In a very careful, critical and well-reasoned discussion, Dr W. D. A. Smith has argued that there are several reasons for believing that pollution of the operating theatre environment is probably harmful and that “the onus of proof... is on demonstrating their [inhalation anaesthetics'] innocence” (Smith, 1976). However, it is obvious that complete elimination of all anaesthetic molecules from the atmosphere of the operating theatre, anaesthetic room or recovery room is an impossible task. Therefore, one requires to know the threshold level of contamination below which trace concentrations of anaesthetic agents have no harmful effects on medical and nursing staff. Unfortunately, the task of obtaining such information in humans is formidable. Such data as exist have been obtained only for human volunteers in the artificial environment of the laboratory and relate only to effects on psychological and psychomotor performance.

Basing its conclusions on laboratory tests carried out by Bruce and his colleagues (Bruce, Bach and Arbit, 1974; Bruce and Bach, 1975, 1976), and also upon data relating to existing levels of contamination of the operating theatre, the National Institute for Occupational Safety and Health (NIOSH) has made certain recommendations on the standards for occupational exposure to waste anaesthetic gases and vapours (NIOSH, 1977), notably that no worker should be exposed to halogenated anaesthetic agents in concentrations exceeding 2 p.p.m. and that when nitrous oxide is used as the sole anaesthetic agent, its concentration must not exceed 25 p.p.m.

Regrettably, it is now apparent that the data relating to trace concentrations of anaesthetic agents and psychomotor performance are open to various interpretations. Bruce and his colleagues found that medical and dental students of U.S. origin were significantly affected, in terms of an audiovisual response test, a tachistoscope task and also memory tests, by exposure to nitrous oxide 500 p.p.m. and halothane 15 p.p.m. (Bruce, Bach and Arbit, 1974). Similar findings were obtained in a subsequent study on the effects of a combination of nitrous oxide 500 p.p.m. and enflurane 15 p.p.m. (Bruce and Bach, 1975). Further studies were carried out by Bruce and Bach under contract to NIOSH. Concentrations of nitrous oxide of 50 p.p.m. and nitrous oxide 50 p.p.m. in combination with halothane 1 p.p.m. were found to cause measurable decrements in psychological tests in male volunteers, whilst nitrous oxide 15 p.p.m. in combination with halothane 0.5 p.p.m. had no effect (Bruce and Bach, 1976).

These findings have not been confirmed. Smith and Shirley (1977) have examined the effects of nitrous oxide 500 p.p.m. with halothane 15 p.p.m. on psychomotor performance using the same audiovisual reaction time tests as those employed by Bruce. No decrement in performance was noted following a 3–4 h exposure. Using essentially the same reaction time test developed by Bruce, and the same tests of memory function, Cook and others (1976) found that the threshold inspired concentration for an effect of nitrous oxide on psychomotor performance was 5–10% of one atmosphere (50 000–100 000 p.p.m.). Frankhuizen and others, in this issue, have also failed to confirm the earlier work from Chicago. Although there may be subtle nuances in experimental design, which may account for these conflicting data, it seems that some weight should be given to the fact that three independent laboratories in three different countries have so far failed to confirm the findings of Bruce and his colleagues.

Despite the inconclusive nature of these studies on psychomotor performance, extrapolation of the results
of the effects of low concentrations of anaesthetic gases in the laboratory to the working environment of the operating theatre is open to enormous error. The performance of an anaesthetist involves reception of a large fluctuating quantity of auditory, visual and tactile stimuli, the identification and interpretation of this information, and the appropriate motor response superimposed upon a varying background of activity and influenced by innate physiological variations induced by fatigue, stress and emotion. The extent of these variables will indicate, even to the psychologically unsophisticated, that measurement of performance "in the field" is a task of a different order of magnitude from that in the laboratory. Nonetheless, this is a problem which is currently receiving attention as it is conceivable that fatigue and stress have important effects on the performance of anaesthetists whilst the level of pollution in unscavenged operating theatres (Smith, 1976) has no effect on performance. It is possible that anaesthetists, rather than unforeseeable reactions to drugs, are responsible for patient morbidity and mortality which is labelled "anaesthetic" and it is only prudent to consider if anaesthetic mishaps may be produced by remediable deterioration in performance from whatever cause.

It remains a paradox in the U.K. that, whilst fatigue is recognized as having a deleterious effect on the performance of those responsible for controlling public transport vehicles (with subsequent limitation of the hours on duty), no such recognition applies to medical staff responsible directly for the lives and safety of individual members of the public. The hours of recommended duty for air crew are modest in comparison with those worked by junior staff in many hospitals in the United Kingdom. It is appropriate, therefore, for those who are responsible for organizing the duty rota of staff to consider the possible effects of excessive duty on anaesthetic morbidity and mortality.

Although the current balance of experimental data supports the view that average levels of pollution in the operating theatre have no effect on performance, it neither excludes the possibility of interaction with other factors which may impair performance, nor does it have any bearing on anaesthetists who respire in close proximity to the unshielded exhaust valves of anaesthetic circuits.

We conclude that at present there are no data for establishing permissible levels of contamination of areas used by medical and nursing staff. Nonetheless, there are compelling reasons for reducing pollution to the minimum which may be achieved and these are based on "common sense" (Smith, 1976) rather than any evidence for deleterious effects on psychological performance.

G. Smith

REFERENCES


