

wavelengths greater than  $290\text{ m}\mu$ , which may be attributed to the  $300\text{ m}\mu$  band absorption.

The absorption spectra of nitrates in the crystal state and in the fused state have also been studied, and the absorption curves are very similar to those obtained with aqueous solutions. Thus in these states also, the absorption bands have presumably the same origin and are due to the two types of photo-dissociation of  $\text{NO}_3^-$  described above.

It is remarkable that when the absorption measurements are made with *single crystals* of  $\text{KNO}_3$  and  $\text{NaNO}_3$ , in which the  $\text{NO}_3^-$  ions are all orientated parallel to one another, the above two absorption bands are very intense when the incident light-vibrations lie in the plane of the  $\text{NO}_3^-$  ions, while for the vibrations along the normal to the  $\text{NO}_3^-$  planes the absorptions are much feebler.<sup>7</sup> This experimental result, when considered in relation to the origin of these absorption bands given above, as due to the photo-dissociation of  $\text{NO}_3^-$  ion to  $\text{NO}_2^-$  ion and O atom in the ground state and in the excited state respectively, suggests that *the efficiency of the photo-dissociation of the  $\text{NO}_3^-$  ion is much greater when the exciting light-vibrations are in the plane of the  $\text{NO}_3^-$  ion than when they are along the normal to its plane.* Experiments are in progress to test this conclusion by direct measurements.

A detailed report of the work will appear in the *Symposium on Molecular Spectra* to be published by the *Indian Academy of Sciences*.

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### The Metabolism of Carotene: the Possible Role of the Reticulo-Endothelial System.

THE susceptibility of vitamin A-deficient animals to certain infections of a non-specific type is now generally recognised, and though Harris<sup>1</sup> has indicated the probable course of events in the epithelial cells deprived of vitamin A, the root-cause of the defect in the defence mechanism of the

tissues is still unknown. An impairment of the functioning capacity of the reticulo-endothelial system has been suggested as the primary effect of vitamin A deprivation, and the experimental studies of Lassen<sup>2</sup> lend a certain degree of support to this view, though it appears that even in advanced stages of vitamin A deficiency the anti-body producing mechanism may still be functioning with effect.<sup>3</sup>

Our observations made during studies on the metabolism of carotene, however, indicate a possible rôle of the reticulo-endothelial system in the animal function of the formation of vitamin A from carotene. On following the course of colloidal carotene injected into the blood stream, it was found to disappear rapidly from the circulation and appeared to be localised chiefly in the liver, the spleen, and to a smaller extent in the lungs, as evidenced by the amount of yellow colour of the ether extract of the tissues. In view of the capacity of these cells for phagocytosis and intracellular digestion it was probable that these cells which abound in the liver and the spleen take up the pigment though histological evidence on this point could not be obtained.\*

When carotene was administered to a dog as a course of intravenous injections of the colloidal pigment for a certain period, no increase was noticed in the vitamin A content of the liver (a piece of the liver was removed by a surgical operation before the injections to act as control), while spleen (ordinarily deficient) appeared to contain large stores of vitamin A, almost approaching the liver in its richness.<sup>4</sup> The presence of a large proportion of the pigment in the spleen after its injection and later a large store of vitamin A is significant, as this organ while probably the richest store-house of the reticulo-endothelial cells has not been previously known to contain

<sup>2</sup> Lassen "Experimental Studies on the Course of Paratyphoid Infections in Avitaminous Rats, Copenhagen," 1931; *Z. Immunitäts*, **73**, 221, 1932.

<sup>3</sup> Zilva, *Biochem. J.*, **13**, 172, 1919; Werkman, *J. Inf. Dis.*, **32**, 247, 1923; Werkman, Baldwin and Nelson, *ibid.*, **35**, 549, 1924; Cramer and Kingsley, *B. J. Expt. Path.*, **5**, 300, 1924.

\* Professor J. C. Drummond has obtained evidence that the Kupfer cells of the liver and similar cells of the spleen rapidly take up the pigment from the blood after its introduction into circulation (private communication).

<sup>4</sup> Ahmad, Grewal and Malik, *Ind. Med. Gaz.*, June Number, 1934 (in the press).

<sup>7</sup> See Krishnan and Das Gupta, *Nature*, **126**, p. 12 (1930) and *Indian Journ. Phys.*, **8**, p. 49 (1933).

<sup>1</sup> Harris, *Lancet*, **2**, 614, 1932; *Annual Rev. Biochem.*, **2**, 272, 1933.

any appreciable amount of the body stores of vitamin A.<sup>5</sup>

A similar observation has been recorded in the case of a cat fed with carotene for a short period, though the concentration of vitamin A in the spleen did not approach the high figure recorded in the case of a dog and was much less than that of the liver. It may incidentally be pointed out that the previous observations of Ahmad<sup>6</sup>, Rea and Drummond,<sup>7</sup> and Ahmad and Malik<sup>8</sup> on the inability of the cat to form vitamin A from carotene, may be due to the reason that higher animals like cats and dogs in which the spleen is more highly developed and contains in its meshes a large proportion of the reticulo-endothelial cells (as compared to the liver), vitamin A may appear first in the spleen which those authors omitted to examine. But the question must needs be further investigated.

In the short term experiments<sup>4</sup> in which the increase in the vitamin A content of the liver was taken as the criterion of the formation of vitamin A from carotene administered intravenously, it appeared that it was only in the rabbit that any significant amount of vitamin A formation took place, while it failed in other species of animals. That this should be so, may be due to the probability that the reticulo-endothelial system of the rabbit is functionally more powerful, which is supported by the common observation that of all the experimental animals the rabbit responds more quickly in immunisation experiments.

At the same time one might take into consideration the analogous rôle of the reticulo-endothelial cells in the phagocytosis and ingestion of red-blood cells and the formation of bilirubin.<sup>9</sup> Further analogy is furnished by the rôle of monocytes in anti-body formation from foreign proteins.<sup>10</sup>

<sup>5</sup> Sherman and Boynton, *J. Amer. Chem. Soc.*, **47**, 1646, 1925; Kerppola, *Skand. Arch. Physiol.*, **56**, 181, 1930; Moore, *Biochem. J.*, **25**, 275, 1931; Simmonet and Busson, *Comp. Rend. Soc. Biol.*, **109**, 182, 1932; Davies and Moore, *Biochem. J.*, **28**, 288, 1934.

<sup>6</sup> Ahmad, *Biochem. J.*, **25**, 1195, 1931.

<sup>7</sup> Rea and Drummond, *Z. Vitaminforsch.*, **1**, 177, 1932.

<sup>8</sup> Ahmad and Malik, *Ind. J. Med. Res.*, **20**, 1033, 1933.

<sup>9</sup> McNee, *Quart. J. Med.*, **26**, 390, 1923.

<sup>10</sup> Hektoen and Carlson, *J. Inf. Dis.*, **7**, 319, 1910; Luckhardt and Becht, *Amer. J. Physiol.*, **28**, 257 & 274, 1911; Topley, *J. Path. Bact.*, **33**, 339, 1930.

There is a striking parallelism between the concentration of reticulo-endothelial cells and the concentration of vitamin A in tissues of the animal body. Liver is a rich store of both. Spleen which might have been an exception is now known to contain relatively large amounts of vitamin A in higher animals particularly after a high carotene intake. Other animal tissues containing appreciable quantities of vitamin A are the adrenals, blood, lungs, bonemarrow, and the kidneys, all of which abound in the reticulo-endothelial cells with the exception of the last named. Of course, it should be taken into consideration that different types of reticulo-endothelial cells may have differentiated functions.

An attempt has been made to study this question further by examining the effects of splenectomy and the blockade of the reticulo-endothelial system in the rat during carotene administration. The results are on the whole inconclusive. The method is fraught with the obvious danger that the blockade or the removal of the reticulo-endothelial cells at one centre would lead to the active proliferation of these cells in other tissues.

This fragmentary evidence presented here is strongly suggestive. It is reported in the hope of stimulating investigations into this question at other centres of research.

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Notes on the Occurrence of *Grammothele cineracea* Bres. *Kneiffia grisea* Berk. and Curtis.

*Grammothele cineracea* Bresadola, a member of the family Hydnaceæ, is very common in Bengal; but curiously enough no report as to its occurrence in India has yet been made.<sup>1</sup> This unique and conspicuous species is not rare to a careful observer. It grows on trunks of *Phoenix sylvestris* and other palms, particularly on the persistent leaf-bases near the soil. I have also seen it growing on logs and posts. The fructification is entirely resupinate and crustaceous, characterised by

<sup>1</sup> Butler and Bisby, *The Fungi of India*, 1931.