

MAPPING CHEMICAL EXPOSURES

BY

Kenneth D. Kreitel

## ABSTRACT

The Hazard Section of the Surveillance Branch is actively pursuing several new techniques for focusing on potential worker exposures to chemicals in use in industry. This paper reports on a technique to display the geographic concentration of potential worker exposures through the linking of large computer files and data bases.

The computer files from NIOSH's National Occupational Hazard Survey are searched for specific instances where a chemical material of interest was identified during the site visit phase of the survey. Those companies in which the material was observed are classified by their four-digit Standard Industrial Classification (SIC) code. The names and addresses of similar companies are then extracted from the Dun & Bradstreet computer files. The resultant computer file is then analyzed statistically and a cartography system at The National Oceanic and Atmospheric Administration (NOAA) produces a map of the continental United States with each county shaded appropriately.

For the purpose of providing immediate visual impact, areas of the United States which contain large numbers of companies similar to those which were observed using the materials in question are shaded very dark. Areas less likely to contain significant quantities of such chemicals are shaded in lighter half-tones.

The system is capable of producing maps for each of the 8,000 potentially hazardous materials encountered during the National Occupational Hazard Survey, either individually, or in combination.

## I. INTRODUCTION

The purpose of this paper is to give a preliminary report on a new technique that the Hazard Section of NIOSH is actively pursuing.

The Hazard Surveillance Section of NIOSH is charged with the responsibility to develop, compile, and analyze information on the number and distribution of workers exposed to potential occupational hazards to enhance the preventive aspects of occupational health.

It is natural, therefore, for the Hazard Section to be interested about the geographical dispersion of various industrial materials throughout the United States. Our interest in this stems from the often expressed need for greater awareness of potential occupational exposures to hazardous materials.

This awareness is very difficult to achieve because of two built-in confounding factors. Chief among these factors is the practice of tradenaming products. That factor only slightly overshadows the other; which is inadequate labelling requirements. Taken together, these two constitute a rather large impediment to the kind of awareness we feel it is necessary to build.

The Hazard Section does, however, have access to a unique resource which is useful in penetrating the mystique surrounding

the question of who is potentially exposed to what in the work place. This report is an attempt to briefly describe that unique resource, and to introduce an intriguing new use of its data.

## II. GOAL

The goal of the mapping project is to develop maps of the continental United States showing suspected locations and concentrations (if possible) of potentially hazardous exposure agents. Furthermore, insofar as practical, we would like to compare these maps and the underlying data with other data sources such as NCI's "Cancer Mortality by County: 1950-1959" (1) and their "Atlas of Cancer Mortality for U. S. Counties: 1950-1969."(2)

## III. RESOURCES

The principal resource used for the mapping project was NIOSH's National Occupational Hazard Survey Data Base. The National Occupational Hazard Survey (NOHS) was conducted during the period 1972 through 1974. It was a nationwide effort to gather information on potential workplace exposures to hazardous material through the use of 20 field surveyors who actually visited over 4,500 different plant sites throughout the United States.

The surveyor's job, to simplify it greatly, was to first interview the plant management about current practices within the plant, and then to conduct a detailed walk-through survey of the plant, noting occupational exposures to potential chemical, physical, and biological hazards. The surveyors also noted the conditions under which the exposures were occurring, and the control measures that were being applied.

The plants that were surveyed represented a national probability sample of selected industries. The result of that effort is a computerized data base which contains almost five million records, and which is useful for describing potential occupational exposures by industry, by occupation, and by exposure agent. (3)

NIOSH's experience in compiling this data base indicated that most of the workers' exposures were to products that were tradenamed as opposed to being in pure chemical form with the chemical adequately labelled. Some 70% of all exposures noted during the survey were, in fact, to tradenamed products. NIOSH then began a program of follow-up by writing to the manufacturers of the tradenamed products to obtain the ingredients and the formulation of the product. This auxiliary effort, dubbed "TNIC" or Trade Name Ingredient Clarification yielded information which has proven to be invaluable for the mapping project. Now integrated into the main NOHS data base, the TNIC data provides

very valuable insights into the potential for occupational exposures to hazardous materials that were formerly obscured or disguised due to the twin problems of tradenaming and inadequate labelling. Of the approximately 80,000 different tradenamed products encountered in the course of the NOHS survey, about 64,000 or 80% have been resolved into components through the cooperation of the manufacturers.

The secondary resource that the mapping project draws upon is the Dun & Bradstreet file. This computerized file contains information on 4.3 million companies throughout the United States. Each company record includes the company name and address, its size in terms of the number of people employed there, and its Standard Industrial Classification (SIC) code.

#### IV. METHODOLOGY

As a first step, a single important industrial material suspected of being in widespread usage throughout the United States was chosen as an appropriate vehicle for developing the methodology. This material was chosen because it was suspected of being incorporated into a wide range of products which enjoyed a wide variety of uses within industry.

This material, asbestos, was used as the basis for a computerized search of the entire NOHS data base. The result was a compilation of all the plants in which NOHS surveyors had noted at least one worker potentially exposed to the material by virtue of his or her job, during the period 1972 through 1974. Any worker who

indicated he or she used this material (or a tradenamed product which, upon resolution was found to contain this material) for periods totaling more than one-half hour per week in the aggregate served to nominate an entire industry for further consideration.

The list of industries nominated through this process by the NOHS data base was lengthy. It included one-hundred and forty-seven distinctly different industries, as delineated by the four-digit Standard Industrial Classification (SIC) code.

The length of the list was due, in part, to the ability of the integrated NOHS and tradenames data bases to penetrate the tradename barriers and detect obscure or unrecognizable exposures to the material. This is expected to become a regular occurrence in future attempts at mapping.

The list of nominated industries was then analyzed a number of ways, to determine the extent to which the NOHS study accurately reflected each of the industries in question. A set of decision rules was then developed which was capable of separating the list into two smaller lists of industries; one qualified for further consideration, and one unqualified. The decision rules were carefully applied to each of the industries on the candidate list.

The first rule specified that NIOSH surveyors must have observed the material in question at least twice in an industry during 1972-1974. The second rule specified that in addition to Rule #1, the NIOSH surveyors must have noted exposures to the material in question in at least 25% of the plants of that industry type that were visited. The two tests were designed to eliminate from further consideration those industries in which the NOHS data was too limited to provide a good case for continuing.

The fully qualified list of industries (see Table 1) then formed the basis for extracting the records of similar business establishments throughout the United States from the Dun & Bradstreet file. The entire Dun & Bradstreet file was searched for companies whose industry codes matched the twenty-five (25) on the "fully qualified industries" list. Records of approximately 60,000 business establishments were extracted using the matching procedure.

These records were then organized by county and analyzed with the aid of a widely-available computerized statistical analysis system. Results were tabulated and displayed on a county-by-county basis as a means of providing the researcher with some preliminary insight prior to readying the data for the cartography system.

The cartography system was county-based. It contained X and Y coordinates of all the county lines, and required only the proper county code and a code to indicate the desired shade of darkness for each of the counties.(2) The proper country identification code was not

the one extracted from the Dun & Bradstreet file, however. Therefore, a code conversion table was built and software developed which was capable of automatically converting the Dun & Bradstreet code to the preferred code.

The shade code was assigned to each county on the basis of the number of qualified industrial facilities within the county. To provide clarity and to achieve the greatest visual impact, the counties with the highest number of qualified facilities were shaded the darkest. Nine different shading protocols were investigated as a means of becoming familiar with the variation in subsequent outcomes that the different protocols afforded. As the maps show, it is possible to prepare shading protocol that becomes more selective until only the very, very high interest counties remain shaded on the map.

#### V. RESULTS

The maps appear to corroborate the conventional wisdom that asbestos and asbestos-containing tradenamed products conceivably were used in industrial settings across most of the face of America.

The industries that were rated "fully qualified" tend to be found in conjunction with large population centers. There are, however, some notable exceptions. Fargo, North Dakota, and Sioux Falls, South Dakota, for example, with populations less than 100,000 persons, cannot be considered major population centers, yet each contains several "fully qualified" industries. Two large population centers in particular, Cook County, Illinois, and Los Angeles

County, California, contain very large numbers of businesses that fit the "fully qualified" description.

These maps are not "rate" maps. That is, they are independent of population considerations and thus they serve only to locate geographical areas with large numbers of fully qualified industries. They do not attempt to depict nor to predict high incidence rates of asbestos-related illnesses.

## VI. LIMITATIONS

There are two principal limitations inherent in this technique which must be understood for correct interpretation of the results. First, the NOHS survey was not designed to be statistically representative of industries at the four-digit SIC code level. Some industries represented by four-digit codes, in fact were not visited during the survey. Those industries are not represented anywhere in the data. In addition, more four-digit industries in general were not sampled with enough frequency to assume that the sample that was drawn was representative. The decision rules detailed in the methodology section above formed the sole basis for qualifying industries to the list of highly interesting industries.

The second principal limitation upon the interpretation of the results is more mechanical than statistical. The NOHS data was described in terms of 1967 SIC codes. The Dun & Bradstreet

file uses the 1972 version of the same publication. (4) There were some industry classification changes between the two versions of the publication. The changes were minor in nature. The major problem involved in the methodology above is the great "leap of faith" that was made in assuming that an industry as delineated by a four-digit SIC code in 1972 is essentially the same as the industry typified by the same SIC code in 1979. No attempt was made to account for possible changes in technology, methods of production, changes in regulations, or geographic shifts in industry in the years between 1972 and 1979.

The maps simply represent the distribution of industries that qualified as being of "high interest" through the methodology above at a single point in time.

Asbestos was chosen only as a first attempt to map chemical exposures. The Hazard Section is continuing to develop this technique, and will map other industrial materials in response to the Institute's Surveillance needs.

TABLE 1

STANDARD INDUSTRIAL CLASSIFICATION CODES OF  
INDUSTRIES CONSIDERED "FULLY QUALIFIED"

<u>1967 SIC CODE</u>	<u>INDUSTRY DESCRIPTION</u>
1742	Plastering, Drywall, and Insulation
1752	Floor Laying & Floor Work N.E.C.
1761	Roofing and Sheetmetal Work
2011	Meat Packing Plants
2821	Plastics Materials and Resins
2851	Paints and Allied Products
2911	Petroleum Refining
2952	Asphalt Felts and Coatings
3241	Cement, Hydraulic
3291	Abrasive Products
3292	Asbestos Products
3312	Blast Furnaces and Steel Mills
3352	Aluminum Rolling & Drawing
3433	Heating Equipment, Except Electric
3443	Fabricated Platework (Boiler Shops)
3519	Internal Combustion Engines, N.E.C.
3661	Telephone and Telegraph Apparatus
3711	Motor Vehicles and Car Bodies
3713	Truck and Bus Bodies
3721	Aircraft
3731	Ship Building and Repairing
3742	Railroad Equipment
3791	Trailer Coaches
3843	Dental Equipment and Supplies
3996	Hard Surface Floor Coverings

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## Discussion

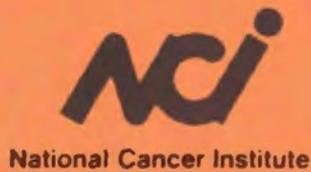
Dr. Jenkins (EPA): How are you planning to utilize the data you are now collecting from both the labor unions and industry on specific chemicals and specific plants, and how is this going to interface in the future with updating this mapping system?

Mr. Kreitel (NIOSH): It is actually a little too soon to tell that. The information that we are collecting from the unions that relates specific chemicals to specific plants is not coming in on anything that resembles a nationwide basis at all, so it really would have to have much more complete coverage before we could do anything like this with it, so it probably will not interface for a large number of years.

Dr. Bellin (EPA): I am just curious, as an ancillary question, what is your experience with trade name products? How often does their composition change? Can we assume that something that had a certain composition in 1972 has the same composition now?

Mr. Kreitel (NIOSH): As a matter of fact, that is probably a very dangerous assumption to make. We believe that there is a product life cycle out there and that products in certain industries turn over much faster than products in other industries and other uses.

There are a few more presentations that will be made today on our plans to update that data base and on a brief description of that data base itself.



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