

INDUSTRIAL EMISSIONS AND CANCER INCIDENCE  
IN CONTRA COSTA COUNTY:  
PROGRESS ON THE EPIDEMIOLOGICAL STUDY

INTRODUCTION

Contra Costa County continues to be the major industrialized county in the San Francisco Bay Area. This industrial complex, in addition to five major petroleum refineries and many petrochemical plants, included Kaiser's major shipbuilding center during World War II. At present, 70 percent of the shipping going through the Golden Gate Bridge either enters or leaves ports in Contra Costa County. Sixty-eight percent of the total stationary air pollution emissions in the San Francisco Bay Area originates in Contra Costa County.

Considerable speculation exists on how much air pollution contributes to cancer mortality in urban areas. Previous studies have linked air pollution to four anatomic sites--lung, stomach, prostate, and lymphoma. Mortality study of U. S. counties with petroleum industries found other sites with greater than expected frequencies. These results raise the question of how much of the excess cancer mortality is due to occupational exposures, to ambient air pollution exposure, or to other relevant variables.

Investigators encounter several problems in trying to identify or quantitate the contribution of each variable to the greater-than-expected cancer mortality. These problems are:

- o Small size of study population;
- o Latent period for cancer development;

- o Population density;
- o Smoking effect; and
- o Other associated variables not measured or included in the study.

The monograph on cancer mortality by counties (1950-1969) by Mason and McKay<sup>1</sup> revealed high site specific cancer mortality rates in industrialized counties with petroleum refineries and petroleum chemical plants.

As part of the NCI/EPA collaborative research program, EPA completed the review process and funded a grant request from Contra Costa County Department of Health. This coincided with the publication of Blot's report in Science. Blot et al.<sup>2</sup> compared cancer mortality rates in 39 counties with petroleum refineries employing at least 100 people with 117 control counties. Both men and women had a significantly higher lung cancer mortality rate in the petroleum refinery counties than in the control counties. High lung cancer mortality rates among women suggests ambient or personal (smoking or in-door) rather than occupational exposure. Men also had a significantly higher cancer mortality rate for several other site specific cancers. This publicity created many community pressures to take action in what was locally being called "cancer county." Industry countered by saying that San Francisco and Alameda counties had cancer rates as high as Contra Costa County. This issue became an emotional and a political battle between various adversaries which prevented the Contra Costa Department of Health from getting started on the study.

As a result of this impasse, the funds were transferred to California State Department of Health Services, Resources for Cancer Epidemiology, where the California Tumor Registry is located.

California State legislature and OSHA funded Dr. Austin's group to extend the cancer study to four additional counties (Figure 1). These are: San Francisco, Alameda, San Mateo, and Marin. San Francisco and Alameda counties have cancer mortality rates comparable to Contra Costa County.

Bear with me a moment please; we were not out of the woods yet. During the summer of 1978, the voters of California passed "Proposition 13", which resulted in the Executive Branch of the State Government freezing all personnel actions, including filling of positions. Thanks to the effort and support of the Department of Health Services, the effort and support of Mr. Paul DeFalco, Jr., Administrator, Region IX and his staff, and the picketing of Dr. Austin's office and the Health Department by various environmental groups, Dr. Austin was given permission in late June to complete the staffing of the project. This was completed by August 1, 1979.

The northern part of Contra Costa County is heavily industrialized with five major petroleum refineries, many petrochemical plants, and was the home of Kaiser shipbuilding during World War II. Many complaints have been raised by individuals and groups about the air quality in certain sections of Contra Costa County.

Population census was collected and data published at the census tract level for both 1970 and 1975 in Contra Costa County. Cancer incidence data has been collected in Contra Costa County since 1969. The Third National Cancer Survey collected incidence data between 1969 and 1971. The California Tumor Registry collected incidence data from 1972 onwards.

This study contains four major tasks. These are:

- o Cancer incidence analyses;
- o Occupational monitoring;
- o Case control studies;
- o Industrial emissions analyses

#### Cancer Incidence Analyses:

Preliminary analyses revealed a dramatic difference in lung cancer rates for males between the industrialized and non-industrialized parts of Contra Costa County for years 1972-1975. Years 1967-1971 are being added. The investigators have gone back to the 1970 and 1975 census data to validate the classification of each census tract as industrial or non-industrial. The analysis is being rerun for the extended period on the reclassified (validated) (industrial-non-industrial) census tracts.

The size of the difference between lung cancer incidence rates in the two parts of the county gives the highest priority for further investigation to this cancer site. Current funding for this grant includes the case-control study for lung cancer incidence.

#### Occupational Monitoring:

The purpose of occupational monitoring is to determine whether any labor union or occupational group has a higher incidence rate for any cancer site than other union or occupational groups in Contra Costa County. Names of union members, employed persons, and professional groups are being merged with the cancer incidence files of Resources for Cancer Epidemiology Section (RCE). RCE has collected identifying information on various cohort groups (Table 3). Matching has been completed for these. RCE has contacted many additional groups (Table 4).

Monitoring of occupational groups is an attempt to identify working groups with special cancer risks who, by their residential patterns, may affect the observed cancer rates of the population in a specific geographic area.

#### Case-Control Study:

The past two months have been spent in planning this study. A questionnaire has been circulated for comment and is being prepared for printing. The study is scheduled to start June 2, 1980.

Approximately 150 cases (lung cancer, men and women, white and black, ages 20-74) and 300 controls will be stratified and matched by age, sex, and race. The primary intent of the case-control study is to identify the major factors associated with the difference in lung cancer rates between the industrialized and non-industrialized parts of Contra Costa County. Some of the factors included are smoking history, occupation history, and geographic location of residence history.

This phase of the study examines the problems of latent period, occupational and environmental exposure history, migration history, smoking history, and socioeconomic class. The investigator may be able to get some suggestion as to the effect of family income below the poverty line since 15% of the workforce in Contra Costa County falls into this socio-economic class (Tables 1 and 2).

#### Industrial Emission Analyses:

Air emission collection sites were established in November 1978. The 15 station network contains 5 permanent (part of the Bay Area Air Management District) stations and 10 temporary stations (Figure 2). Air samples collected from November 1978 through October 1978 were analyzed

for total suspended particulates, inorganic substances (lead, nitrates, sulfates), benzene-soluble organics, polycyclic aromatic hydrocarbons, and mutagenicity using the Ames test. Gas and meteorological data were collected during this one-year period.

Data are now being used in a modeling technique to characterize Contra Costa County census tracts by estimating a value for each of the air pollutants measured.

#### ACCOMPLISHMENTS

The first major accomplishment: We have a research effort underway after being caught between the various industrial, environmental, and political adversaries for two years. This project is staffed with a highly motivated and qualified staff who are interested in obtaining sound, valid scientific results.

Established the following Technical Advisory Committee:

- o Dr. James Sandberg, Meteorologist;
- o Dr. Alice Whitmore, Biostatistician; and
- o Dr. Warren Winklestein, Jr., Epidemiologist.

Many staff tasks and activities have been completed during the past six months, for example, review of literature (Attachment A); meetings with Technical Advisory Committee, and the Citizen's Liaison Committee; meeting with persons, agencies and organizations in the effort to develop cooperative program and project relationships; and preparation of numerous in-house reports.

Drs. Austin and Mandel presented a paper at the 72nd Annual Meeting of the American Institute of Chemical Engineers, November 28, 1979, San

Francisco, California.<sup>3</sup> They discussed the role and importance of population monitoring as a step to cancer prevention in professional chemists.

Analyses of air samples have been completed for five standard air pollutants in samples collected during July 1979 to October 1979. These samples are currently being analyzed for chemical carcinogens and for mutagenic activity, with a scheduled completion date of July 1980.

The findings and progress in the past six months are described in a report presented at the second symposium and the application of short-term bioassays in the fractionation and analysis of complex environmental mixtures at the Williamsburg, Virginia, March 4-7, 1980.<sup>4</sup>

Dr. Austin discovered, as a collateral development of the Contra Costa County and Bay Area cancer incidence study, what appears to be a sharp increase in incidence of malignant melanoma among employees of the Lawrence Livermore Laboratory. More than 18 months' work went into completing the status report,<sup>5</sup> which is being reanalyzed by a panel of experts assembled by the Department of Energy. Nineteen cases of malignant melanoma occurred among laboratory employees between 1972 and 1977 including three deaths, among them the Laboratory Director. Since then six more cases have been reported, three in 1980.

## REFERENCES

1. Mason, T. J. and F. W. McKay, U.S. Cancer Mortality by County: 1950-69 (Government Printing Office, Washington, D.C., 1973).
2. Blot, W. J., L. A. Brinton, J. F. Fraumeni, Jr., and B. J. Stone, Cancer Mortality in U.S. Counties with Petroleum Industries: Science, 198:51-53, 1977.
3. Austin, D. F. and W. Mandel, Population Monitoring: A Step to Cancer Prevention in Professional Chemists. Presented at the 72nd Annual Meeting, American Institute of Chemical Engineers, November 8, 1979, San Francisco, California.
4. Flessel, C. P. et al., The Integration of the Ames Bioassay and Chemical Analyses in an Epidemiological Cancer Incidence Study. In: Proceedings of the Second Symposium on the Application of Short-Term Bioassays in the Fractionation and Analysis of Complex Environmental Mixtures, Williamsburg, Virginia, March 4-7, 1980, in process.
5. Austin, D. F., A Study of Cancer Incidence in Lawrence Livermore Laboratory Employees, California Department of Health Services, Report No. 7, April 17, 1980.

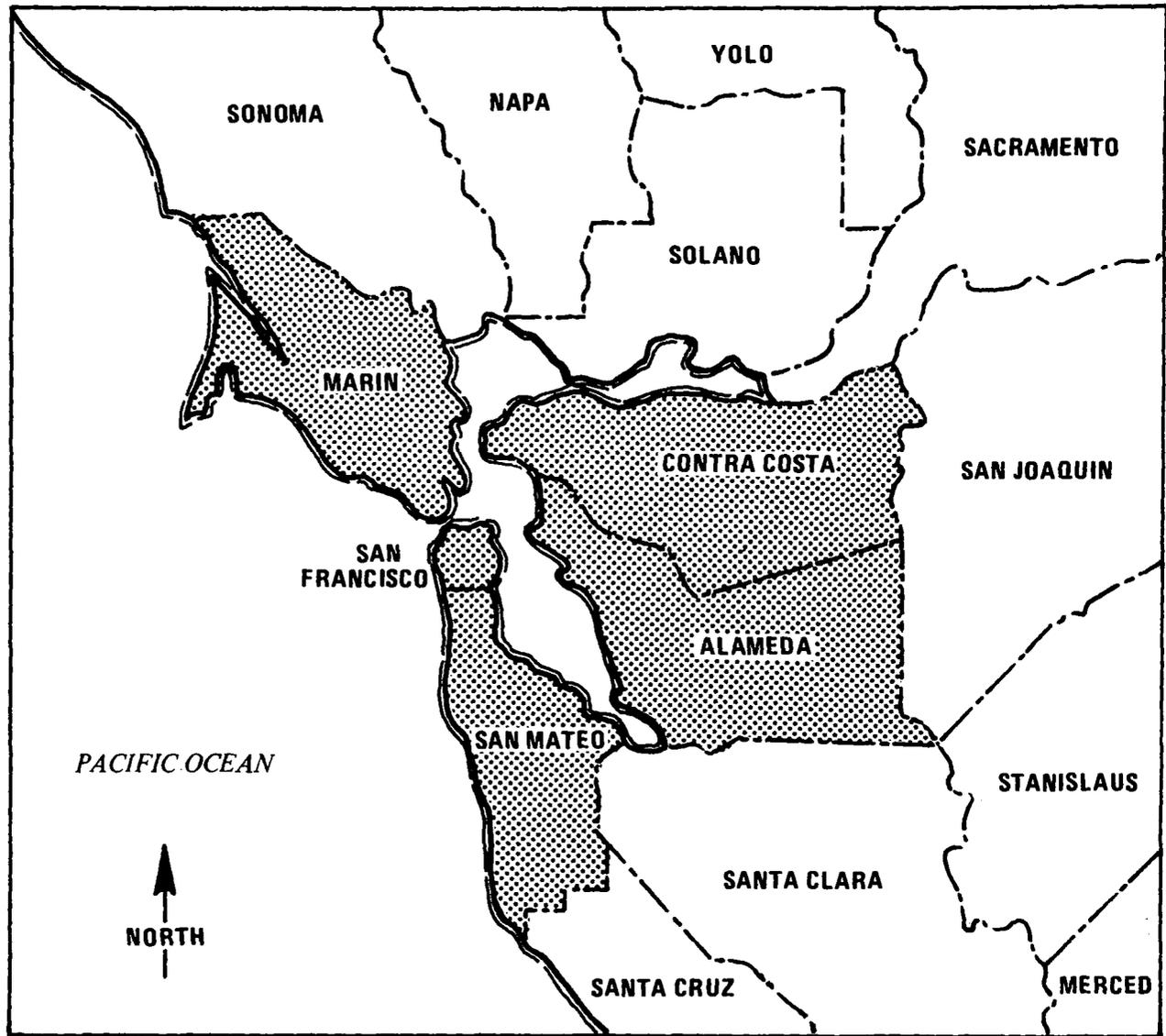


Figure 1. Bay area environmental cancer study counties.

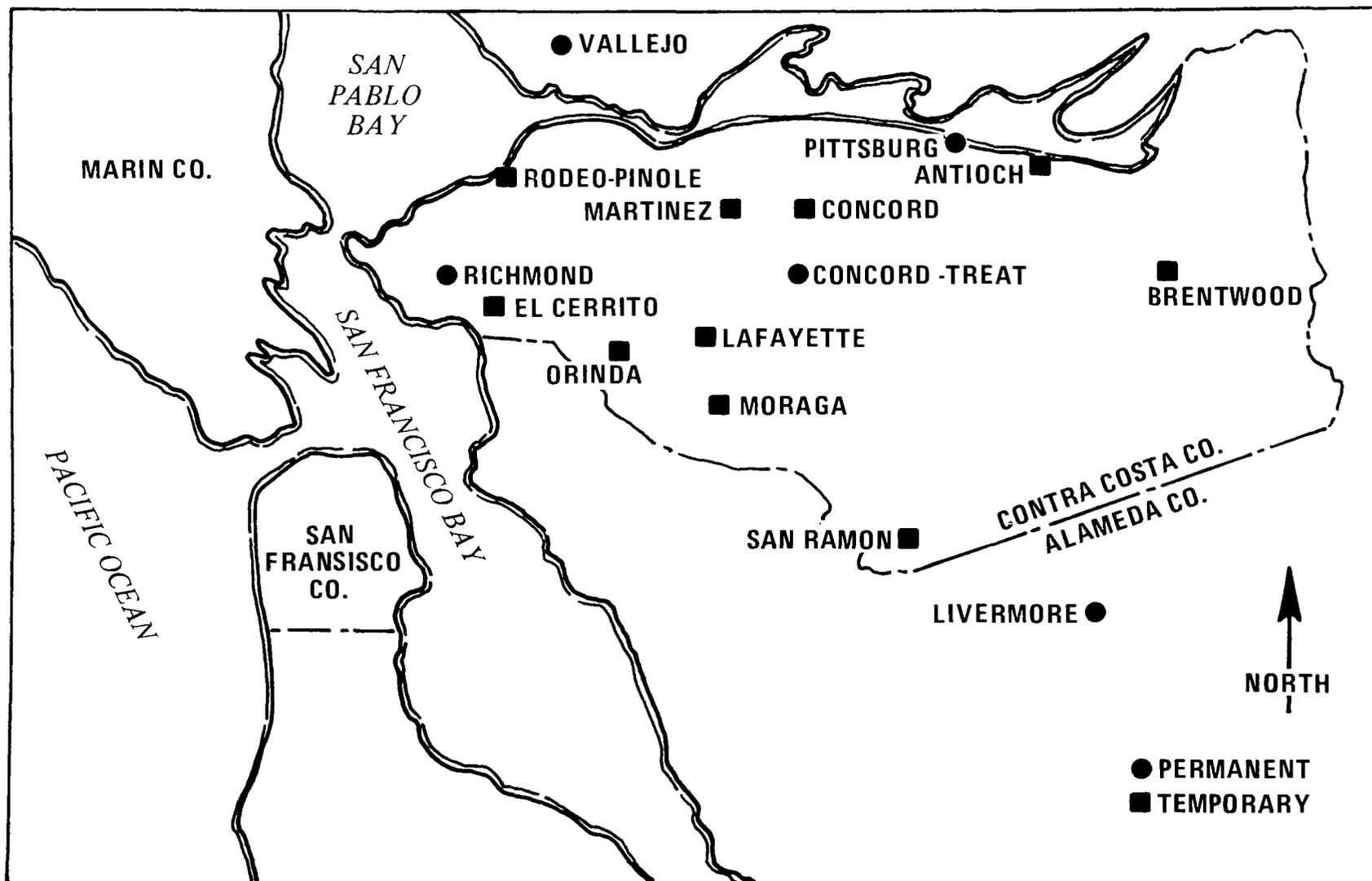


Figure 2. Location of sampling stations in Contra Costa county, CA.

Table 1  
 CONTRA COSTA COUNTY  
 CIVILIAN LABOR FORCE BY RACE AND SEX  
 Projected, 1980

	Contra Costa County (excluding Richmond)	Richmond	Total
Total	288,500	36,000	324,500
Male	170,370	18,790	189,160
Female	118,130	17,210	135,340
Total white	273,010	14,570	287,580
Male	162,120	8,100	170,220
Female	110,890	6,470	117,360
Total black	7,880	19,310	27,190
Male	4,090	9,610	13,700
Female	3,790	9,700	13,490
Total others	7,610	2,110	9,720
Male	4,160	1,080	5,240
Female	3,450	1,030	4,480
(Spanish-American)**	(23,810)	(3,860)	(27,680)
Male	(14,490)	(2,100)	(16,590)
Female	(9,330)	(1,760)	(11,090)

\*6,810 are age 65+ (2.1%)

\*\*Already counted

Source: State of California, Employment Development Department, May 1, 1979.

Table 2  
 CONTRA COSTA COUNTY  
 PERSONS BELOW POVERTY LEVEL, 1980

	Contra Costa County (excluding Richmond)	Richmond	Total
White	31,970	2,250	34,220
Black	4,890	8,110	13,000
Other	1,050	390	1,440
Total	37,910	10,750	48,660

Source: State of California, Employment Development Department, May 1979.  
 Projected 1980.

Table 3  
STATUS OF PAST COHORTS

	No. groups	No. locals	Approximate No. persons
1. Unions updated by EHA*	5	14	6,000
2. Unions to be updated**	12	60	24,000
3. Asbestos workers	1	1	250
4. Dry cleaners			
Union members	1	1	
Fabric care licensees	-	-	4,000
5. Cosmetologists	1	-	20,500
6. Livermore Radiation Lab	<u>1</u>	<u>-</u>	<u>6,000</u>
Total	21	76	60,750

- \*1. Bakers
- 2. Painters
- 3. Plasterers
- 4. Plumbers & Steamfitters
- 5. Roofers

- \*\*1. Cement Masons/Plasters
- 2. Cooks/bartenders
- 3. Firefighters
- 4. Hod Carriers
- 5. Industrial Iron Workers
- 6. Lathers & Plasterers
- 7. Laborers
- 8. Oil, Chemical and Atomic Workers
- 9. Painters
- 10. Paint Makers
- 11. Plumbers
- 12. Steamfitters

Table 4  
POSSIBLE NEW COHORTS IN SF-0 SMSA

Group	Approximate No. persons
State of California	18,000
Operating Engineers	6,900
Teamsters	6,500
Contra Costa County	6,000
State University	4,200
Apprentices	3,900
American Chemical Society	2,000
Oil, Chemical, Atomic Workers (1-1978)	1,600
Int'l Association Flight Attendants	1,000
City of Hayward	800
California Veterinarian Association	450
Oil, Chemical, Atomic Workers (1-326)	<u>350</u>
Total	51,700

ATTACHMENT A

SEVEN SELECTED MAJOR REFERENCE SOURCES ON OCCUPATIONAL CARCINOGENESIS  
(Listed Chronologically)

- I. Compilation of some 28,500 citations, including approximately 5,800 reprints, published during 1960 and 1975.
- II. Approximately 1,450 abstracts on occupational and environmental carcinogenic hazards (1969 to 1974)
- III. Proceedings of 1976 conference on occupational carcinogenesis.
- IV. Listing of 233 references published from 1963 to 1974.
- V. Listing of 584 abstracts of current cancer research on occupational and environmental carcinogenesis.
- VI. Abstracts on cancer research epidemiology with many citations on occupations and cancer.
- VII. Listing of 148 references in a summary article on occupationally-related carcinogens.

- I. U. S. Department of Labor. Citations on Occupations and Cancer. 1960 to 1975.

Compilations of 28,498 citations (including approximately 5,784 reprints) on occupational cancer published during 1960 to 1975. The citations were gathered from secondary sources (e.g., Index Medicus and Excerpta Medica). The citations have been classified by subject headings. Selected subject bibliographies have been prepared. This reference source was prepared under contract with the Occupational Cancer Data Bank of the George Washington University.

- II. Abstracts and Indexes to Selected Literature on Occupational and Environmental Carcinogenic Hazards. Prepared by the Franklin Institute Research Laboratories, July 10, 1975 (338 pp).

This compilation of approximately 1,450 abstracts was prepared for a conference on cancer registries and occupational cancers held in 1975. The abstracts were obtained from Volumes 7 through 11 (1969 to 1973) and the first two issues of Volume 12 (1974) of Carcinogenesis Abstracts. Where abstracts were not present, they were taken from Excerpta Medica, Biological Abstracts, Chemical Abstracts or from the article. There are three extensive indexes; namely, agents, sites, and agents-site-tumors.

The pages are not numbered. The references are listed by the volume and reference number in Carcinogenesis Abstracts. The publication brings together many abstracts dealing with occupational and environmental carcinogenic hazards.

- III. Occupational Carcinogenesis, Vol. 271, Annals of the New York Academy of Sciences, 1976 (560 pp).

This monograph contains the proceedings of a conference held on May 28, 1976. The many articles are grouped into nine sections with references following each article. These references serve as a comprehensive and varied listing of citations in the field of occupational carcinogenesis.

- IV. Decoufle, P: A Retrospective Survey of Cancer in Relation to Occupation. DHEW (NIOSH) Publication No. 77-178, 1977 (215 pp).

This study, performed at the Roswell Park Memorial Institute contains 233 references from the American and European literature during the years 1963 and 1974. The references cover occupations, industries, hazards, and cancers.

- V. Special Listing. Current Cancer Research on Occupational and Environmental Carcinogenesis, July 18, 1979. U. S. Department of Health, Education and Welfare. Public Health Service. National Institutes of Health. National Cancer Institute (85 pp).

This listing contains 584 abstracts of current research projects in seven major categories; namely, asbestos; metallic salts or oxides; organic chemicals, specific occupations; pollution and other environmental factors; detection and measurement of environmental carcinogens; and other studies on environmental and occupational carcinogenesis.

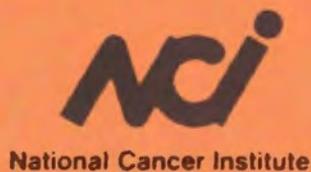
The only index consists of an alphabetical listing of investigators.

- VI. Directory of On-Going Research in Cancer Epidemiology. IARC Publications No. 28, World Health Organization, International Agency Research on Cancer, Lyon, 1979 (672 pp).

- VII. Schottenfeld, DM; Haas, JF: Carcinogens in the Work Place. CA- A Cancer Journal for Physicians. 29:144-173, May/June 1979.

This summary article on occupationally-related carcinogens contains 148 references. These references cover many of the important current topics in the field and can serve as an excellent source for persons interested in the subject matter.

NO DISCUSSION FOLLOWING THIS PAPER



PROCEEDINGS OF THE  
FIRST NCI/EPA/NIOSH COLLABORATIVE WORKSHOP:  
PROGRESS ON JOINT ENVIRONMENTAL AND  
OCCUPATIONAL CANCER STUDIES

MAY 6-8, 1980

SHERATON/POTOMAC, ROCKVILLE, MARYLAND

The papers included in these Proceedings were printed as they were submitted to this office.

Appropriate portions of the discussions, working groups and plenary session were sent to the participants for editing. The style of editing varied, as could be expected. To the extent possible, we have attempted to arrive at a consistent format.

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