

## LETTERS TO THE EDITOR

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SIR:

I wonder whether I may take advantage of the opportunity presented by your publication of the two papers by Professor Robson and his co-authors to make some personal comments on the fascinating subject of mental performance under nitrous oxide.

Professor Robson and his colleagues mention the possible similarity between anaesthesia and head injury or electroshock therapy as regards retrograde amnesia. I think it is important to bear in mind, however, that as far as anaesthetic agents are concerned, there is little evidence that retrograde amnesia occurs. Several cases are known to me in which patients have recalled the experience of being intubated, and in a recent case of my own a patient distinctly remembered hearing me counting aloud during the first minute of trichlorethylene administration after intubation under thiopentone. This case was perhaps particularly interesting in view of the fact that the patient had over four hours of complete amnesia following the termination of the anaesthetic.

The ability to learn non-meaningful syllables is certainly depressed under the influence of nitrous oxide, and we (Parkhouse *et al.*, 1960) were also able to demonstrate that with 40 per cent N<sub>2</sub>O delayed recall of presented material (that is, 30 minutes after resumption of air breathing) is relatively more impaired than immediate recall. Surely, though, one need seek no very abstruse explanation for this: in common-sense terms, it is the subject's *concentration* which is interfered with. Before an experiment the subject is alert, attentive, and anxious to do his best, and I believe that this is responsible for much of the apparent facilitation or "fixing" of memory at this stage. Under the influence of nitrous oxide, the subject resembles a sleepy person, a bored person, or an intoxicated person; he no longer cares very much about the quality of his performance, he is ready to seize upon any distraction which presents itself or to fall asleep if left undisturbed. We are far from being able to offer exact explanations for these phenomena, but they are surely global effects upon the brain: to attempt an account of them in terms of selective effects of nitrous oxide upon specific functions is a mistake.

My own experiences of pain tests under nitrous oxide, and the experiences of many of my fellow subjects, lead me to believe that impairment of concentration is also important in the assessment of analgesia. This is discoverable, of course, only with a prolonged, continuous pain stimulus: what then happens is that for most of the time there is no awareness of pain because one is thinking of other things. Occasionally, however, one "comes round" to an acute awareness of the continuing pain, but before one has time to analyse the experience, attention has again wandered.

We noted a marked tendency to perseveration under nitrous oxide, and I think this may be important in two ways. Firstly, coupled with a loss of self-critical inhibition, it could very well explain the repetition of the number 2 instead of 6 by Professor Robson's subject. What I am suggesting is that a fully orientated person might well have thought to himself "I can remember the number which was presented to me before: it was 2, but that was under a different concentration of the gas"; whereas under the influence of nitrous oxide the same subject might quite cheerfully repeat his "2" knowing it to be inappropriate but hoping that it might prove acceptable, or be better than nothing. Secondly, although it may be true that nitrous oxide produces a reduction in the rate of accumulation of new remembered events, this does not necessarily imply a reduction in total thought processes since a great deal of mental activity may be devoted to perseveration and to a heightened attentiveness to trivial events.

This lays open the whole question of time estimation under nitrous oxide. The suggestion of Burns *et al.* that distortions of time estimation are attributable to changes in the rate of accumulation of events leads to a well-known paradox. Suppose, for the sake of argument, that when a subject breathed nitrous oxide accumulation of events occurred at one half the normal rate. The number of mental events customarily associated with the passage of one second would then occupy two seconds of clock time. In a given period of clock time there would, therefore, according to the subject, be a smaller number of seconds: for example, one hour would seem to the subject like half an hour. Paradoxically, this phenomenon is described by Burns *et al.* as an *increase* in time estimate. I am reluctant to accept the hypothesis that a subject breathing nitrous oxide makes some kind of mental estimation of time by comparing the rate of accumulation of new events with an arbitrary normal rate, not only because it underestimates the probable influence of introspection and perseveration, but also because it fails to take account of the wide variations that occur, in every day life, in the rate of accumulation of new events. I believe that the "sense of time," whatever this may be, is determined not so much by the total number of new events as by the rapidity with which they *appear* to follow each other. In some mental states, including those induced by certain drugs, events may seem to follow each other with kaleidoscopic rapidity, and this leads to the impression of a short but crowded period of time rather than a long and "normally" filled one. In any event, I believe the estimation of 15-second periods to be a poor test, and in our studies we abandoned it early on. The principal difficulty is that almost all the subjects count to themselves in order to form a reasonable estimate and again, under nitrous oxide, it is the subjects' ability to concentrate on their counting which is being tested.

Finally, may I make a remark about Professor Robson's findings in regard to proprioception and dizziness. He and his colleagues express surprise at the apparent mildness of proprioceptive difficulties, particularly in view of the fact that many subjects admitted to feeling dizzy. I think that this is not surprising, and I believe that it brings into sharp focus the most important feature of all the work that has been done in this field. The truth is that all tests which are customarily applied are so crude that they can do no more than pick out *gross* changes

in mental performance. Any fairly experienced person, after an hour or two at a cocktail party, can retain sufficient self-control to appear outwardly normal—even relatively exacting tests can be performed. Yet the person in question may feel quite dizzy, and may be very well aware of the fact that his mental state is far from being as normal as it appears. All that a simple proprioception test is capable of demonstrating is that under the influence of nitrous oxide a subject can, by making an effort, perform a task which normally requires no effort at all. When *sustained* tests are employed, the subject makes the necessary effort to begin with but soon loses his concentration. Perhaps if Burns *et al.* had asked their subjects to sight-read a difficult piece of piano music they would have obtained a more striking result!

J. PARKHOUSE

#### REFERENCE

PARKHOUSE, J.; HENRIE, JOYCE R.; DUNCAN, GLEN M.; & ROME, HOWARD P. J. Pharmacol. & Exper. Therap. 128: 44-54 (1960).

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SIR:

We must first thank you for the opportunity which you have given us of reading the letter from Dr. Parkhouse before its publication.

Dr. Parkhouse has legitimately raised a number of technological questions concerned with our two recent publications. These are dealt with below. Far more important in our opinion is Dr. Parkhouse's attack upon the commonly accepted methods in medical research. He appears offended that one should question the "obvious." "Surely," he says, "one need seek no very abstruse explanation" for the fact that the inhalation of nitrous oxide interferes with the ability to learn non-meaningful syllables: "in common-sense terms, it is the subject's *concentration* which is interfered with." Any attempt to account for these facts, "in terms of selective effects of nitrous oxide upon specific functions is a mistake." It is not always wise to accept explanations based upon subjective experience. For example, one could maintain that the well-known rapid accommodation of perception of light touch was due to distraction of the subject's attention to the maintained stimulus. Before 1920 this interpretation of common knowledge would have seemed common sense. We now know that this accommodation is largely a peripheral phenomenon. Equally we might still believe that there were no communicating channels between arteries and veins had not William Harvey questioned the obvious.

We are thankful to Dr. Parkhouse for bringing to our attention two serious omissions from the texts of our papers. We omitted to mention that none of the subjects of our experiments was aware of the composition of the inspired gases. Moreover, we have not reported that all subjects asked to estimate time were

instructed not to count; in many of our experiments they were asked to add together a pair of single digits to insure that counting was impossible.

We should apologize for confusing Dr. Parkhouse about the estimations of time given by our subjects. We agree with him that, for persons breathing nitrous oxide, "one hour would seem to the subject like half an hour" spent when breathing air. For this reason, when asked to estimate a one-hour period by telling us when he felt that 60 minutes had elapsed, he will estimate a period measuring two hours by clock time. This we refer to as an "increase in time estimate."

It would be commendable for any reader to question facts presented to him which were inconsistent with his own findings. He might also justifiably dispute the interpretation of facts. Dr. Parkhouse, however, criticizes us because we were not content to explain analgesia by saying one has no awareness of pain because one is thinking of other things. We have tried to find out why the inhalation of nitrous oxide makes it possible to think of other things. In our opinion it is frequently worthwhile to question subjective experience. It seems to us that the progress of medical science has been largely dependent upon the willingness of practitioners and scientists to question their common sense.

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