

following a frost-bite suffered two years previously. A similar case was recorded by Andrews and McNitt, who observed a cancer of the external ear in a coachman who had sustained frost-bites 30 years previously. The ear had remained swollen ever since and a small scab had formed on the edge of the ear. Eckermann noted the occurrence of a squamous cell carcinoma of the foot in a man, 56 years old, whose feet had been frozen and had become partly gangrenous when he was 9 years old. The malignancy started from an ulcer which developed in the stump of one foot following a contusion sustained nine years previously. Treves and Pack as well as Iwamoto observed cancers developing from frost-bites. Pohl mentioned a cancer of the nose in a man, 35 years old, after congelation. Finally a case of sarcoma of the large toe after a frost-bite may be mentioned which appeared in a man, 64 years old, and developed 10 months after the injury in a swollen and ulcerated toe (Leonhard).

Experimental observations reported by Berenblum as well as Mansens support the causal relationship between frost-bites and cutaneous malignancy. These investigators succeeded in producing carcinomas in the skin of mice which had been frozen repeatedly with solid carbon dioxide. It is significant that Berenblum was able to elicit a tumorous response by a single application of carbon dioxide snow, if the skin had been tarred previously. Such neoplastic reactions, however, were obtained only when the necrotizing effect of the carbon dioxide burn was not too severe, as in such a case the superimposition of two "carcinogenic" agents resulted in an inhibition of the carcinogenesis and not in a summation of two carcinogenic stimuli.

Inasmuch as frost-bites are anatomically and functionally equivalent to second degree thermic burns, the development of carcinomas on the basis of frost-bites is comparable to a corresponding phenomenon observed in connection with thermic burns. The causative mechanism operating in bringing about the cancerous response to a nonspecific physical agent is obscure. It may be pointed out, however, that frost-bites are accompanied by the development of rather persistent vascular dilatation in the affected area associated with circulatory disturbances (Leriche and Kunlin). The tumor formation following these injuries occurs most often in regions which are exposed to other carcinogenic, exogenous agents, such as, especially, solar rays. The possible and probable influence of these additional factors is illustrated by the observations of Berenblum in mice which had been tarred in addition to the application of carbon dioxide snow.

III. THERMIC BURNS

Causation. Thermic burns and burn scars appear to be particularly prone to undergo malignant transformations (Arndt). Ullmann stated that 80 per cent of all scar cancers occur in burn scars, while Fischer-Wasels noted that only