., is professor of medical statistics, London School of Hygiene and Tropical Medicine.

The present paper presents data on possible exogenous factors other than tobacco smoking that have been considered by some writers to play a role in the induction of lung cancer. These data concern the urban and rural distributions and the occupations of lung-cancer patients. It is clear that all factors of irritation must be investigated in order to determine which one or which group of factors, if any, plays a responsible part. By comparing the data of this paper with those of our previous publication, we may note whether tobacco, and more particularly cigarets, is a major factor or just one of many factors involved in the etiology of cancer of the lungs.

METHOD OF STUDY

The present paper is based on 857 cases of proved bronchiogenic carcinoma. All of the patients were individually interviewed and data collected. This survey included 760 males who had epidermoid, undifferentiated, or unclassified bronchiogenic carcinoma, including 51 interviewed in Europe. The study also includes 43 males who had adenocarcinoma, as well as 54 females, of whom 32 had epidermoid or undifferentiated carcinoma and 22 adenocarcinoma. For the comparative evaluation of the results regarding the urban and rural distributions of the patients, respectively, we give only the data from the Barnes Hospital Chest Service, St. Louis. For proper evaluation of the other data, similar control studies would have to be made in each section of the country. The size of the locality in which a given patient was placed depended on where he had lived during most of his adult life.

In the presentation of occupational data the lung-cancer patients are compared with the patients having other diseases of the chest seen at the Barnes Hospital Chest Service, both groups being of similar age and economic distribution. These groups in turn are compared with the occupational groups of lung-cancer patients in hospitals elsewhere in the United States. To be placed in a given occupational category the patient must have worked in that job at least five years and within the last 40 yr. of his life. If a given worker was employed in more than one major occupation, that occupation was selected in which he felt he had been exposed the most to irritative dusts or fumes. The occupational history taken includes all jobs that a given person had held in his lifetime. It attempted not merely to get the names of the occupations but to learn the specific tasks that such jobs involved with special consideration of those in which the patient was exposed to irritative substances. The search for such substances was extended by questioning the patients about hobbies which might expose them to irritative factors.

RESULTS

Tobacco Consumption of Patients Interviewed.—This report adds data on 128 additional cases of lung cancer to our previous data. Among the 760 male patients (709 American and 51 European) with proved epidermoid, undifferentiated, or unclassified bronchiogenic carcinoma of the lungs there were 1.4% nonsmokers, 2.6% light smokers, 9.7% moderately heavy smokers, 34.9% heavy smokers, 30.5% excessive smokers, and 20.8% chain smokers.[7] Table 1 shows the results broken down into three independent surveys, in all of which, however, the same questionnaire was used. Group A includes 166 persons interviewed by nonmedical

7. Nonsmokers were persons who smoked less than one cigaret per day for more than 20 yr.; light smokers, from one to nine cigarets per day for more than 20 yr.; moderately heavy smokers, from 10 to 15 cigarets per day for more than 20 yr.; heavy smokers, from 16 to 20 cigarets per day for more than 20 yr.; excessive smokers, from 21 to 34 cigarets per day for more than 20 yr.; chain smokers, 35 cigarets or more per day for at least 20 yr. Pipe and cigar smokers have been included by arbitrarily counting one cigar as five cigarets and one pipeful as 2½ cigarets.

The term "light smokers" used above includes minimal smokers, from 1 to 4 cigarets a day (or the equivalent in pipes or cigars) for more than 20 yr.

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investigators[8] at Barnes Hospital, who did not know the diagnosis of any given case in advance. Group B includes those patients interviewed and data collected by one of us (E. L. W.). Group C comprises the persons interviewed by other physicians.[9] Group C includes 37 persons interviewed by Mr. John Borrie, in England.[10] Borrie's patients include 0.0% nonsmokers, 2.7% light smokers, 18.9% moderately heavy smokers, 37.8% heavy smokers, 24.3% excessive smokers, and 16.2% chain smokers.

The 43 male patients with adenocarcinoma of the lungs include 9.3% nonsmokers, 4.7% minimal smokers, 6.9% light smokers, 13.9% moderately heavy smokers, 39.5% heavy smokers, 9.3% excessive smokers, and 16.3% chain smokers. Among the 32 female patients with epidermoid and undifferentiated carcinoma of the lungs there are 43.7% nonsmokers and 3.1% light smokers, with 53.1% being at least moderately heavy smokers. Among the 22 women with adenocarcinoma of the lungs there were 9.1% light smokers, the remainder being nonsmokers.

TABLE 1.—*Percentage Distribution of 760 Male Patients with Epidermoid Undifferentiated, or Unclassified Bronchiogenic Carcinoma According to Tobacco Consumed Over a Twenty-Year Period* *

	Group A 160	Group B 428	Group C 160	Total 760
Nonsmokers	1.2	1.6	1.2	1.4
Light smokers	5.4	1.6	2.4	2.6
Moderately heavy smokers	6.0	11.5	9.0	9.7
Heavy smokers	33.8	36.7	31.3	34.9
Excessive smokers	30.1	30.4	31.3	30.5
Chain smokers	23.5	18.2	24.7	20.8

* For comparison the results are broken down into three independently conducted surveys in which the same questionnaire was used. The percentages relate to the number in the group.

TABLE 2.—*Percentage Distribution of 200 Lung-Cancer Patients and 200 Patients with Other Diseases of the Chest from Barnes Hospital Chest Service, Both Groups of the Same Age and Economic Status*

Size of Locality	Lung-Cancer Patients (200)	Patients with Other Diseases of the Chest (200)
100,000 plus	32.0	35.0
50,000	18.5	9.5
10,000	14.0	22.5
10,000 or less	25.0	20.5
Farm areas	10.0	12.5
	100.0	100.0

Urban-Rural Distribution of Patients.—The locality distribution of 200 lung-cancer patients and 200 patients with other chest diseases, both groups from the Barnes Hospital Chest Service and both of the same age and economic status, are shown in Table 2.

8. Betty G. Proctor, B.A., and Adele B. Croninger, M.A.

9. Dr. E. J. Ehrenhaft, University of Iowa Hospital; Lt. Col. J. M. Salyer, Fitzsimmons General Hospital; Dr. E. J. Shabart, Veterans Administration Hospital, Hines, Ill.; Dr. C. T. Surington, Crile Veterans Hospital, Cleveland; Dr. H. G. Turner, Bellevue Hospital, New York; Dr. G. W. Ware, Boston City Hospital, Boston.

10. Mr. Borrie is assistant surveyor, Shanley Bridge, [illegible]

Statistical evaluation of the locality distribution data by Mr. Jerome Cornfield, chief of the Research Studies Unit, Biometric Section, National Cancer Institute,

TABLE 3.—*Percentage Occupational Distribution of Male Patients with Chest Diseases and Male Patients with Epidermoid, Undifferentiated, or Unclassified Lung Cancers of Barnes Hospital and Other United States Hospitals, Who Were Believed or Known to Have Been Exposed to Irritative Dusts and/or Fumes*

	Barnes Hospital Chest Service			
	Diseases of Chest Other Than Lung Cancer, 200 Patients	Cancer, 200 Patients	Other U. S. Cancer, 509 Patients	Total U. S. Cancer 709 Patients
Painter	1.0%	5.5%	6.3%	6.1%
Hot metal worker	3.0	5.5	5.9	5.8
Cold metal worker	4.0	3.0	5.5	4.8
Automobile mechanic	2.5	5.0	2.6	3.2
Carpenter	1.5	2.0	3.3	2.9
Chauffeur	1.0	2.0	2.8	2.5
Railroad worker	4.0	3.5	1.8	2.3
Electrician	2.0	2.5	1.8	2.0
Cook	0.0	1.0	2.4	1.8
Construction worker	0.5	2.0	1.8	1.8
Fireman	1.0	0.5	2.0	1.6
Truck driver	2.5	2.5	1.2	1.6
Shoe repairman	1.0	2.0	1.2	1.4
Coal miner	7.0	2.5	1.0	1.4
Tailor	0.5	0.5	1.6	1.3
Oilfield worker	2.0	3.5	0.4	1.3
Plumber	0.5	2.5	0.6	1.1
Garage worker	2.0	2.0	0.4	0.9
Lead miner	2.0	3.0	0.0	0.9
Baker	0.0	0.5	1.0	0.9
Cabinet maker	1.0	1.0	0.8	0.9
Mason	1.0	1.0	0.6	0.7
Janitor	1.0	1.0	0.6	0.7
Printer	1.0	0.5	0.8	0.7
Gardener	0.5	0.5	0.8	0.7
Cable splicer	0.0	0.0	0.6	0.4
Junkman	0.0	0.0	0.6	0.4
Coal truck driver	0.0	0.5	0.4	0.4
Stationary engineer	0.0	0.5	0.4	0.4
Hoisting engineer	0.0	0.5	0.4	0.4
Paper cutter	0.0	0.5	0.4	0.4
Rock driller	0.0	0.0	0.4	0.3
Quarry worker	0.0	0.0	0.4	0.3
Plasterer	0.0	0.0	0.4	0.3
Railroad conductor	0.5	0.5	0.2	0.2
Oil truck driver	0.0	0.5	0.0	0.1
Gasoline and oil handler	0.0	0.5	0.0	0.1
Asphalt worker	0.5	0.0	0.2	0.1
Packer	0.0	0.0	0.2	0.1
Asbestos worker	0.0	0.0	0.2	0.1
Windowshade maker	0.0	0.0	0.2	0.1
Upholsterer	0.0	0.0	0.2	0.1
Powder worker	0.0	0.0	0.2	0.1
Circus performer	0.0	0.0	0.2	0.1
Tombstone setter	0.0	0.0	0.2	0.1
Wire roper	0.0	0.0	0.2	0.1
Longshoreman	0.0	0.0	0.2	0.1
Motor assembler	0.0	0.5	0.0	0.1
Subway motorman	0.0	0.0	0.2	0.1
Radio repairman	0.0	0.0	0.2	0.1
Refrigerator repairman	0.5	0.0	0.0	0.0
Glass blower	1.0	0.0	0.0	0.0
	45.0%	50.5%	53.2%	55.0%
	90	119	271	390

revealed "no systematic statistically significant difference" in locality distribution between the lung-cancer patients and the other chest-disease patients.

Of the remainder of the 509 American lung-cancer patients with epidermoid, undifferentiated or unclassified cancers, 8.4% lived in farm areas and 46.9% in

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Cancer, 0 Patients	Other U. S. Cancer, 509 Patients	Total U. S. Cancer 709 Patients
5.5%	6.3%	6.1%
5.5	5.9	5.8
3.0	5.5	4.8
5.0	2.6	3.2
2.0	3.3	2.9
2.0	2.8	2.5
2.5	1.8	2.3
2.5	1.8	2.0
1.0	2.4	1.8
2.0	1.8	1.8
0.5	2.0	1.6
2.5	1.2	1.6
2.0	1.2	1.4
2.5	1.0	1.4
0.5	1.6	1.3
3.5	0.4	1.3
2.5	0.6	1.1
2.0	0.4	0.9
3.0	0.0	0.9
0.5	1.0	0.9
1.0	0.8	0.9
1.0	0.6	0.7
1.0	0.6	0.7
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100,000 or more. Of the 32 female patients with epidermoid or undifferentiated lung cancers, and the 22 female patients with adenocarcinoma, 12.5% and 18.2%, respectively, came from farm areas and 65.6% and 54.5% came from cities with a population of 100,000 or more. Data from the United States Census Bureau show that in April, 1949, the total civilian population living on farms amounted to 19.0%,[11] and preliminary data show that in 1950 29.3% of the American population lived in cities of 100,000 or more.[12]

TABLE 4.—*Percentage Occupational Distribution of Male Patients with Chest Diseases and Male Patients with Epidermoid, Undifferentiated, or Unclassified Lung Cancers of Barnes Hospital and Other United States Hospitals Who Were Believed Not to Have Been Exposed to Irritative Dust and/or Fumes*

	Barnes Hospital Chest Service			
	Diseases of Chest Other Than Lung Cancer, 200 Patients	Cancer, 200 Patients	Other U. S. Cancer, 509 Patients	Total U. S. Cancer 709 Patients
Clerk	10.5%	5.5%	7.5%	6.9%
Farmer, rancher	15.0	9.0	5.5	6.5
Executive	6.0	6.5	5.1	5.5
Salesman	5.0	3.5	6.1	5.4
Merchant	1.0	2.5	3.5	3.2
Accountant	1.5	0.5	1.6	1.3
Bartender	1.0	0.5	1.4	1.1
Armed forces	0.5	0.5	1.4	1.1
Lawyer	0.0	1.0	1.2	1.1
Physician	2.5	0.5	1.2	1.0
Waiter	0.5	0.5	1.2	1.0
Barber	1.0	1.0	1.0	1.0
Draftsman	1.0	1.0	0.8	0.9
Musician	0.0	0.0	1.0	0.7
Banker	0.5	0.5	0.8	0.7
Butcher	0.5	0.5	0.8	0.7
Policeman	1.0	1.0	0.6	0.7
Engineer	1.0	1.0	0.6	0.7
Postman	0.0	0.5	0.6	0.5
Actor	0.0	0.5	0.6	0.5
Pharmacist	1.5	1.0	0.4	0.5
Porter	0.5	1.0	0.4	0.5
Jeweler	0.5	0.0	0.6	0.4
Dentist	1.0	0.5	0.4	0.4
Huckster	0.5	0.5	0.4	0.4
Surveyor	0.0	0.0	0.4	0.3
Contractor	0.0	0.0	0.4	0.3
Teacher	0.5	0.0	0.4	0.3
Stevedore	0.0	0.5	0.0	0.1
Priest	0.5	0.5	0.0	0.1
Sealer	0.0	0.0	0.2	0.1
Window cleaner	0.0	0.0	0.2	0.1
Baseball umpire	0.0	0.0	0.2	0.1
Tea blender	0.0	0.0	0.2	0.1
Pilot	0.0	0.0	0.2	0.1
Caddie	0.0	0.0	0.2	0.1
Ship captain	0.5	0.0	0.0	0.0
Gambler	0.5	0.0	0.0	0.0
Movie operator	1.0	0.0	0.0	0.0
	55.0%	40.5%	46.8%	45.0%
	110	81	238	319

Distribution of Patients Relative to Occupations.—The patients from whom data on occupational exposures were collected have been divided into Group A, workers exposed to known or suspected irritative dusts and/or fumes (Table 3), and Group B, workers not believed to have been exposed to such substances any more than one is ordinarily exposed in his daily environment (Table 4).

[11] [illegible] Census Population Characteristics Report Series P-20 No. 26

Fifty different occupations were presented in Group A and 36 in Group B, totaling 86 occupations found among 709 American male lung-cancer patients.

Group A: Three hundred and ninety of the total number of American male lung-cancer patients fall into Group A (55%). The Barnes lung-cancer patients show a percentage of 59.5 in that group, compared with 45.0% of the Barnes patients with noncancer chest diseases. The highest occupational incidence in Group A is that of painters (6.1%). There are 5.8% hot-metal workers and 4.8% other metal workers, giving a total of 10.6% metal workers. Among those exposed to hot metal are 27 foundry and steel-mill workers, 6 welders, 5 smelters, and 3 blacksmiths. Among the other metal workers are 21 machinists, 8 sheet-metal workers, 3 metal grinders, and 2 metal polishers (1 brass and 1 nickel). Additional workers who may be exposed to some metals are electricians (1.8%), plumbers (1.1%), lead miners (0.9%), and printers, (0.7%); automobile mechanics total 3.2%. Other workers who had been exposed to gasoline and oil fumes include oil-field workers (1.3%), garage workers (0.9%), and oil-truck drivers, and gasoline-and-oil handlers (0.1% each). A higher-than-average gasoline-fume exposure may also involve chauffeurs (2.5%) and truck drivers (1.6%). Carpenters (2.9%) and cabinet makers (0.9%) are exposed to wood dust. The latter are also exposed to varnish. One packer (0.1%) was exposed to wood dust (excelsior).

Group B: There are 319 American male lung-cancer patients whose histories reveal no significant known or suspected inhalation of irritative dusts or fumes (45.0%). In the Barnes lung-cancer subgroup 40.5% are in Group B and in the control Barnes chest subgroup 55.5%. The occupations with a high percentage in Group B are those which have a high percentage among the general population, as may be seen from the Barnes chest control group. In the total United States cancer group there are 6.9% clerks, 6.5% farmers and ranchers, 5.5% executives, 5.4% salesmen, and 3.2% merchants. Physicians make up 1.0% of the total group.

Statistical Analysis of the Occupational Incidence: The statistical analysis of these data was also carried out by Mr. Cornfield. He concludes:

> Chi-square computed for all 66 occupations having at least one patient in the Barnes Hospital group was 60, somewhat less than the expectation of 65, and consequently not significant. The only occupation, considered by itself, which occurred with significantly higher frequency among the cancer group was that of painter. The probability of obtaining at least as large a positive difference as that observed was 0.01. This calculation does not take into account, however, the fact that painters were selected for a significance test because they showed the largest difference between the cancer and noncancer Barnes Hospital subgroups. When allowance is made for the fact that 17 occupations could have shown at least this large a difference, the probability is increased to over 0.10. In consequence, the difference observed for painters is no larger than the largest difference that could have been observed in a series of this size if no difference in fact existed.
>
> When all workers handling metals are combined, a higher percentage is observed among the cancer patients than among the other chest disease patients. A positive difference of this magnitude could have equaled or exceeded by chance alone five times out of 100 (p is 0.05). A similar consideration of all workers exposed to oil and gasoline fumes yields a positive difference that could have been equaled or exceeded by chance alone 10 times in 100 (p is 0.10).
>
> In summary, while there are several suggestive relationships, there is no decisive statistical

in Group A and 36 in Group B,
ican male lung-cancer patients.
ıe total number of American male
The Barnes lung-cancer patients
l with 45.0% of the Barnes patients
upational incidence in Group A is
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rs, 6 welders, 5 smelters, and 3
are 21 machinists, 8 sheet-metal
(1 brass and 1 nickel). Additional
ıre electricians (1.8%), plumbers
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European Data.—Fifty-one patients were interviewed in Europe (43 in England and eight in France). Thirty-seven of these were interviewed by Mr. Borrie, who obtained most of his subjects from a highly industrial region. Thirty-one of the Europeans (60.8%) had been exposed to some known or suspected dust and/or fumes. Among them were seven miners, six hot-metal workers, four electrical engineers, three carpenters, two metal workers, two automobile mechanics, two chauffeurs, one rock laborer, one baker, one painter, one railroad worker, and one shoe repairer. The remainder (39.2%), with no known or suspected occupational exposures, included six clerks, three merchants, two executives, two salesmen, two farmers, one photographer, one ship captain, one merchant, one dairyman, and one general laborer.

Nonsmokers and Minimal Smokers.—Among the 760 males presenting epidermoid, undifferentiated, and unclassified bronchiogenic lung cancers there were 18 nonsmokers or minimal smokers. Their occupation distribution has been tabulated in Table 5.

TABLE 5.—*Occupational Distribution of Eighteen Male Patients with Epidermoid Undifferentiated, or Unclassified Bronchiogenic Carcinoma, Who Were Either Nonsmokers or Minimal Smokers*

Cabinet makers	3
Painters	2
Hot metal workers	2
Gasoline and oil workers	2
Engineer (gardener)	1
Shoemaker	1
Hoisting engineer	1
Canvas rigger	1
Packer	1
Salesman	1
Accountant	1
Lawyer	1
Stevedore	1

Among the 11 nonsmokers two patients, a lawyer and an accountant, gave no history of having been exposed to known or suspected exogenous irritants. Among the seven minimal smokers were two patients with no such exposures, a salesman and a stevedore.

Histories of Occupational Exposures of Nonsmokers.—1. K. J., a white man, 65, with squamous cell carcinoma of the right upper-lobe bronchus, had double pneumonia in 1919 and 1925. He lived in a small town. He had been a painter through all of his adult life and had mixed his own paints. He had never used spray paints.

2. F. B., a white man, 46, with an undifferentiated carcinoma of the left lower-lobe bronchus, gave no history of previous lung disease. He had lived in large cities most of his life. From 18 to 30 yr. of age he was a painter, working chiefly on ships. He used spray paints and also mixed his own paints. Since that time he had done more general construction work (builder's laborer) but still did considerable painting.[13]

3. G. B., a white man, 74, with squamous-cell carcinoma of the right upper lobe, lived in a mining town in the Middle West. He gave no history of previous lung diseases. For nearly 60 yr. he had worked in a smelting refinery where he was excessively exposed to hot-metal fumes in particular to lead, copper, and zinc. He also had worked periodically in the arsenic shop of the plant.

4. H. H., a white man, 72, with epidermoid carcinoma of the bronchi of the middle and upper lobes of the right lung, gave a history of pneumonia (1925) and repeated bouts of influenza. He lived in a rural community in Missouri. From 1911 to 1937 he had been a blacksmith, exposed to hot steel fumes and coal smoke. Since that time he had been a buyer of hides, wools, and furs with no specific exposures.

5. L. Y., a white man, 57, with squamous-cell carcinoma of the right middle-lobe bronchus, lived in a town of 5,000 population in Illinois. He gave no history of previous lung diseases. He had been a farmer until he was 37 yr. old. After that he drove a gasoline truck for 12 yr. During the latter period he was exposed to gasoline fumes. He stated that on two occasions lead poisoning developed. After the last attack he left the job and became street commissioner, with no further specific occupational exposures.

6. C. F., a white man, 49, with an unclassified bronchiogenic carcinoma of the right upper lobe, had influenza in 1941. He lived in a town of 25,000. From 1916 to 1944 he delivered oil and gasoline to neighboring farm areas. In some instances he delivered the oil in barrels, but in many cases he had to transfer the oil from the barrels to permanent containers by means of a crude pump. He also handled the gas station of his father's general store. From 1944 to 1947 he merely operated the store, and from 1947 to 1949 he did no particular work. From October 1949 to May 1950 he was an oil-tank driver.

7. C. G., a white man, 59, with a squamous-cell carcinoma of the right lower-lobe bronchus, lived in Los Angeles and gave no history of previous lung diseases. Throughout his adult life he had been a cabinet maker. In this occupation he was exposed to sawdust as well as to varnish and occasional paints.

8. C. R., a white man, 52, with a squamous-cell carcinoma of the right upper lobe, lived in a town of 50,000. He gave no history of previous lung diseases. He had been a telephone engineer and had not undergone any occupational exposures. However, he raised flowers as a hobby. In this connection he had been exposed to a variety of insecticide sprays for the past 14 yr. These included primarily kerosene, nicotine, and arsenical sprays. Eight years prior to the development of symptoms of lung tumor, the patient noted the appearance of multiple skin tumors over the extremities and the trunk. These tumors were shown to be benign basal-cell epitheliomas. No determination of the arsenic content of these tumors was made. The lesion of the lung was regarded as a primary epidermoid carcinoma. The patient never used a mask while spraying.

9. H. H., a white man, 72, with a squamous-cell carcinoma of the right upper lobe, lived in a small village in Missouri. He had pneumonia in 1919. In 1927 he fractured his lower ribs bilaterally. He had been an accountant, with no occupational exposures. About once a year during the seven years prior to the interview he had sprayed his flowers with nicotine.

10. P. S., a white man, 52, with an undifferentiated carcinoma of the left lung, lived in Cleveland. There is no history of previous lung diseases. In his youth the patient had worked for eight years in newspaper plants where, he stated, he was exposed to excessive paper dust. Since 1923 he had practised law, with no further history of occupational or hobby exposures.[14]

11. T. S., a white man, 39, with a squamous-cell carcinoma of the left lower-lobe bronchus, lived in New York and gave no history of previous lung disease. He had been a sail maker and canvas rigger by trade. During the war years he worked in a job where he had to cover pipes with asbestos.[15]

Adenocarcinoma in Males.—Among the 43 male patients with adenocarcinoma of the lungs are 22 with known or suspected occupational dust or fume exposures (51.2%): three hot-metal workers (6.9%), two painters, two chauffeurs, two truck drivers, and two railroad workers (4.7% each); the group also includes a Diesel-engine driver, a shoe-factory worker, a lumber-mill worker, a tailor, a

14. This case was contributed by Dr. C. T. Surington, Crile Veterans Hospital, Cleveland.

15. This case was contributed by Dr. H. G. Turner, Columbia Chest Service, Pelham

blocker, a gas-station attendant, a construction worker, a longshoreman, a baker, a mason, and a plumber (2.3% each).

Among the patients with no suspected occupational exposures (48.8%) are four executives and four clerks (9.3% each), three salesmen and three farmers (6.9% each), and a poolroom operator, an army officer, a draftsman, a collector, a physician, a minister, and an editor (2.3% each).

The four nonsmokers are a 34-year-old clerk, a 50-year-old jeweler, a 73-year-old minister, and a 59-year-old merchant. The two minimal smokers are a 65-year-old farmer and a 60-year-old truck driver. Among these six patients only the truck driver had some occupational exposure. The jeweler worked chiefly in the executive branch of his profession. Two of the nonsmokers (the jeweler and the merchant) had terminal bronchiolar carcinoma.

Epidermoid Carcinoma in Women.—Among 18 women with a smoking history are six with some occupational exposure (33.3%): a cigar-factory worker, a weaver, a gunpowder-factory worker, a laundry worker, a shoe-factory worker, and a seamstress. The other 12 patients include five housewives, three clerks, two salesgirls, one waitress, and one writer. The shoe-factory worker was exposed to leather dusts but not to dyes. The cigar-factory worker had been a heavy smoker for many years.

The 12 nonsmokers include six housewives, two clerks and a secretary, a teacher, a weaver, and a seamstress.

Adenocarcinoma in Women.—Among the 22 patients in this group, which includes two light smokers, there are two women with some occupational exposure, one an egg-case maker and one a shoe assembler. Among the remainder are 15 housewives, including three farmers' wives, three clerks, two salesgirls, and one stenographer.

Role of Locality.—In general an evaluation of locality distribution depends largely on the locality of the hospital at which the patients are seen. The patients at Barnes Hospital come from many widely separated cities and rural communities, most of which are in the Midwest and Southwest. The data from Barnes Hospital seem to indicate that city life plays no significant role in the induction of primary carcinoma of the lung. The remaining locality data show a suggestive higher frequency of lung cancer among city patients. This, however, may be at least partly due to the fact that this survey has been conducted primarily in hospitals in large cities. British studies have indicated a higher incidence of lung cancer in the city population.[16] In this connection we must consider that city people have better access to the large hospitals, where better means of diagnosis are available. One cannot rule out the possibility, however, that city life plays a part in the induction of lung cancer in individual cases, especially in view of the fact that city dust has been shown experimentally to be weakly carcinogenic.[17] Yet, city life, to which women are exposed as much as men, could not explain the greater incidence of lung cancer among men.

16. Stocks, P.: Thirteenth Annual Report of the British Empire Cancer Campaign, London, Royal College of Surgeons, Lincoln's Inn Field, 1936, p. 239.

17. Campbell, J. A.: Cancer of Skin and Increase in Incidence of Primary Tumours of Lung in Mice Exposed to Dust Obtained from Tarred Roads, Brit. J. Exper. Path. 15:287-294 (Oct.)

are those based on the Schneeberg and Joachimstal miners. Machle and Gregorius, in this country, have stressed the high incidence of lung cancer among chromate workers,[20] while Lynch and Smith[21] found carcinoma of the lung more commonly than expected among workers exposed to asbestos. In England Bradford Hill and his co-workers[22] have presented good evidence that lung cancer is higher among arsenical workers than among the general population. Among the occupational hazards possibly exposing the worker to carcinogenic substances Hueper lists tar fumes, mineral-oil mists, chromium dusts, nickel-carbonyl vapors, arsenic dusts and fumes, asbestos dust, isopropyl-oil vapors, and radioactive gases and dust.[23] Mueller[24] felt that lead may be carcinogenic in the lungs.

The increase of the incidence of lung cancer has been too universal to be explained by any or by all of the above-mentioned exposures. This conclusion was also reached by the Kennaways,[25] who, after studying the death certificates of all lung-cancer patients dying in England and Wales from 1921 to 1938, stated, "No special occupations have been found among the 63 examined to which the increase in the total number of cases of cancer of the lung could be attributed." Most of the industries so far emphasized in the literature as having a high incidence of lung cancer are limited to a small group of people, so that they would not appear significant in a countrywide survey of lung-cancer incidence. It is not surprising, therefore, that these occupations do not stand in the foreground in our results. As 86 different occupations have been encountered among patients with cancer of the lungs, indeed a good cross section of occupations generally found in this country, it appears clear that a statistical evaluation of each given occupation would not show very significant results. The data, however, are suggestive that certain occupations expose the worker to cancer-inducing substances.

The occupations most suggestive in this regard are those that fulfill the following criteria: 1. The occupation should have a markedly higher incidence among lung-cancer patients than among other patients. 2. The occupations must have a

18. Rostoski, Saupe, and Smorl: Die Bergkrankheit der Erzbergleute in Schneeberg in Sachsen, Ztschr. Krebsforsch. **23**:360-384, 1926.

19. Pirchan, A., and Sikl, H.: Cancer of the Lung in the Miners of Jáchymov, Am. J. Cancer **16**:681-722 (July) 1932.

20. Machle, W., and Gregorius, F.: Cancer of Respiratory System in U. S., Chromate-Producing Industry, Pub. Health Rep. **63**:1114-1127 (Aug. 27) 1948.

21. Lynch, K. M., and Smith, W. A.: Pulmonary Asbestosis: III. Carcinoma of the Lung in Asbestos-Silicosis, Am. J. Cancer **24**:56-64 (May) 1935.

22. Hill, B. A., and others: Studies in Incidence of Cancer in Factories Handling Inorganic Compounds of Arsenic. Mortality Experience in Factory: Clinical and Environmental Investigation, Brit. J. Indust. Med. **5**:1-15 (Jan.) 1948.

23. Hueper, W. C.: A Methodology for Environmental and Occupational Cancer Survey, Technical Monograph No. 1, Federal Security Agency, United States Public Health Service, 1942; Occupational Tumors and Allied Diseases, Springfield, Ill., Charles C Thomas, Publisher, 1942; personal communication to the authors.

24. Mueller, F. H.: Tabakmissbrauch und Lungencarcinom, Ztschr. Krebsforsch. **49**:57-85, 1939.

25. Kennaway, N. M., and Kennaway, E. L.: A Study of the Incidence of Cancer of the Lung and Larynx, J. Indust. Hyg. **36**:267 (July) 1936; Kennaway, A Further Study of the Incidence of Cancer of the Lung and Larynx, Brit. J. Cancer **1**:260-298 (Sept.) 1947.

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III. Carcinoma of the Lung

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either nonsmokers or minimal smokers. It seems that if a given occupation qualifies on all three points, good circumstantial evidence has been established that this particular occupation exposes the worker to substances that are carcinogenic. The three occupations that stand out in this regard are those exposing the worker to hot-metal fumes and metal dust, to paint, and to lubricating oils and gasoline fumes. The occupations occurring with greatest frequency were those in which workers were exposed to metal fumes or dust. In 6.1% of the lung-cancer patients, inhalation of hot-metal fumes was noted, and 5.5% were exposed to cold metal. One nonsmoker had a lifelong exposure to hot-metal fumes as a smelter, and one had been a blacksmith for 17 years.

The data on painters seem particularly striking. Among 43 painters (6.1%) there were two nonsmokers. About one-half of the painters used spray guns. They all mixed their own paints. Cabinet makers with exposure to varnish and some paint, as well as to wood dust, may fall into a similar occupational category. It is noteworthy that in spite of the comparative rarity of this occupation we found one nonsmoker and two minimal smokers with lung cancer among cabinet makers. Automobile mechanics (3.2%) are exposed to a variety of irritative fumes, including those from gasoline, welding, and lubricating oils. The fact that one nonsmoker with lung cancer was a gasoline-and-oil handler, and that another nonsmoker had been an oil-tank truck driver, lends suspicion to a possible carcinogenic influence of the inhalation of gasoline and oil fumes. In one worker exposed to asbestos no evidence of asbestosis could be established. No chromate workers were encountered in this survey. Mueller [24] has recorded a lung cancer that occurred in a chromate worker who was a nonsmoker. Of special significance may be arsenic exposure of workers. Smelting workers are exposed to some arsenic. Four of 25 patients with lung cancer seen in Utah were smelting workers. These workers, however, are also exposed to hot-metal fumes and metal dust. One nonsmoker had been exposed to arsenical insecticide. No others were encountered who had undergone excessive exposure to arsenical insecticides. It must be considered, however, that most lung-cancer patients have been exposed to arsenic, because of its presence in cigaret paper and because tobacco itself is sprayed with arsenical insecticides during its period of growth. Of some significance may be carpenters (2.9%); they, like cabinet makers, are exposed to wood dust.

There are some other occupations that seem to appear more frequently among lung-cancer cases which have been listed previously. It seems evident that because of their relative specialization, the lung-cancer incidence of these occupations can be fully appreciated only by a survey among workers involved in these specific industries.

Other General Occupational Surveys.—In addition to studies concerning lung-cancer in particular industries, several general surveys of occupations among lung-cancer patients have been carried out. Most of these studies have been based on mortality records. The most extensive of them have been presented by the Kennaways,[25] who reviewed the occupations of 23,549 lung-cancer patients from England and Wales, covering the period from 1921 to 1938. Among 63 examined occupational groups, the Kennaways [25] recorded 39 metal grinders with a ratio of 202 (the

and a ratio of 517, and gas stokers and coke-oven chargers with 85 cases and a ratio of 284. A study of cancer mortality in Sheffield, England (1926 to 1935), by Turner and Grace,[26] showed a significantly high mortality of cancer of the respiratory system in foundry workers, grinders, and engineers, all of whom are exposed to either hot or cold metals. In the survey painters were not found to have a significantly high incidence of lung cancer.

The Clinical Research Committee of the British Empire Campaign,[27] in 1944, analyzing more than 1,000 cases of primary carcinoma of the lungs, found that engineers, mechanics, painters, and decorators are more liable to the development of cancer of the lung than other occupational groups. Fulton,[28] analyzing 1,610 cases cases of lung cancer from the register of the Liverpool Cancer Control Organization (1944 to 1948), called attention to the apparently high number of cases occurring among furnace men and painters. A Dutch survey by Versluys,[29] based on mortality records (1931 to 1935) and covering 1,291 lung-cancer cases, shows a high incidence especially among "white collar" workers, diamond cutters, drapers, barmen, hall porters, cigar makers and tobacconists. In Germany among 86 lung-cancer patients, about all of whom information was obtained by special forms, Mueller [24] found that 8.1% were painters, 5.8% lead workers, 3.5% plumbers, 2.3% wire makers, 1.2% foundry workers and 1.2% tool and die makers.

An American survey by the Metropolitan Life Insurance Company [30] (1937 to 1939) includes 1,682 lung-cancer cases and covers white male wage earners insured under its industrial policy. It lists occupations with probably higher than average death rate from cancer of the lungs. In these data the percentages indicate number of deaths from cancer of the lungs per 100 deaths from all causes. The list includes 5 engravers (6%), 7 welders (3.2%), 62 painters (2.2%), and 9 coppersmiths (2.2%), as well as blacksmiths, plumbers, steam fitters, masons, cooks, laundry workers, mail carriers, miners (excluding coal miners), plasterers, slaughter-and-packing-house workers, street cleaners, tannery workers, tailors, and traveling salesmen. In this study painters make up 3.9% of the total lung-cancer group.

The best agreement among these general occupational surveys of lung-cancer patients concerns the high proportion of metal workers and of painters among lung-cancer patients. It must be realized, of course, that data based on mortality records may conceal occupational exposures that workers may have had in their earlier life. For this reason, complete occupational histories appear essential if one is to evaluate fully the importance of industrial exposures in the production of lung cancer.

Sectional Differences.—With the great variety of occupations encountered in life it becomes evident that thousands of control cases would be necessary to evaluate

26. Turner, H. M., and Grace, H. G.: An Investigation into Cancer Mortality Among Males in Certain Sheffield Trades, J. Hyg. **38**:90-103, 1938.

27. Clinical Research Committee of the British Empire Campaign, editorial, Brit. M. J. **1**:122, 1944.

28. Fulton, J. S.: Carcinoma of the Lung, Proc. Roy. Soc. Med. **42**:775-782 (Oct.) 1949.

29. Versluys, J. J.: Cancer and Occupation in the Netherlands, Brit. J. Cancer **3**:161-185 (June) 1949.

30. By L. I. Dublin and R. J. Vane of the Metropolitan Life Insurance Company, Statistical Division.

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out a given country, occupations vary markedly, depending on climate, special industries, and other conditions. We used for our control data the Barnes Hospital Chest Service noncancer cases. These comprise rather large numbers of farmers, miners, railroad workers and oil-field workers, reflecting the industries of the area surrounding St. Louis. Similarly, we have noted a preponderance of heavy-metal workers in the Middle West and in the industrial Eastern section, a high incidence of restaurant workers in California, and a high ratio of tailors and taxicab drivers in New York City.

General Role of Occupations.—While this survey may not show a high incidence of highly specialized and sectional industries which may have an influence on the production of lung cancer, it nevertheless gives a good indication of the prevalence of lung cancer among general occupations on a nationwide basis. The great number of occupations involved shows that the occupational exposures per se could not have given rise to the great increase in the incidence of lung cancer. The high incidence of lung cancer among "white collar" workers, too, and the high incidence among workers who were not known or suspected to have been exposed to irritative dusts and fumes speak against this concept. There are a few occupations, however, listed previously, which, in addition to those already recorded in the literature, seem to exert some influence on the induction of lung cancer. In contrast to the Schneeberg and Joachimstal mines and possibly a few other specialized industries with which exposures have been associated, most occupations listed in this report seem to be, if at all, but weakly carcinogenic. It is possible that their main effect may lie in an action synergistic with that of tobacco smoke, since the vast majority of these patients also have been considerable smokers. In this connection one should recall the work of Berenblum,[31] who showed a very definite synergistic effect of croton resin in experiments in which carcinoma was produced with carcinogenic agents.

Adenocarcinoma in Males.—Because of the relatively few patients in this group no definite conclusions can be drawn. We previously concluded that tobacco smoking does not bear as clear a relationship to this histological type as to the epidermoid and the undifferentiated carcinoma of the lung. Since in this group, however, we do find more excessive smokers than in the general hospital populations, as well as an apparently high number of workers in industries found more commonly associated with the other types of lung cancer, it would appear that perhaps exogenous irritation also plays a part in the induction of adenocarcinoma in some cases. We feel that these factors play no significant role in the induction of adenoma and the so-called alveolar-cell carcinoma.

Carcinoma of the Lungs in Women.—Our studies of tobacco smoking have shown that among women 43.7% of those presenting the epidermoid and undifferentiated types and 89.9% of those showing adenocarcinoma were nonsmokers. In the latter type of cancer, tobacco was found to have no statistically significant influ-

31. Berenblum, I.: The Mechanism of Carcinogenesis: Study of the Significance of Cocarcinogenic Action and Related Phenomena, Cancer Res. 1:807-814 (Oct.) 1941.

[illegible], was also an excessive smoker. It is difficult to state whether the female lung-cancer patients have a lower incidence of tobacco and occupational-carcinogen exposures because the female population is normally exposed less to these substances, or whether women inherently are more susceptible to lung cancer than men and thus may have lung cancer in the absence of strong exogenous irritation. In this connection Kemler and Graham [32] have demonstrated that bronchiogenic carcinoma can be transplanted from male patients to the eyes of both male and female guinea pigs with equal facility. This would suggest that inherent sex factors have little, if anything, to do with certain differences noted in the incidence as well as in the causation of bronchiogenic carcinoma in men and women.

Academic and Clinical Aspects.—The evaluation of occupational exposures falls within obvious confines of preventive medicine and public health. Beyond this it is also of academic importance, for it may point out carcinogens not yet known to be active against human tissues and thus expand present knowledge about carcinogenesis. Clinically it is of significance as an aid in the differential diagnosis of chest diseases. In taking the history of an adult patient with chest symptoms one should, in addition to recording an accurate history of smoking, pay special attention to occupations; for a patient who is an excessive smoker and who in addition has also been employed in occupations that seem to have a high incidence of cancer of the lungs appears to be particularly prone to the development of bronchiogenic carcinoma. On the other hand, without such exposures a male patient will not commonly be found to have an epidermoid carcinoma or an undifferentiated carcinoma of the lungs.

Industrial Carcinogens.—It does not lie within the scope of this communication to elaborate on what substance or substances encountered in a given occupation may be carcinogenic. In this report we have merely tried to outline the occupations reported by lung-cancer patients, leaving for other studies the determination of why certain industrial workers may have a higher than expected incidence of bronchiogenic carcinoma. Special attention should be paid to arsenic, a substance generally accepted as a carcinogen for man, because it is encountered in several occupations with a high incidence of lung cancer and because it is present in tobacco.[33] Occupational data also place emphasis on the need for further studies of heavy metals. Research on the organic fractions encountered in occupations with a high incidence of lung cancer should be extended. This also applies to tobacco tars, which should be studied with the care and resourcefulness that have been applied to the study of coal

32. Kemler, R. L., and Graham, E. A.: Studies on the Influence of Sex Hormones on Successful Heterologous Transplantation of Human Bronchiogenic Carcinoma, Cancer **3**:735-738 (Aug.) 1950.

33. Neubauer, O.: Arsenical Cancer: Review, Brit. J. Cancer **1**:192-251 (June) 1947. Thomas, M. D., and Collier, T. R.: Concentration of Arsenic in Tobacco Smoke Determined by Rapid Titrimetric Method, J. Indust. Hyg. & Toxicol. **27**:201-206 (Sept.) 1945. Daff, M. E., and Kennaway, E. L.: The Arsenic Content of Tobacco and Tobacco Smoke, Brit. J. Cancer **3**:173-182 (June) 1950.

Chief Factor in Lung-Cancer Increase.—We know that several factors may be responsible for the induction of primary carcinoma of the lungs. Undoubtedly, one of these factors is intrinsic, since not every person exposed to carcinogenic substances contracts cancer of the lungs. The nature of this intrinsic factor remains unknown for the present. Factors of exogenous nature, however, seem to be of similar importance in the development of lung cancer. While a few occupations seem to play a role in this regard, we believe that the most important factor, which can explain the universal and predominantly male increase in lung-cancer incidence, is tobacco smoking. The data presented in this, as well as in other recent investigations, should lead research to concentrate its efforts in an attempt to identify and possibly isolate carcinogenic agents in tobacco smoke and in certain industrial substances with the hope that by their possible removal, or at least reduction, the incidence of primary cancer of the lungs may be decreased.

CONCLUSIONS AND SUMMARY

Additional data on tobacco smoking continue to indicate that tobacco plays a major role in the induction of primary carcinoma of the lungs. Very similar data and conclusions have been presented from a recent large-scale British study by Doll and Bradford Hill.

City dusts and fumes cannot account for the increased incidence of lung cancer.

A few occupations appear with greater-than-expected frequency among the lung-cancer group even though decisive statistical evidence is lacking. Among those of the most general importance are the occupations of metal workers, painters, and workers exposed to excessive fumes of oils, gasoline, varnish, and wood dust.

The greater the amount of tobacco smoked, the greater seems the risk that primary carcinoma of the lungs may develop.