

TABLE IX.—*Sites of Tumours Other than Lung*

| Site/Tumour type                   | Asbestos treated |                | Control    |           |
|------------------------------------|------------------|----------------|------------|-----------|
|                                    | Benign           | Malignant      | Benign     | Malignant |
| Digestive organs and peritoneum    | 4                | 3              | 1          | 3         |
| Bone and skin                      | 3                | 4              | 0          | 2         |
| Breast                             | 100              | 0              | 20         | 1         |
| Ovary                              | 3                | 7              | 0          | 0         |
| Other female genito-urinary organs | 2                | 8              | 0          | 4         |
| Male genito-urinary organs         | 3                | 8              | 0          | 0         |
| Intracranial                       | 173              | 1              | 34         | 0         |
| Thymoma                            | 7                | 1              | 0          | 1         |
| Lymphoma/leukaemia                 | —                | 8              | —          | 2         |
| Others                             | 5                | 3              | 1          | 0         |
|                                    | thyroid          | mediastinum    | suprarenal |           |
|                                    | adrenal (4)      | salivary gland |            |           |
|                                    |                  | thyroid        |            |           |

of the lung had a mesothelioma tunica vaginalis. Mesotheliomata of the vaginalis were seen in this and one other rat; there is no evidence to suggest an association with exposure to asbestos. Also, in some cases there were secondaries, for example, a synovioma had spread to the lung. In all such cases tumours have been classified by the primary site and in the few cases of multiple malignant tumours there was no difficulty in recognizing the distinct types, i.e. one was not a secondary of the other.

## DISCUSSION

Our finding that the asbestosis produced by exposure progressed after cessation of exposure is in agreement with human experience but contrasts with the early inhalation experiments reported by Vorwald, Durkan and Pratt (1951) in which progression did not occur. Wagner (1963) reported more asbestosis with amosite than with chrysotile in guinea-pigs, rats and monkeys but our experiments show that of the UICC standard reference samples amosite is the least fibrogenic in rats.

Gross *et al.* (1967) found lung cancers in 25 of 72 rats which survived 16 months' exposure to chrysotile dust at a mean concentration of 86 mg/m<sup>3</sup> for 30 hours a week. They considered that contamination of the asbestos by trace metals

from the worn hammer of the mill used to produce the respirable fibre could have been a factor in the causation of the tumours. However, our results now show that there is no need to invoke such a hypothesis to explain the high rate of lung tumours.

The amount of chrysotile retained in the lungs did not show any clear increase with dose in rats exposed for longer than 3 months. In two earlier experiments (Wagner and Skidmore, 1965; Morris *et al.*, 1967) a higher airborne dust concentration was used to give a cumulative dose in 6 weeks similar to that given in the present experiment over 3 months. The weight of asbestos found in the lungs of rats exposed to amphibole was 3 times greater than in those exposed to chrysotile. In the present experiments the ratio was 6 to 1 after 3 months, but increased with continuing exposure as the weight of amphibole in the lungs continued to increase, but the amount of chrysotile did not. The previous experiments had shown that the rate of elimination of dust from the lungs was much greater for chrysotile than for the amphiboles. The present results may be explained on this basis, the weight of chrysotile having reached equilibrium level, i.e. the rate of elimination equalling the rate of retention.

There are a number of features of the results presented above which we found