played the dominant rôle until late in the disease. This is particularly true of the pneumonic phase of the primary complex in infants. Furthermore, it is thought that a great many of the associated conditions in tuberculosis may be attributed to these rapid growing forms that seem to emanate from the tubercle-forming organism in environments not suited for a development of the slowly growing waxy form.

[1] Sweany, H. C., *Amer. Rev. Tuber.*, 1928, xvii, 53.

3898

Nutritional Edema and Its Relation to the Incidence of Common Colds.

FREDERICK HOELZEL. (Introduced by A. J. Carlson.)

From the Department of Physiology, University of Chicago.

In the course of 20 years of personal experimentation with fasting and various diets, edema was frequently manifested. It often occurred after periods of undernutrition but was most prominent after prolonged fasting. Edema has also been observed in others after fasting. It is apparently similar to the starvation edema *(Hungerödem)* which developed among the undernourished masses of Europe during the late war. The European studies of this "war edema" made it clear that nutritional factors and not impairment of the circulation or of kidney function were responsible. But the detailed analysis of the nutritional factors was complicated by the fact that the dietary of the afflicted individuals was not only insufficient in quantity but was also inadequate in other respects. Thus, some investigators were led to attribute the edema mainly to an excessive salt and vegetable intake while others considered it a consequence of deficiency in vitamins or fat.

The edema observed in the subject of the present study occurred independent of some of the factors which complicated the European studies. Hence, it is possible to say definitely that vitamin deficiency, fat starvation or an excessive salt intake were not fundamental factors in the development of this edema. Instead, the observations in this study indicate that protein starvation is the primary factor in giving rise to this type of hydration. The finding of Kohman[1] is hereby supported. However, the gross manifestation of nutritional edema seems to be possible only when the diet con-

tains sufficient salt or carbohydrate or both. Water taken alone is not stored and water restriction only creates thirst without removing the cause of the edema.

Data concerning the state of hydration before, during and after a 33-day fast were secured with the intradermal salt solution test of McClure and Aldrich[2] by Dr. Kunde.[3] Further observations were made later in connection with a 41-day fast. In tests made on the arm and near the knee, the disappearance time of the wheals decreased, by the fifth day after fasting, to about 25% of the pre-fasting rate. At the ankle, it went down to about 5%. With a liberal protein intake following the 33-day fast, the edema practically cleared up within a month; but with 16 days of protein restriction following the 41-day fast, some edema remained for at least 3 months.

A liberal, but not an excessive, protein intake immediately after fasting therefore seemed to mitigate the post-fasting edema but the best results in reducing the severe edema after the 41-day fast were obtained with a few 24-hour fasts and modified fasts. In fact, tests with the method of McClure and Aldrich also showed a dehydration (30 to 40% increase in disappearance time) *during* the 41-day fast. This is contrary to the reports of increased hydration of animals with starvation but the intradermal salt solution test reflects only local (cutaneous or subcutaneous) conditions directly and, very likely, the hydration of starvation is not an edema. The fact that fasting reduces the edema which it helps to create has been a large factor in leading to repeated fasting—now totaling over 500 days.

Nutritional edema, in mild form, seems to be very common. The conditions following illness associated with undernutrition specially favor its development. Hence a consideration of the possible relation of such edema to other common complaints naturally suggests itself. The purpose here is only to emphasize that, in personal experience, a close parallelism between the incidence of colds and nutritional hydration has been observed. Colds were never caught during prolonged fasting or marked and prolonged undernutrition. They developed almost invariably after such periods when edema was also most prominent. Distinct colds (of more than 24 hours duration) have been prevented by keeping the hydration of the organism at a relatively low level, mainly by restricting the carbohydrate intake and maintaining an adequate protein intake. In the light of these observations, colds are regarded as a common consequence of a chilling of highly hydrated and sensitive skin, with the

result that an overload of fluid is thrown upon already hydrated internal structures, including the upper respiratory tract. Bacteria may then play a complicating rôle after excessive secretions have thus been established.

[1] Kohman, E., *Am. J. Physiol.*, 1920, li, 378.
[2] McClure, W. B., and Aldrich, C. A., *J. Am. Med. Assn.*, 1923, lxxxi, 293.
[3] Kunde, M. M., *Arch. Int. Med.*, 1926, xxxviii, 57.

3899

The Penetration of Ultra Violet Light Into the Human Skin.

A. BACHEM AND J. KUNZ. (Introduced by W. F. Petersen.)

From the Departments of Radiology and Physics, University of Illinois, Chicago and Urbana, Ill.

The problem of the penetration of ultra violet light into the human skin is not yet solved. This problem is of great interest, however, particularly from the point of view that certain limited parts of the ultra violet spectrum produce certain characteristic biological effects, such as erythema, pigmentation, bactericidy, antirachitic action, and others. For the scientific explanation of this reaction it is of interest to know to what depth of the skin these biologically active rays penetrate and by what substances they are selectively absorbed. In order to contribute to the solution of this problem absorption measurements were made for the various parts and biological constituents of the human skin.

Two methods have been used, the photographic and the photoelectric, both in connection with a mercury quartz arc and a Hilger spectrograph. The photoelectric method has the advantage that the whole spectrum can be obtained within a few minutes, and that it gives a crucial test about the end absorption in the far ultra violet. The photoelectric method gives more exact quantitative results, except at the farthest ultra violet end, where a trace of spectral impurity lowers the exactness of the measurements. Besides, it takes a long time to go over the whole spectrum, and it is difficult to keep the conditions of biologic specimens constant for such a length of time. Both methods used are superior to the thermoelectric method as their pronounced ultra violet selectivity makes them more independent from scattered visible and infrared light.

Results: (1) The difference between living and dead tissue kept