5

AN EPIDEMIOLOGIC STUDY OF SELECT CAUSES OF DEATH IN COUNTIES OF THE UNITED STATES EXPOSED TO COPPER-NICKEL MINING/SMELTING IN COMPARISON WITH COUNTIES NOT EXPOSED, WITH THEIR RESPECTIVE STATES, AND WITH THE UNITED STATES AS A WHOLE

Eunice E. Sigurdson, R.N., M.P.H.
Robert Knorr, M.P.H.
Chronic Disease Epidemiology Unit
Minnesota Department of Health
Peter Ashbrook, M.S.
Regional Copper-Nickel Study
April 28, 1978

INTRODUCTION

This document is a summary report of an epidemiologic study of the mortality experience of county populations in the United States exposed to copper-nickel mining and/or smelting, in comparison with selected counties not exposed, and also compared with the respective states in which they are located and with the United States as a whole. The purpose of the study was to provide information about the effect of copper-nickel development on the mortality of nearby communities.

The study was recommended in the document, Copper-Nickel Mining, Smelting, and Refining as an Environmental Hazard to Human Health - A Review of Epidemiology Literature and Study Recommendations, which was completed November 1976 by the Division of Epidemiology, University of Minnesota, under contract with the Regional Copper-Nickel Study. This study has been done in fulfillment of a contract between the Minnesota Environmental Quality Board and the Minnesota Department of Health dated April 6, 1977. A more detailed report of the methodology and the problems encountered in conducting the study is on file in the Chronic Disease Epidemiology Unit at the Minnesota Department of Health.

METHODS

Publications from the U.S. Bureau of Mines and the U.S. Department of Commerce provided information which indicated 48 counties in the United States were locations of copper or nickel production (mining, smelting, and/or refining). From these 48 exposed counties, the study counties were selected based on the following criteria:

1. Copper-nickel industry must have been in operation prior to 1960, in order to allow for an adequate induction period for health effects from exposure.

2. Copper-nickel industry must have been the principal industry in the county, in order to avoid confounding variables of possible pollutants from other industries.

3. Copper-nickel mining and/or smelting must have been the primary operation of the copper-nickel industry.

4. The industry must have employed more than 50 workers. This was considered an indication of the size of the industry, providing for selectivity of industries with greater potential of environmental impact.

5. None of the counties must have an urban population larger than 50,000, in order to minimize any effect from urban pollutants.

6. Each of the various types of operations within the copper and nickel industry must be represented by at least one county, and would include (a) underground mine only; (b) open pit mine only; (c) underground mine and smelter; (d) open pit mine and smelter.

After applying these criteria, 7 exposed counties remained in the study. An additional county (not one of the original 48) was added because it was adjacent to an underground mine and smelter and to one of the 7 exposed counties. Furthurmore, 19% of the population of the adjacent county was employed in the mine and smelter. This provided a total of 8 exposed counties selected for the study. The demographic and industrial characteristics of these populations are listed in the Appendix and are based on 1970 census data unless otherwise stated. Counties with each of the industrial operations listed in #6 above were selected for the study.

Counties without copper-nickel mining/smelting were selected based on the following criteria for comparison to the eight exposed counties:

1. Absence of any copper or nickel industry within the county.

2. Location within the same state as the exposed county.

3. Without an urban population greater than 50,000.

4. Similar to the size and distribution of the population of the exposed county by age, sex, race/ethnic, socioeconomic, and occupational characteristics, as provided by the 1970 census. The distribution of each of these population characteristics was not to vary by more than 10% from the exposed county. Two counties would be combined if necessary to provide an adequate population base.

5. Similar industrial operations (other than copper-nickel) to the exposed county.

6. Use of a non-exposed county more than once within the same state for comparison if no suitable county available.

Difficulties were encountered with the selection of comparison counties. In southwestern United States, small population areas, widespread mining of various types, and large ehtnic groups in nonexposed counties created difficulties. Counties elsewhere in the country were difficult to match because of very dissimilar industrial characteristics. However, these problems were eventually resolved.

The comparison counties that were selected are listed in the Appendix with selected demographic and industrial characteristics. Table I lists the counties selected for the study:

TABLE I

States	Exposed Counties	Non-exposed Counties
Arizona	Yavapai (open pit copper mine)	Yuma
Nevada	Lyon (open pit copper mine)	Churchill
	White Pine (open pit copper mine and smelter)	Churchill & Nye
New Mexico	Grant (open pit copper mine and smelter)	Dona Ana
	Hidalgo (underground copper mine)	Dona Ana
Oregon	Douglas (open pit nickel mine and smelter)	Coos & Yamhill
Tennessee	Polk (underground copper mine and smelter)	Sevier & Unicoi
Georgia	Fannin (adjacent to mine in Tennessee)	Cherokee

Mortality data for the counties and the states were obtained for the time period 1969-1973 from each of the State Health Departments, and data for the United States as a whole were obtained from the National Center for Health Statistics. For Nevada, data were available for the entire study period for only five categories of cause of death, All Causes and Cancers. The causes of death selected for analysis are listed in Table II.

TABLE II

Cause of Death	ICDA Codes (Eighth Revision)
All Causes	000.0 - E999.9
All Malignancies	140.0 - 209.9
Digestive Cancers	150.0 - 159.9
Respiratory Cancers	160.0 - 163.9
Urinary Cancers	188.0 - 189.9
Respiratory Disease	490.0 - 493.9
	515.0 - 516.9
	519.2 - 519.3
Accidents	E800.0 - E807.7
	E820.0 - E823.9
	E864.0 - E867.9
	E870.0 - E887.9
	E891.0 - E902.9
	E904.0 - E904.9
	E909.0 - E909.9
	E913.9 - E921.9
	E923.0 - E929.9

For analysis, data were transcribed onto keypunch cards and then processed on the CDC 3300 computer at the University of Minnesota Health Sciences Computer Center.

The non-white component of the population represented 1-2% and not more than 9% of the total population of each of the study counties. Therefore, numbers of deaths for whites and non-whites were combined, and rates were not calculated for whites and non-whites separately. Age-specific and age-adjusted rates were calculated for males and females separately based on the 1970 population.

Age-specific rates are in the complete report which is on file in the Chronic Disease Epidemiology Unit at the Minnesota Department of Health. Only the age-adjusted mortality rates have been analyzed in this summary report.

ANALYSIS OF AGE-ADJUSTED MORTALITY RATES

Introduction

Average annual age-adjusted mortality rates are shown in Tables 1-3. In the following discussion comparisons will be made between the individual states and the United States; individual counties (groups of two counties in some cases) and the respective states; and individual exposed counties and nonexposed counties. Data for the State of Nevada as a whole are not available, and data for respiratory diseases and accidents in that state are incomplete and are not used in the analysis. Each of the seven mortality categories will be discussed separately and will contain analyses for males, females, and both sexes combined.

All Causes of Death

Both sexes combined: Rates for Arizona and New Mexico were very close to that of the United States. Oregon had lower rates than the United States, while Tennessee and Georgia had higher rates. Each exposed county (n=5) had higher mortality rates than its state; however, Fannin County had a much lower mortality rate than the state of Georgia. Two of the nonexposed counties had higher rates and two had lower rates than their respective states; Cherokee County had a lower rate than Georgia. When compared to the appropriate nonexposed counties the mortality rates for exposed counties were higher in six of the seven cases; however, Fannin had a lower rate than Cherokee.

Males: Rates for males show trends identical to those for both sexes combined, except for four out of five exposed counties which had higher mortality rates than their respective states.

Females: Tennessee and Georgia had higher mortality rates than the United States, while the other three states have lower rates. All exposed counties (n=5) had higher rates than their states, while three of four nonexposed counties had lower rates; both Fannin and Cherokee had lower rates than Georgia. Six of the seven exposed areas had higher mortality rates than their nonexposed comparison counties; however, Fannin had a lower rate than Cherokee.

All Cancers

Both sexes combined: All five states had rates lower than that of the United States, ranging from 5 to 18% lower. Four of five exposed counties had rates higher than state averages; Fannin is also higher than its state. Three of four nonexposed counties had rates lower than their states; however, Cherokee had a higher rate than its state. Five of the seven exposed counties had rates higher than their nonexposed comparison counties, although one of the five is higher by only 1%. Fannin has a lower rate than Cherokee.

Males: Rates for males show trends identical to those for both sexes combined except for three of four nonexposed counties which had rates higher than their states (as opposed to lower for both sexes combined).

Females: All five states had rates lower than that of the United States. Two of five exposed counties and none of four nonexposed counties had rates higher than their respective states. Fannin was lower than its state, while Cherokee was higher. Five of the seven exposed counties had rates higher than their nonexposed comparison counties; however, Fannin had a lower rate than Cherokee.

Digestive Cancers

Both sexes combined: Mortality rates for the five states are 6 to 20% below that of the United States. Two of five exposed counties and two of four nonexposed counties had rates higher than their states. Fannin had a lower rate and Cherokee had a higher rate than Georgia. Two of the seven exposed counties had rates higher than their nonexposed comparison counties. Fannin had a lower rate than Cherokee.

Males: Rates for males show trends very similar to those of both sexes combined with only two minor differences. Three of the seven exposed counties had rates higher than their nonexposed comparison counties, and the rate for Cherokee County was lower than that for Georgia.

Females: Trends for females are similar to those for both sexes combined with a few minor differences. One of five exposed counties and one of four nonexposed counties had higher rates than their states. Four of seven exposed counties had rates higher than their nonexposed comparison counties.

Respiratory Cancers

Both sexes combined: All five states had rates lower than the United States; however, four of five are within a two percent difference. Three of five exposed counties and three of four nonexposed counties had rates higher than their states. Fannin had a slightly higher rate and Cherokee had a lower rate than Georgia. Four of the seven exposed counties had a rate higher than that of their nonexposed comparison counties. Fannin was also higher than Cherokee.

Males: Two of the five states had rates higher than the United States. Three of five exposed counties and four nonexposed counties had rates higher than their states. Fannin and Cherokee had rates below Georgia. Four of the seven exposed counties had rates higher than their nonexposed comparison counties. Fannin was lower than Cherokee.

Females: Two of the five states had rates higher than the United States. Four of the five exposed counties and two of the four nonexposed counties had rates higher than their states. Fannin was higher and Cherokee was lower than Georgia. Five of the seven exposed counties had rates higher than their nonexposed comparison counties, as did Fannin County.

Urinary Cancers

Both sexes combined: Four of five states had lower rates than the United States. Three of five exposed counties and two of four nonexposed counties had rates higher than their states. Fannin and Cherokee had higher rates than Georgia. Four of the seven exposed counties had rates higher than their nonexposed comparison counties. Fannin also had a higher rate than Cherokee.

Males: Four of the five states had lower rates than the United States. Two of five exposed counties and two of four nonexposed counties had higher rates than their state. Fannin and Cherokee had higher rates than Georgia. Four of the seven exposed counties had higher rates than their nonexposed comparison counties. Fannin had a lower rate than Cherokee.

Females: All five states had rates below that of the United States, although the rate for the United States (0.49/10,000 population) was very low. Three of five exposed counties and two of four nonexposed counties had rates higher than their states. Fannin had a higher rate and Cherokee had a lower rate than Georgia. Three of seven exposed counties had rates higher than their nonexposed comparison counties. Fannin also had a higher rate than Cherokee.

Respiratory Diseases

Both sexes combined: All five states had higher rates than the United States.

Three of five exposed counties and one of four nonexposed counties had higher rates than their states. Fannin and Cherokee had lower rates than Georgia. Three of five exposed counties had rates higher than their nonexposed comparison counties (and two of those three were only 1% higher). Fannin had a lower rate than Cherokee.

Males: Trends for males were identical to those of both sexes combined.

Females: Four of the five states had rates higher than the United States, while Tennessee had the same rate. Two of five exposed counties and all four nonexposed counties had higher rates than their states. Fannin and Cherokee both had lower rates than Georgia. One of the five counties had a higher rate than its nonexposed comparison county. Fannin had a lower rate than Cherokee.

<u>Accidents</u>

Both sexes combined: All five states had rates higher than the United States. All five exposed counties and three of four nonexposed counties had rates higher than their states. Fannin and Cherokee had lower rates than Georgia. All five exposed counties had higher rates than their nonexposed comparison counties. Fannin was also higher than Cherokee.

Males: Trends for males were very similar to those for both sexes combined, with two small differences. Two of four nonexposed counties had rates higher than their state and Fannin had a higher rate than Georgia.

Females: Three of five states had rates higher than the United States. Four of five exposed counties and two of four nonexposed comparison counties had rates higher than their states. Fannin and Cherokee had lower rates than Georgia. Four of the five exposed counties had rates higher than their nonexposed comparison counties. Fannin had a lower rate than Cherokee.

Discussion

The purpose of this mortality study was to determine if there is any evidence, based on mortality data, that copper or nickel mining and/or smelting have any effect on the health of the general population residing in counties with such industries. Before discussing the evidence, several points should be kept in mind. First, mortality studies, in general, must be interpreted with caution. They are based on death certificate data which are known to be subject to considerable error of reporting cause of death and coding of underlying cause of death. In addition, mortality from some diseases may not accurately reflect the occurrence of disease in a population and may only be the "tip of the iceberg" as in chronic respiratory disease. However, results from mortality studies serve as a valuable base upon which to mount morbidity studies and case-control studies. The latter are more expensive but provide more accurate data regarding disease rates in a population and the possible etiological factors contributing to those diseases. Such studies are recommended for furthur investigation into the health effects of copper-nickel mining/smelting. Second, nonexposed counties were chosen in an attempt to have populations and environmental conditions identical to the exposed counties, but without the copper or nickel industry. Perfect comparison counties are not available, hence there are a number of possible confounding variables. Third, we have little information concerning the location of the population, wind roses, and levels of pollutants. This information may help to explain some of the findings and could be used in a more detailed analysis. Lastly, the populations studied were fairly small, and in no case did any of the counties have a city with a population over 50,000.

Keeping the above information in mind, and the utility of such an analysis in proper perspective, there is some evidence, although differences are relatively small, which supports the hypothesis that copper and/or nickel development may affect health. Comparisons of most significance for this analysis are those between exposed counties and nonexposed counties (summarized in Table 4).

For all causes of death, six of the seven comparisons showed higher mortality rates for the exposed counties, irrespective of whether males, females, or both sexes combined were being considered. This is suggestive that copper or nickel development adversely affects health. Similarly with accidents, all five comparisons showed higher mortality rates in the exposed counties for males and both sexes combined, while for females the numbers were four of five. This, too, is suggestive of adverse effects on health from copper-nickel development. For all cancers, five of the seven comparisons showed higher mortality rates for the exposed counties for males, females, and both sexes combined. Although this finding is suggestive, it is much less convincing than the findings for all causes of death and accidents.

Looking at respiratory diseases in females, only one of five exposed counties had a higher rate than its nonexposed comparison county. In addition, comparisons for digestive cancers, respiratory cancers, urinary cancers, and respiratory diseases (for males and both sexes combined) showed little difference, and hence, give no evidence that health may be affected by copper or nickel development for these diseases.

Two counties are of sufficient interest to be discussed separately. The first is Fannin County, Georgia. This county does not have copper or nickel development but was studied because of its close proximity to Polk County, Tennessee, which does have a copper industry. If Fannin County can be considered an exposed county, it would tend to lessen the evidence that a copper industry adversely affects health. However, there are several good reasons why Fannin County should not be considered an exposed county, and it was discussed separately in the above analysis.

The other county of particular interest is Douglas County, Oregon. It has the only nickel mine and smelter in the United States (with the exception of a nickel refinery opened by AMAX in Louisiana in the past year). Nickel has been implicated as a lung carcinogen. It is therefore of interest that the respiratory cancer mortality rate for Douglas County was 10% higher than its nonexposed comparison counties for males and was twice as high for females. In conclusion, based on this analysis there is some suggestion that copper or nickel development adversely affects health. The evidence which is available is only mildly convincing at best. Additional data and a more detailed analysis of mortality in these and other counties seems warranted based upon what has been collected for this study.

TABLE 1

Average Annual Age-Adjusted Mortality Rates Per 10,000 (1969 - 1973)
MALES AND FEMALES COMBINED

	All Causes	All Cancers	Digestive Cancers	Respiratory Cancers	Urinary Cancers	Respiratory Diseases	Accidents
United States	95.49	16.61	4.68	3.59	0.76	1.99	1.61
Arizona - State	95.23	15.78	4.11	3.55	0.79	4.10	1.69
Yavapai County, AZ(M)	115.94	16.51	4.14	4.11	0.87	5.52	2.68
Yuma County, AZ (C)	114.44	17.58	4.24	5.26	0.78	5.48	1.75
Georgia - State	106.36	13.63	3.76	3.55	0.62	2.10	1.84
Fannin County, GE(M&S)**	87.60	13.71	2.80	3.59	0.83	1.12	1.59
Cherokee County, GE(C)	91.87	15.00	3.83	3.33	0.72	1.91	1.28
Nevada - State*	0	0	0	0	0	0	0
Lyon County, NV (M)	111.79	17.97	4.02	5.87	1.19	*	*
Churchill County NV(C)	96.96	18.05	4.43	3.20	1.63	*	*
White Pine County, NV (M&S)	97.47	16.67	5.63	4.37	1.36	*	*
Churchill & Nye Counties, NV (C)	97.74	15.51	4.08	2.57	1.32	*	*
New Mexico - State	95.55	14.54	4.40	2.91	0.61	2.86	2.26
Grant County, NM (M&S)	96.14	15.95	3.45	3.74	0.86	2.87	2.54
Hildago County, NM (M)	113.83	13.73	2.42	2.36	0	1.93	3.93
Dona Ana County, NM(C)	89.11	13.72	3.79	3.55	0.78	2.84	1.41
Oregon - State	88.35	15.71	4.03	3.52	0.30	2.62	1.62
Douglas County, OR(M&S)	95.36	16.44	3.63	4.29	0.26	3.83	2.53
Coos & Yamhill Counties, OR (C)	89.28	15.37	4.22	3.40	0.33	2.56	2.20
Tennessee - State	99.52	15.73	4.08	3.52	0.62	2.03	1.72
Polk County, TN (M&S)	109.60	17.00	4.18	2.84	0.82	1.18	2.53
Sevier & Unicoi Counties, TN (C)	96.36	13.91	3.36	3.80	0.46	1.81	2.09

C= Nonexposed Comparison Counties
S= Smelting

M= Mining
*= Incomplete Data
**= Adjacent to Mining/ Smelting County

TABLE 2

Average Annual Age-Adjusted Mortality Rates Per 10,000 (1969 - 1973)

MALES ONLY

	All Causes	All Cancers	Digestive Cancers	Respiratory Cancers	Urinary Cancers	Respiratory Diseases	Accidents
United States	109.80	18.61	5.13	5.91	1.05	3.21	2.13
Arizona - State	111.26	17.57	4.48	5.61	1.07	6.30	2.50
Yavapai County, AZ(M)	139.25	17.77	4.47	6.31	1.24	8.06	4.94
Yuma County, AZ (C)	124.23	20.44	4.79	7.94	0.80	7.40	2.02
Georgia - State	127.36	16.10	4.25	6.32	0.86	3.55	2.57
Fannin County, GE(M&S)**	108.84	16.51	3.42	4.67	0.93	1.53	2.73
Cherokee County, GE(C)	110.20	16.90	3.99	5.71	1.04	3.08	1.97
Nevada - State *	0	0	0	0	0	0	0
Lyon County, NV (M)	120.39	16.29	2.30	7.47	1.48	*	*
Churchill County, NV(C)	110.29	16.13	3.68	4.30	0.97	*	*
White Pine County, NV (M&S)	106.24	15.36	4.58	5.99	1.56	*	*
Churchill & Nye Counties, NV (C)	107.41	13.99	3.39	3.43	0.92	*	*
New Mexico - State	109.49	14.94	4.55	4.26	0.79	4.14	3.09
Grant County, NM(M&S)	108.90	17.80	4.97	4.90	0.64	4.61	3.44
Hildago County, NM(M)	136.97	15.71	3.48	2.61	0	2.61	6.29
Dona Ana County, NM(C)	101.44	15.00	3.99	4.87	1.27	3.95	1.74
Oregon - State	101.39	17.27	4.21	5.54	0.37	3.99	2.38
Douglas County, OR(M&S)	105.12	17.16	3.96	6.11	0.26	5.68	3.84
Coos & Yamhill Counties, OR (C)	102.63	17.92	4.42	5.59	0.51	3.71	3.29
Tennessee - State	116.12	18.00	4.35	6.14	0.81	3.31	2.31
Polk County, TN(M&S)	134.23	21.53	4.47	5.86	0.95	2.10	3.77
Sevier & Unicoi Counties, TN(C)	113.26	16.73	3.79	7.15	0.45	2.68	3.21

C= Nonexposed Comparison County
S= Smelting
M= Mining
*= Incomplete Data
**= Adjacent to Mining/Smelting County

TABLE 3

Average Annual Age-Adjusted Mortality Rates Per 10,000 (1969 - 1973)
FEMALES ONLY

	All Causes	All Cancers	Digestive Cancers	Respiratory Cancers	Urinary Cancers	Respiratory Diseases	Accidents
United States	81.93	14.72	4.26	1.39	0.49	0.83	1.12
Arizona - State	78.07	13.65	3.68	1.38	0.48	1.69	0.90
Yavapai County, AZ(M)	90.34	14.89	3.67	1.74	0.36	2.35	0.45
Yuma County, AZ (C)	97.90	12.69	3.15	1.49	0.69	2.49	1.55
Georgia - State	88.38	11.60	3.36	1.14	0.42	0.87	1.17
Fannin County, GE(M&S)**	66.79	10.86	2.20	2.52	0.71	0.71	0.48
Cherokee County, GE(C)	73.57	13.06	3.68	1.00	0.40	0.74	0.62
Nevada - State*	0	0	0	0	0	0	0
Lyon County, NV (M)	97.37	19.18	5.99	3.59	0.73	*	*
Churchill County, NV(C)	78.46	19.65	5.21	1.84	2.47	*	*
White Pine County, NV (M&S)	82.96	17.55	6.56	2.04	1.06	*	*
Churchill & Nye Counties, NV (C)	81.49	16.56	4.78	1.25	1.81	*	*
New Mexico - State	80.32	13.87	4.18	1.45	0.41	1.43	1.47
Grant County, NM(M&S)	82.12	13.86	1.79	2.47	1.09	0.94	1.68
Hidalgo County, NM (M)	87.82	10.76	0.87	1.88	0	1.13	1.88
Dona Ana County, NM (C)	75.29	12.22	3.53	2.12	0.27	1.61	1.07
Oregon - State	74.55	13.97	3.82	1.44	0.23	1.18	0.88
Douglas County, OR(M&S)	81.92	14.95	3.10	1.96	0.25	1.36	1.19
Coos & Yamhill Counties, OR (C)	73.87	12.33	3.94	0.96	0.12	1.23	1.14
Tennessee - State	84.10	13.60	3.82	1.08	0.45	0.83	1.19
Polk County, TN (M&S)	86.14	12.68	3.90	0	0.67	0.32	1.31
Sevier & Unicoi Counties, TN (C)	78.99	10.94	2.84	0.46	0.47	0.91	1.06

C= Nonexposed Comparison Counties
S= Smelting

M= Mining
*= Incomplete Data
**= Adjacent to Mining/Smelting County

TABLE 4

Summary of comparisons of mortality rates between exposed counties and nonexposed comparison counties

	All Causes	All Cancers	Digestive Cancer	Respiratory Cancer	Urinary Cancer	Respiratory Diseases	Accidents
BOTH SEXES	6/7*	5/7	2/7	4/7	4/7	3/5	5/5
MALES	6/7	5/7	3/7	4/7	4/7	3/5	5/5
FEMALES	6/7	5/7	4/7	5/7	3/7	1/5	4/5

* x/y x= number of times exposed county had a higher rate than nonexposed county
y= total number of comparisons

Note: these comparisons do not include Fannin County, Georgia.

BIBLIOGRAPHY

1. Census of Mineral Industry. U.S. Department of Commerce, U.S. Census Bureau. 1963, 1967.

2. Census of Manufacturers. U.S. Department of Commerce, U.S. Census Bureau. 1954, 1963.

3. Characteristics of the Population; 1970 Census of the Population. U.S. Department of Commerce, U.S. Census Bureau.

4. County Business Patterns. U.S. Department of Commerce, U.S. Census Bureau. 1947, 1959, 1960, 1970.

5. Special Reports - Annual Survey of Manufacturers. Census of Manufacturers. U.S. Department of Commerce, U.S. Census Bureau. 1959, 1963.

6. 1974 Arizona Blue Book. Arizona Blue Book. 1974.

7. Arizona Statistical Review. Valley National Bank of Arizona, Economic Research Department. September, 1976.

8. The Economy of Arizona. Arizona Department of Economic Security. August, 1973.

9. The Economy of Arizona. Research and Reports Division, Employment Security Division of Arizona. December, 1950.

10. Georgia Statistics Abstract, 1974. Division of Research, College of Business Administration, University of Georgia, Athens, Georgia. 1974.

11. New Mexico Statistical Abstract, 1972. Bureau of Business Research, University of New Mexico, Alburquerque, New Mexico. 1972.

12. Oregon Blue Book, 1975-1976. Publisher - Clay Meyers, Secretary of State. 1976.

13. Oregon, An Eccmomic Profile. Department of Economic Development, State of Oregon.

14. Oregon Economic Statistics, 1977. Bureau of Business Research, University of Arizona. 1977.

15. Tennessee Statistical Abstracts, 1974. Center for Business and Economic Research. College of Business Administration, University of Tennessee, Knoxville. 1974.

STATE/COUNTY	[illegible]		SELECT POPULATION CHARACTERISTICS				INCOME		OCCUPATION				
	MINING	SMELTING	NUMBER	% MALE	% SPANISH	% NON-WHITE	MEAN	MEDIAN	% WHITE COLLAR	% BLUE COLLAR	% FARMING AND SERVICE	% IN MINING	% IN PRIMARY METALS (SMELTING)
UNITED STATES	-	-	203,211,926	48.6%	-	12.5%	$10,999	$9,590	45%	41%	14%	-	-
Arizona	-	-	1,770,900	49.2%	18.8%	9.4%	$10,501	$9,187	51%	34%	15%	-	-
Yavapai	open pit copper	no	36,733	49.9%	12.1%	2.7%	$ 8,332	$7,405	40%	40%	20%	6%	-
Yuma	-	-	60,827	51.9%	26.7%	8.3%	$ 9,265	$8,188	44%	31%	25%	-	-
Georgia	-	-	4,589,575	48.6%	-	26.1%	$ 9,491	$8,167	44%	43%	13%	-	-
Fannin	adjacent to underground copper mine & smelter		13,357	48.2%	-	0.4%	$ 6,299	$5,704	28%	62%	10%	19%	
Cherokee	-	-	31,059	49.2%	-	3.8%	$ 8,456	$7,902	30%	58%	12%	-	-
Nevada	-	-	488,738	50.7%	5.6%	8.3%	$11,872	$10,692	47%	27%	26%	-	-
Lyon	open pit copper	no	8,221	51.6%	1%	6.5%	$10,357	$9,334	31%	42%	27%	14%	-
White Pine	open pit copper	yes	10,150	50.5%	8%	3%	$ 9,916	$9,111	35%	48%	17%	4%	21%
Churchill	-	-	10,513	52%	4%	7%	$ 9,348	$8,263	42%	32%	26%	-	-
Nye	-	-	5,599	56.4%	5%	6%	$11,944	$10,224	36%	43%	21%	12% (gold magnesite)	
New Mexico	-	-	1,016,000	49.3%	40%	10%	$ 9,193	$7,849	51%	32%	17%	6%	-
Grant	open pit copper	yes	22,030	49.6%	56.1%	1.8%	$ 8,888	$7,898	37%	48%	15%	34%	-
Hidalgo	underground copper mine	no	4,734	49.2%	58.8%	1.4%	$ 7,444	$6,568	34%	37%	29%	13%	-
Dona Ana	-	-	69,733	50%	50.8%	3.3%	$ 8,862	$7,395	52%	28%	20%	-	-
Oregon	-	-	2,091,385	50%	-	2.8%	$10,695	$9,489	48%	37%	15%	-	-
Douglas	open pit nickel	yes	71,743	50.1%	-	1%	$ 9,470	$8,670	38%	47%	15%	0.9%	2%
Coos	-	-	56,515	50.1%	-	1.2%	$10,157	$9,243	35%	52%	13%	-	-
Yamhill	-	-	40,213	50%	-	1.8%	$ 9,821	$8,633	40%	39%	21%	-	-
Tennessee	-	-	3,923,687	48.4%	-	16.1%	$ 8,619	$7,447	41%	46%	13%	<1%	1%
Polk	underground copper mine	yes	11,669	48.8%	-	.01%	$ 7,240	$6,678	25%	58%	17%	11%	3%
Sevier	-	-	28,241	49%	-	.5%	$ 7,295	$6,377	32%	49%	19%	-	3%
Unicoi	-	-	15,254	48.7%	-	.01%	$ 7,196	$6,487	30%	57%	13%	-	-