velocities obtained from the above-mentioned equation will therefore be greater than the specific velocity of the cation of the base by the specific velocity of the casein anion. In the case of the neutral caseinate of sodium the sum of the ionic velocities was found to be slightly greater than the velocity of the Na ion, indicating a specific velocity of 2.6×10^{-5} cm. per sec. for the casein anion at 25°. In the case of ammonium caseinate, however, the sum of the ionic velocities was found to be considerably *less* than the specific velocity of the ammonium ion. This can only be interpreted, I think, as indicating the presence in this solution of complex cations containing ammonium. Other considerations show that the effect is not due to viscosity. If casein be regarded as an ampholyte of the type HXOH, the sodium salt would be of the type $Na^+ + XOH^-$; it is possible that the ammonium salt in solution forms ions of the type $NH_4X^+ + OH^-$ or $NH_4X^+ + XOH^-$.

So far as I am aware, this constitutes the first direct experimental indication of the actual existence, in vitro, of the compounds of protein and alkalies and alkaline earths in which the non-protein ion is not dissociable as such, the existence of which, in living tissues, has been pointed out by Loeb.

95 (238)

The Altmann's granules in kidney and liver and their relation to granular and fatty degeneration.

By **WILLIAM OPHÜLS.**

[*From the Pathologic Laboratory of Cooper Medical College, San Francisco, Cal.*]

In the kidneys of dogs, rabbits and guinea pigs we find the following arrangement of the Altmann's granules: In the connecting, the convoluted tubules and in the descending parts of the loops of Henle, the granules are rather coarse, very definitely rodshaped and arranged in radial rows in the basilar two thirds of the cells, often so closely set end to end that it is difficult to make out the dividing lines between them. In the part of the cells directly adjoining the lumen there are few scattered short rodshaped granules and none in the "Bürstenbesatz." These details are naturally more plainly shown in the large cells of the convoluted tubules but in a general way the smaller cells in the connecting tubules and in the descending loops of Henle resemble them very closely. Some groups of convoluted tubules have much coarser granules than others. I have not been able to make out whether this is a constant anatomic difference or due to different functional stages. If the granules have any relation to the function of the cells, which seems probable, one would surmise that the connecting tubules cannot purely serve the function of conducting the urine from one place to another, all the more so as in the large ducts in the pyramids which serve this purpose alone, the granules are very scanty and irregularly arranged. In the large light cells of the ascending parts of the Henle's loops the granules are exceedingly small, also slightly rodshaped, extremely numerous and scattered all through the cells in an irregular fashion. This might be used as an argument in favor of a difference in function of this portion of the tubules. In the cells of the liver of these animals the granules vary greatly in size from just visible to quite coarse granules. All of them are rods, some short, others quite long and more or less wavy. The granules are scattered irregularly all over the cells.

In granular degeneration the characteristic macroscopic and microscopic pictures of which can be best produced by intravenous injection of bichromate of potash, the granules enlarge in size, become more or less spherical, lose their normal arrangement and stain very deeply with Altmann's stain contrary to what has been generally assumed after the work of Schilling,[1] who seems to be the only one to have investigated this question. Whether there is an actual multiplication of the granules, it is difficult to decide but on the whole the evidence seems against it. The change is almost exclusively in the convoluted tubules; the connecting tubules and the loops of Henle as a whole are slightly affected if at all. In the liver the change is similar, all cells being equally involved. The albuminous granules in granular degeneration, then, are not new formed granules but largely the enlarged and disarranged normal Altmann granules. I was able to confirm this

[1] Schilling: *Virch. Arch.*, 1897, cxxxv, p. 410.

view in two pronounced cases of parenchymatous degeneration in man.

The relation of the Altmann's granules to fat absorption and fat secretion has already been studied carefully by Altmann himself and his pupils Krehl and Metzner, and they have also touched upon the behavior of the granules in fatty degeneration in phosphorus poisoning. Their conclusion is that fat in all cases appears first in and around the Altmann's granules ; they even succeeded in demonstrating remnants of the granules in the center of the initial fat droplets. My observations on the kidneys and liver are confirmatory of these views, although I never succeeded in seeing these remnants of granules in the center of the first fat droplets. It seemed more as if the granules were changed to fat in toto. In fatty degeneration (I use this term for want of a better one) the granules first stain gray with osmic acid and do not take the acid fuchsin stain any more. They may still retain their rod shape. Later they become black and round. The first fat droplets invariably have very nearly the size and in a general way the arrangement of the Altmann's granules. Larger droplets are formed by the fusion of these small ones. I am far, however, from concluding with Altmann that these changes indicate any vital activity in the granules. I should rather imagine that a considerable part of their substance normally must be made up of a combination of fats which does not give the usual reaction of fat and that during fatty degeneration this combination is broken up and the fat liberated.

These observations furnish some explanation why granular and fatty degeneration so frequently occur simultaneously, both being the result of abnormal conditions in the Altmann's granules.

I am greatly indebted to the Rockefeller Institute for financial aid in carrying out these experiments.