CCXCI. THE INFLUENCE OF CONCENTRATED POTASSIUM THIOCYANATE SOLUTIONS ON THE STRUCTURE AND THE VOLUME OF THE VITREOUS BODY.

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(Received 6 December 1935.)

In an earlier paper on the vitreous body [1934] I demonstrated ultramicroscopic changes in its structure after treatment with KCNS solutions in *N* and higher concentrations. In these solutions the ultramicroscopic aspect of the fibrils became hazier in comparison with that of the fibrils of the fresh vitreous. The same phenomenon could be observed under the action of concentrated KI solutions and in my opinion is due to increased hydration of the fibrils. Such a lyotropic influence of concentrated KCNS and KI solutions on hydrophylic colloids is well known. The fact that salt solutions with a dehydrating action (for example K_2SO_4 solutions) caused an opposite change of the ultramicroscopic aspect, lent support to the view that in the case of KCNS the changes were due to increased hydration of the fibrils. After treatment with concentrated K_2SO_4 solutions the fibrillar pattern became much more accentuated than in the normal fresh vitreous as would be expected from dehydration of the fibrils.

In 2*N* and stronger KCNS solutions the vitreous body undergoes a rapid shrinkage to a minute fraction of its original volume. This decrease could be explained in the sense that the increase of hydration under the action of KCNS must in the last resort lead to peptization of the fibrils and accordingly to progressive solution of the framework of the vitreous.

Moreover it could be demonstrated [1935] that the vitreous never showed an increase in volume in more concentrated KCNS solutions. On the contrary, at all concentrations between 0.2 and 0.3 *N* there was a diminution proportional to the concentration (Fig. 1). These experiments showed therefore that increase in hydration of the fibrils does not cause increase in volume of the isolated vitreous.

This fact was important in view of later investigations [1935] in which I observed an extensive increase in volume of the vitreous after removal of the salts which are normally present. This change in volume was not due to increased hydration of the fibrils but was apparently connected with an augmentation of the capillary-electric charge of the fibrils. This increased capillary-electric activity causes greater mutual repulsion of the fibrils which leads to enlargement of the interfibrillar spaces and causes more capillary water to be taken up, so that the volume increases.

In a recent paper Duke-Elder & Davson [1935] questioned my interpretation of the shrinkage of the vitreous in concentrated KCNS solutions and expressed the view that the diminution in volume was not due to solution as indicated above but must on the contrary be regarded as the result of dehydration of the vitreous.

This criticism caused me to make further investigations of the influence of KCNS solutions on the vitreous and to make identical examinations of some other salts for comparison. A brief report of the results of these experiments is given below. It will be shown that the action of KCNS on the vitreous is quite different from those of other salts.

Fig. 1. Influence of KCNS solutions on the volume of the vitreous body.

Fig. 2. — Movement of the volume of the vitreous body in different salt solutions; --- movement of the volume in distilled water.

Exp. 1. Some fresh vitreous were placed in distilled water which was renewed every 24 hours. After about 3 days the beginning of an increase in volume was to be observed. The maximum volume was reached after 5–6 days, and

amounted to 200 % (Fig. 2, curve 1). As mentioned above the increase is connected with an increase in capillary-electric charge of the fibrils after the removal of the salts [see Goedbloed, 1935].

Exp. 2. Some other vitreous were then placed in N K_2SO_4 solutions. As is well known such a solution discharges hydrophylic colloids completely and acts moreover in a dehydrating manner. In this saline solution the vitreous decreased in volume after 5 days to 75 % of the original volume (Fig. 2, curve 2). Thereupon the vitreous were put in distilled water which was several times renewed. By this treatment the salt was removed and after some days an increase in volume was observed to a maximum of 225 %. This experiment proved that the colloid-chemical changes of the vitreous after the preceding treatment with N K_2SO_4 are completely reversible. The final volume reached in Exp. 2 was about the same as in Exp. 1.

Exp. 3. The same experiment as described above was made with $3N$ $NaCl$ instead of K_2SO_4 . In this solution after 2 days the vitreous underwent a decrease in volume to 70 % of the original. After removal of the $NaCl$ in distilled water an increase in volume again set in; the final volume which was obtained was about 200 % (Fig. 2, curve 3). It should be noted that in concentrated $NaCl$ solutions the decrease in volume is rather limited, and that here again the influence of the salt is completely reversible.

Exp. 4. Comparative investigations were then made with concentrated ($3N$) $KCNS$ solutions. After measuring the volume of the fresh vitreous bodies, they were placed in the solution; a very rapid decrease was observed in the volume which after 6 hours was reduced to about 6 % of the original, after 24 hours to 1 % and after 72 hours to 0.5 %. This change of volume is shown by curve 4 of Fig. 2.

Exp. 4 a. Two vitreous bodies which after 6 hours in the $KCNS$ solution had decreased to 6 % of their original volume were placed in distilled water which was several times renewed. After removal of the $KCNS$ an increase in volume was observed which after 72 hours reached a maximum of only 40 % of the original (Fig. 2, curve 4 a).

Exp. 4 b. The same experiment was repeated with some vitreous bodies left in $KCNS$ solutions for 72 hours when the volume was 0.5 % of the original. These showed the phenomenon to a still greater extent, since after removal of the salt in distilled water, a final volume of only 4 % of the original was obtained (Fig. 2, curve 4 b).

DISCUSSION.

In discussing the experiments mentioned above, attention should first be paid to the different behaviours of the vitreous towards $KCNS$ on the one hand and towards K_2SO_4 and $NaCl$ on the other, as is shown by the curves 4, 2 and 3 of Fig. 2. If, as Duke-Elder & Davson thought, the rapid decrease in volume in $KCNS$ were due to simple dehydration of the fibrils of the vitreous, this noticeable difference in the curves would remain unexplained. It is evident that the observations concerning the action of $KCNS$ point more to peptization than to simple dehydration. By such peptization the greater part of the fibrillar proteins (and perhaps also of the other proteins of the vitreous) would be dissolved in the surrounding liquid so that naturally the residue of the vitreous after washing with distilled water would regain a smaller volume than after treatment with K_2SO_4 or $NaCl$. Here it must be repeated that this view is in complete accordance with the observations on the action of concentrated $KCNS$ solutions on the ultramicroscopic aspect of the structure of the vitreous as mentioned at the

beginning of this paper. In this connexion it is to be noted that Duke-Elder & Davson reported increased extensibility of the structure of the vitreous after treatment with KCNS, which in my opinion can only be ascribed to increase in hydration of the fibrils. In this respect the conclusion of the authors about the dehydrating action of KCNS is not in keeping with the results of their own investigations on the elasticity of the vitreous.

SUMMARY.

A brief report is given of investigations of the action of concentrated KCNS solutions on the volume of the vitreous body, in which it is shown that the decrease in volume after treatment with KCNS is largely irreversible. This result is in accordance with earlier investigations of the influence of KCNS on the ultra-microscopic aspect of the vitreous, and with the result of experiments by Duke-Elder & Davson on the extensibility of the framework of the vitreous after treatment with this salt. The experiments indicate that in greater concentrations KCNS acts as hydrating agent and in the last resort causes peptization of the greater part of the vitreous proteins.

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