



**Fig. 2** Apparent variations of group heights recorded at four aerials and the corresponding phase height variations (top trace).

considered and especially when the data show unequal changes in group and phase path. Oscillations in the group path show changes of the order of  $\pm 200$  m while inspection of phase path records show the oscillations to be of the order of  $\pm 10$  m. Other effects such as Doppler shift due to atmospheric winds can also affect the apparent horizontal velocity. Consequently, it is difficult to confidently deduce trace velocities from the data.

Second, Munro and Whitehead consider that if the oscillations represent real changes in group height, then corresponding changes in phase height would occur and that phase height experiments would have previously detected such waves. However this argument ignores the possibility of retardation effects which can be important. Calculations of the effects of irregularities on group and phase path show that changes in phase path can typically be about a tenth of the change in group path<sup>3,4</sup>.

Finally, if the effect is produced by interfering echoes, there is an unusual effect in that the oscillations are restricted to a relatively limited range of frequencies. Although this does not preclude interference as an explanation of these oscillations, it suggests that the interference mechanism will not be simple in nature. If the irregularities producing interference were moving vertically at the speed assumed by Munro and Whitehead, their progression through the layer should have been observed in Fig. 1. If the irregularities move horizontally, velocities of up to  $300 \text{ m s}^{-1}$  are implied which again means that sound or gravity waves might be involved.

It should be noted that the definition of the quantity  $\theta$  used by Munro and Whitehead is strictly only valid for a mirror reflector and the more general definition is  $\theta = 4\pi\Delta h_r f/c$ .

Thus it seems that although interference may be the explanation there are problems with the simple interference approach, but more importantly, invoking interference does not preclude the problem of identifying the type of irregularities responsible.

Clearly more work needs to be done to satisfactorily explain the oscillations and further studies are being carried out at La Trobe University.

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## Swimming rats and human depression

WE believe that the rat swimming test of Porsolt *et al.*<sup>1</sup> is a valuable contribution to drug screening methodology and we are now using it in our present work. Sprague-Dawley rats are individually tested in a narrow plexiglass cylinder (height 40 cm, diameter 18 cm) containing 15 cm of water. Initially, the rats swim vigorously but later make only the movements necessary to keep their heads above water. In drug screening, naïve animals are given a 15-min swim on the first day, then dried and given the first of three spaced drug injections. They undergo a 5-min swimming test 24 h later in which the period of relative immobility is timed. As clinically effective antidepressant drugs are selectively identified in this way, Porsolt *et al.* conclude that the behaviour evaluated represents 'lowered mood' and 'despair' in the animals. We believe this interpretation is contrary to other behavioural activity seen in the test which they do not report.

We replicated their control group condition for the equipment described, strain used (167–230 g), most common subgroup size ( $n = 5$ ), water temperature and procedure. We also made further observations (adjusted for time) comparing day 1 and day 2 tests. We confirm their finding with regard to the behavioural change seen but wish to describe it more fully. The rats quickly learn to touch bottom with their tails and hind feet. They are then able to maintain a position in which they prop themselves against the side of the cylinder without the energy expenditure required in swimming. This we consider to be an adaptive response.

We make the following points: (1) implicit in the two-day test is the idea that behaviour may change in the absence of any other independent variable. Early in the day 1 test, two indicators of behavioural disturbance were seen: diving<sup>2–4</sup> and headshaking. Four of our subjects dived on the first day, none on the second. All showed headshaking on day 1, only one did so on day 2. Again, we interpret these changes as being adaptive in this situation. (2) If the immobility response represents 'despair', it should be maintained once adopted, that is, if the animal has given up, it will not try again. Instead, we found that all animals switched back to swimming and back again to immobility on both days. The count for such changes in the 5-min interval was: day 1,  $\bar{x} = 3.6$ ; day 2,  $\bar{x} = 3.8$ ;  $t_{\text{dep}} = 0.25$ . (3) Finally, emotional defaetion has been used as a measure of fearfulness in a variety of experimental contexts<sup>5–7</sup>. Bolus counts for our subjects gave these results: day 1,  $\bar{x} = 5.6$ ; day 2,  $\bar{x} = 3.0$ ;  $t_{\text{dep}} = 2.23$ , d.f. = 4,  $P < 0.05$  (one-tailed test). This supports the idea that having been rescued on day 1, the rats were less fearful on day 2.

We conclude that the animals are making adaptive responses to a stressful situation. Drug effects which reduce immobility and increase swimming time may predict which new antidepressant drugs will be effective. Such a result will be more convincing when concomitant behaviour is also observed and reported. Even then, such a result should be interpreted cautiously. The swimming test does not provide a model resembling depressive illness in human beings.

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PORSOLT AND JALFRE REPLY—The description of the rat's behaviour provided by Hawkins *et al.* corresponds well with what we have observed ourselves<sup>1,2</sup>;