LETTERS TO THE EDITORS

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Anoxæmic Changes in the Liver, with regard to the 'High-Altitude Death' of Airmen

IN recent papers Büchner[1] and his disciples Pichotka[2], Müller and Rotter[3], as well as Hesse[4], have described peculiar histological findings in livers of airmen who died under the effect of atmospheric conditions at a high altitude. The pictures under consideration consist in the formation of big, round or polyhedric vacuoles in liver cells nearest the acinus centres; these vacuoles do not contain either fat or glycogen; they appear as optically empty spaces, including here and there a crescent-like hem of slightly acidophil, homogeneous material, probably serous liquid.

Corresponding changes could be produced in guinea pigs and rabbits under atmospheric conditions similar to those at high altitude by keeping the animals in low-pressure chambers under normal pressure but reduced oxygen content of the respiratory air.

Reviewing post-mortem material from recent years, Hesse has found identical liver alterations in cases where death had occurred in the course of an acute anoxæmic crisis, as for example, suffocation or drowning, etc.

These findings are important not only from the diagnostic point of view, where they may make possible the diagnosis of 'anoxæmia' by histological methods alone, but from the theoretical point of view as well, for, in combination with physiological methods, they may lead to a new understanding of the results on cell function of reduced or interrupted oxygen supply.

So far, no physiological studies on this special question seem to be available.

In the course of earlier systematic studies on the influence of phosphorus and chloroform poisoning on 54 guinea pigs, we have examined (together with Bueding[5]) the histological features as well as the formation of glucuronic acid of liver tissue, the latter by the method of surviving slices in the Barcroft-Warburg apparatus.

Among the poisoning experiments, generally performed by injection of the toxic compounds, there were but two, where the animals were held in deep, reflexless, chloroform inhalation narcosis for 3·5 hr., after which one of them agonized and was killed by a blow from behind; the second one was killed at the same time having shown no abnormal clinical behaviour.

Both the livers presented histologically exactly the picture as described above. Although at that time we had no knowledge about its possible significance, we noted the peculiarity of the alterations as something unusual, particularly as we have seen no similar features at any time before or after it. Only when reading the above-quoted papers, we became aware of the possible meaning of the changes concerned, particularly as a status of rather pronounced anoxæmia in the animals was safely to be assumed.

The physiological studies were based on the facts shown first by Bueding and Lipschitz[6] that surviving liver tissue possesses the conjugated faculty of forming glucuronic acid in the presence of incombustible alcohols like (0·1–0·25 per mille) borneol or (0·08–0·2 per mille) menthol in a saline phosphate medium; the same authors were able to show, too, that contrary to earlier assumptions, the glucuronic acids are the products of a biological synthesis of triose-alcohols where the synthesis of carbohydrates and that of glucuronic acids are concomitant reactions, the latter occurring, however, only when alcohols of the borneol type are present (which have to be detoxicated). The starting products for these syntheses being triose-alcohols of half-acetal character like lactic acid (or pyruvic acid), the formation of conjugated glucuronic acids is significantly increased by the addition to the saline medium of one of them (for example, 0·02 *M* sodium lactate), provided the liver tissue shows its normal physiological (and, therewith, catalytic) faculties.

In both our livers we have found under such conditions scarcely any changes, indeed, as compared with the behaviour of normal control livers.

We feel, therefore, justified in concluding that, under acute anoxæmic conditions in guinea pigs, at least one of the important functions of liver tissue, closely related to the carbohydrate metabolism, remains intact; further and more specially directed studies have to find out how other basic functions behave under similar conditions.

The accompanying table gives (*a*) the data of the experiments in question as compared with (*b*) results from 20 normal controls and (*c*) with those from 10 guinea pigs poisoned with phosphorus:

		Mgm. glucuronic acid produced by 1 gm. of dried liver	
		Saline containing 0·01 per cent borneol	Saline containing 0·01 per cent borneol and 0·02 *M*. lactate
(*a*) 2 guinea pigs 3·5 hours in chloroform narcosis ('anoxæmic livers')	Limits	3·8—3·9	5·0—7·5
	Average	3·85	6·55
	Average increase		+ 65%
(*b*) 20 normal controls	Limits	1·1—5·4	1·7—11·4
	Average	2·85	5·05
	Average increase		+ 77%
(*c*) 10 guinea pigs poisoned with phosphorus (0·75 mgm. yellow P per 100 gm. animal weight)	Limits	0·25—3·8	0·25—4·9
	Average	1·8	2·0
	Average increase		+ 11%

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