THE ZINC AND COPPER CONTENT OF THE HUMAN BRAIN.

BY MEYER BODANSKY.

(From the Laboratory of Biological Chemistry of the School of Medicine, University of Texas, Galveston.)

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The presence of traces of copper in the human brain was first reported by Thudichum (1). In commenting on Thudichum's work Mathews (2) suggests that this point should be reinvestigated to see whether copper is in reality a normal constituent of all brains. He considers the possibility that the human brains which Thudichum examined might have come from brass-workers or others exposed to copper poisoning.

Despite the statement of Palet (3) who was unable to detect copper in 54 normal human livers there is general agreement among investigators that copper as well as zinc are normal constituents of plant and animal tissues. At the time the analyses recorded in this paper were begun no data concerning the occurrence of zinc in the human brain had appeared in the literature. Recently Rost (4) reported an analysis of a human brain containing 11 mg. of zinc per kilo.

Copper and zinc have been shown to be widely distributed in foods. The continuous ingestion of these metals raises the question as to the extent of their storage in various organs. The relative tolerance of zinc and copper by the animal organism, especially when introduced with foods has been noted by a number of observers. In a brief study of the fate of zinc in the animal organism, Salant, Rieger, and Treuthardt (5) found that after intravenous injection of zinc malate in cats the metal was stored in considerable amounts in the liver, that it was almost always found in the skin and muscles but that none was present in the brain. Giaya (6), on the other hand, finds that the partition of zinc per organ occurs in the following decreasing order: brain, lungs, stomach, liver, kidneys, intestines, heart, spleen.
### The Zinc and Copper Content of the Human Brain. *

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Race or nationality</th>
<th>Age</th>
<th>Occupation</th>
<th>Weight of brain</th>
<th>Amount taken for analysis</th>
<th>Zinc (%)</th>
<th>Copper (%)</th>
<th>Cause of death</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Norwegian</td>
<td>21</td>
<td>Seaman.</td>
<td>1,630</td>
<td>100</td>
<td>0.52</td>
<td>8.48</td>
<td>Fractured skull.</td>
</tr>
<tr>
<td>2</td>
<td>Negro.</td>
<td>23</td>
<td>Laborer.</td>
<td>1,157</td>
<td>100</td>
<td>0.88</td>
<td>10.18</td>
<td>Acute dilatation of the heart.</td>
</tr>
<tr>
<td>3</td>
<td>&quot;</td>
<td>35</td>
<td>&quot;</td>
<td></td>
<td>100†</td>
<td>0.72</td>
<td>7.2</td>
<td>Angina pectoris.</td>
</tr>
<tr>
<td>4</td>
<td>Mexican.</td>
<td>40</td>
<td>&quot;</td>
<td></td>
<td>100†</td>
<td>1.57</td>
<td>15.7</td>
<td>Lobar pneumonia.</td>
</tr>
<tr>
<td>5</td>
<td>White.</td>
<td>&quot;</td>
<td>Fetus about 5 months.</td>
<td>64.5</td>
<td>64.5</td>
<td>0.74</td>
<td>0.74</td>
<td>Nothing to suggest disease of fetus.</td>
</tr>
</tbody>
</table>

* The brains and autopsy records were kindly furnished us by Dr. H. C. Hartman and Dr. Anna M. Bowie of the Pathology Department.

† Analysis of the cerebrum. A separate analysis of the cerebellum of this brain gave 17.5 and 6.7 mg. per kilo of zinc and copper respectively.
Believing the subject to merit further attention we are presenting the results of the analyses of four adult brains and of a fetal brain. These were received in the laboratory immediately after autopsy, washed free of blood with physiological salt solution, and analyzed according to the methods previously described by Rose and Bodansky (7) and Bodansky (8, 9).

The results indicate that copper and zinc occur normally in the human brain, there being nothing in the records of any of the individuals to suggest exposure to zinc or copper poisoning. It will be observed that the values for copper fall within the limited range of 3.6 and 6.8 mg. per kilo. The proportion of zinc in the fetal brain was found to be greater than in three of the adult brains, the proportion of copper being greater than in any of the adult brains. A number of similar observations by other investigators may be mentioned. Ghigliotto (10) analyzed the viscera of a 7 months' old fetus and found the proportion of zinc to be slightly higher than in adults. Giaya (6) found 3 mg. of zinc in 100 gm. of a fetus weighing 420 gm. It appears that during intrauterine life there is more rapid accumulation of zinc and copper as well as of other inorganic constituents, than there is after birth. According to Fenger (11) the thyroids of beef fetuses contain more iodine and phosphorus per unit of body weight than thyroids from fully mature animals. The brain of a newly born albino rat contains greater proportions of phosphorus and sulfur than does the brain of an adult rat, according to the analyses of M. L. Koch (12). That there is a decrease in the ash content of the human brain with growth has been shown by W. Koch and Mann (13). In this connection it may also be of interest to recall that Maquenne and Demoussy (14) recently found in their studies on the migration of copper in the tissues of green plants that copper is most abundant in young actively growing tissues.

**SUMMARY.**

The results of the analyses of four adult brains and of a fetal brain indicate that copper and zinc are normal constituents of the human brain. Judging from our analysis of the one fetal brain, it appears that during intrauterine life there is more rapid storage of zinc and copper in the brain than there is after birth.
In this respect the behavior of these elements is similar to that of other inorganic constituents of animal tissues such as iodine, sulfur, and phosphorus.

BIBLIOGRAPHY.

1. Thudichum, J. L. W., Die chemische Constitution des Gehirns des Menschen und der Tiere, Tübingen, 1901.
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Meyer Bodansky


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