VII. Summary

This report has presented the long-term cause-specific mortality patterns for employees and ex-employees of a large chemical producing plant owned and operated by the Monsanto Company. A cohort was developed from company records consisting of 2490 male wage-earners who were employed a minimum of one year between January 1, 1949 to December 31, 1966. The cohort was verified to be complete via a method which is independant of company-held records. Vital status of the cohort was determined as of December 31, 1976 for all but 7 persons (99.7% follow-up). A total of 603 study members were found to have died. Death certificates were located for 591 or 98.0 percent. The observed mortality among chemical-production workers was compared to the mortality experience of white males in the general populations of the United States, Massachusetts, and the county from which the work force was largely drawn (Hampden County). Findings of most interest are:

(1) The overall mortality of chemical production workers, as reflected by a Standardized Mortality Ratio of 95.8 (U.S. control), was favorable, as would be expected in an employed population. Slightly lower SMR's for all causes of death were observed based on the state and county controls.

(2) For most malignant neoplasms studied, the U.S. based SMR's were larger than those derived from the Massachusetts and Hampden County mortality experiences. However, SMR's for malignant neoplasms based on the two regional control populations were, generally, very similar.

(3) Mortality from all malignant neoplasms resulted in an SMR of 98.5 (county control). Positive gradients in SMR's were observed relative to calendar time, age, and the interval from onset of employment, suggesting the influence of occupational factors on the overall cancer mortality experience.

(4) Based on Hampden County comparisons, elevated SMR's were observed for the overall category of digestive system cancer (SMR=101.8) and the individual sites of stomach (SMR=130.3), rectum (SMR=136.1) and biliary passages and liver (SMR=150.4). SMR's for esophageal cancer (136.5) and pancreatic cancer (116.3) were elevated only following 20 years from onset of employment. None of the digestive cancer excesses were statistically significant, however, the rectal, liver, and pancreatic cancers showed evidence of a relationship with both the duration and the lapsed period from onset of employment. The possible relationship between occupational factors and digestive system cancer mortality was confounded by other factors, such as birth place, which appeared to partly account for some of the excesses observed.

(5) A statistically significant ($P<.05$) excess in deaths from genit - urinary tract cancers was observed based on the U.S., state, and local comparison populations. (SMR's = 169.4, 162.2, and 153.6, respectively). Elevated SMR's were also observed for all individual sites, although, none were statistically significant. The genito-urinary cancer excesses did not appear to be related to calendar time, duration of employment, or to the interval from

onset of employment, although a suspicious clustering of deaths was observed among those study members who worked a total of 10-20 years and who died within 20-30 years from the onset of employment. It is possible that occupational factors could have accounted, at least in part, for the observed excesses in genito-urinary tract cancers.

(6) The only elevated SMR for cancers of the lymphatic and haematopoietic tissues was observed for the residual category "All Other Lymphopoietic Tissue" (4 deaths, county SMR=159.9). Although the small numbers involved prohibited detailed analysis, the presence of three multiple myeloma deaths within this category may be important and should be examined with respect to work histories in future studies.

(7) Based on U.S. comparisons, deficits in deaths were observed for "All Heart Diseases" (SMR=98.2), rheumatic heart disease (SMR=44.1), and hypertensive heart disease (SMR=90.7). An elevated SMR of 108.8 was found for coronary heart disease. Comparisons with the state and county heart disease mortality experience during 1960-1976 generally produced lower SMR's.

(8) Based on comparisons with U.S. white males, mortality from influenza and pneumonia was greater than expected (SMR=130.2) and was found to increase with calendar time, age, and the lapsed period from onset of employment. Comparisons with the state and county controls eliminated or reduced the excess, however, the gradient with time from initial employment was maintained. It is unclear whether occupational or nonoccupational factors are

related to these m rtality patterns.

(9) Statistically significant deficits in deaths were observed for the categories "All External Causes of Death", "All Accidents", and "Motor Vehicle Accidents" (U.S. control). Mortality was greater than expected for motor vehicle accidents, suicides, and homicides when comparisons were based on the state and county control populations.

The results of this study underscore the importance and necessity of additional studies designed to further evaluate the mortality patterns of the Indian Orchard plant workers in relation to work history and occupational exposures.