INFLUENCE OF ALCOHOL ON FUSION*

BY

LORD CHARNWOOD

THE fact that the consumption of a sufficient quantity of alcohol will cause diplopia, even in subjects who normally show no heterophoria, is well known. Until recently, the author, in common with many others, thought that this was due to a toxic exotropia, such as is seen in the early stages of anaesthesia.

Powell (1938) and Colson (1940) have shown that the effect of alcohol on lateral heterophorias is to cause a reduction of exophoria, or an increase of esophoria, but that, in either case, the average change only amounted to about two prism dioptres. These findings have been confirmed by the author; he did not, however, find that alcohol had any effect on vertical heterophorias. The only record that he knows of alcohol influencing vertical heterophorias is a paper by Connolly (1946), whose results seem somewhat inconsistent and difficult to interpret; furthermore the author has not succeeded in confirming them.

It is well known that alcohol makes inhibition more difficult, and Bárány and Halldén (1947) have shown that this applies to the two retinal images. This explains why the subject is conscious of the diplopia, but does not explain why it occurs. In view of the small change in heterophoria produced by alcohol, it seemed likely that the cause of alcoholic diplopia was a reduction in the subject's power to overcome any heterophoria present.

Method

In order to test this assumption, the subject's power to overcome vertical prisms was recorded before and after drinking measured quantities of alcohol. The fixation target was a black horizontal line, 2 mm. wide and 7.5 cm. long, on a white ground illuminated at a level of about 50 foot-candles, seen at a distance of seven metres. The prism power, base up and base down before the right eye, required to produce diplopia was recorded at regular intervals.

Unfortunately only four subjects were available. Two of these were emmetropic and the other two wore their corrections which gave them an acuity of 6/6 or better; none of the four showed any vertical heterophoria at the start or any appreciable horizontal heterophoria. One subject (the author) shows about one prism dioptre of right hyperphoria as a result of prolonged occlusion tests on his two eyes, and the present results suggest that one other subject would also show a small degree of right hyperphoria. All four subjects are completely free from ocular discomfort.

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The alcohol used was a well-known commercial brand of gin containing approximately 30 per cent. ethyl alcohol. Each dose consisted of one fluid ounce of gin (about 7 g. ethyl alcohol), flavoured and diluted to taste. Each subject took five doses (about 35 g. ethyl alcohol). The subjects were allowed a small amount of food, such as would normally be consumed with such a dosage of alcohol at a cocktail party.

As soon as each subject's initial fusional reserves had been recorded he took his first dose of alcohol. At the end of a quarter of an hour his fusional reserves were again recorded and he took a second dose; subsequent doses were taken in the same way and the final measurements recorded a quarter of an hour after drinking the fifth dose.

Vertical fusional reserves were measured in preference to horizontal for the following reasons: they are not complicated by accommodation and convergence; they are smaller, there is little or no evidence that alcohol, in such doses as the author used, has any effect on vertical heterophorias. Measurements were made with a Risley rotary prism, giving a maximum power of six prism dioptres. It was always placed before the right eye and the prism power was increased slowly first base up and then base down. The subject had no knowledge of the reading obtained.

FIG. 1.—Individual readings for each subject.

FIG. 2.—Total vertical reserves for each subject.

Results

As one would expect, there was a considerable variation in the initial readings on the four subjects and the individual readings for each subject do not fall on straight lines or smooth curves. The total fusional reserves of each subject, obtained by adding together the base up and base down readings, form much smoother lines, and the results of averaging the readings of even so few as four subjects produce surprisingly smooth curves, both for prism base up and base down separately and for the total fusional reserves.

Fig. 1 shows the whole of the data collected for each subject. Fig. 2 shows the total fusional reserves for each subject at each recording. Fig. 3 shows the result of averaging the readings on the four subjects, prism base up and base down being shown as well as average total vertical fusional reserves.

Discussion

It is obvious from Fig. 3 that alcohol reduces the subject's power of overcoming vertical prisms, and that, initially, this reduction is in almost direct proportion to the amount of alcohol consumed. The curve of total averages does suggest the flattening out that one would expect, but it also suggests that this flattening out does not occur until the subject's reserves are very seriously impaired.

Figs 1 and 2 show that the reduction of a subject's fusional reserves by alcohol is approximately proportional to their initial

FIG. 3.—Average results for four subjects.

more probably due to the difficulty of measurement inherent in an experiment such as this.

It is generally stated that the eyes diverge during the earlier stages of anaesthesia but return to approximate parallelism when full surgical anaesthesia is reached. This conclusion must be based on comparatively gross objective observations made during the routine of operations. It seems to suggest that the third

value, since the curves in Fig. 2 are not parallel to each other but tend to cut the horizontal axis in approximately the same place. The slight asymmetry between the prism base up and prism base down curves in Fig. 3 is probably due to the right hyperphoria that the author shows under occlusion and the possible right hyperphoria in one other subject already mentioned.

The irregularities of the individual curves in Fig. 1 could be due to random changes in vertical heterophoria similar to, though smaller than, those recorded by Connolly, but they are

nerve nucleus is affected by general anaesthetics before that of the sixth nerve. It is very possible that if an adequate degree of anaesthesia could be obtained with alcohol a similar result might be observed, but the author does not consider this relevant to the present investigation, which is only concerned with sub-clinical degrees of intoxication.

Conclusions

Alcoholic diplopia is the result of two factors: a reduction in the subject's power of overcoming any heterophoria that may be present, and an increase in the difficulty of suppressing the diplopic image.

The frequency with which such complaints as whooping cough and measles appear to be the immediate precipitating cause of squint in hypermetropic children may be due to the production of some specific toxin with an action comparable to that of alcohol.

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