Sir: We feel it inappropriate to comment on the initial points raised by Dr K. de Pauw about the ECT machines marketed by SLE of Croydon but we are sure that the company will address them in due course.

In his last paragraph Dr de Pauw draws attention to the fact that the output currents of various machines are different; this is a very important point and worth examining. Richard Abrams (Abrams, 1992) in his book (p. 113) comments..."the mean threshold dosage obtained of 64 mC (Weaver *et al*, 1978), 102 mC (Weiner, 1980), and 154 mC (Sackeim *et al*, 1987*a,b*), simply reflects the differences in peak current employed, the sex ratio of the samples"..., Sackeim in his recent paper (Sackeim *et al*, 1994), quotes Offner (p. 97) . . . "It is, of course, the passage of the electric current which is responsible for the convulsive shocks, rather than the applied voltage... so that dosage standardisation must be on the basis of the former"...This point is scientifically correct and indisputable. Memory impairment, as a result of giving ECT, is related to the peak current administered during a treatment, Sackeim (Sackeim *et al*, 1994) cites the various researchers who have made these observations (p. 114). For this reason it is desirable, if not essential, to be able to control the current administered to the patient and adjust it accordingly.

The authors agree that there may be some merit in manipulating the stimulation parameters to optimise the treatment. This point has been raised many times over the last 60 years in the literature (too numerous to cite), but the only firm conclusion which is apparent and universally agreed is that pulses lasting between 0.5 milliseconds and 2.0 milliseconds with fast rise times are efficient at inducing fits in the patient. Evidence concerning other parameters is at best anecdotal.

ABRAMS, R. (1992) *Electroconvulsive Therapy* (2nd Edn). New York: Oxford University Press.

SACKEIM, H. A., LONG, J., LUBER, B., *et al* (1994) Physical properties and quantification of the ECT stimulus. *Convulsive Therapy*, **10**, 93–123.

*P. O. BYRNE
Head of Clinical Instrumentation
R. G. FARQUHARSON and I. S. SCHOFIELD
Northern Regional Health Authority, Regional Medical Physics Department, Newcastle General Hospital, Westgate Road, Newcastle upon Tyne NE4 6BE

*Correspondence

Sir: We are aware that stimulus dosing and stimulus titration have aroused much discussion among the psychiatrists who have attended the Training Days in electroconvulsive therapy (ECT), topics discussed by Byrne *et al* (*Psychiatric Bulletin*, 1995, **19**, 207–208). We were concerned that their critique of the physics of electrical stimulation and the units used to quantify the electrical dose were given the title 'Pitfalls of dose titration', perhaps suggesting to some readers that the principles underlying these techniques ought not to be taken up until the 'ideal' ECT machine is manufactured.

The principles underlying stimulus dosing and stimulus titration are now well researched and the forthcoming new guidelines from the Special Committee on ECT (Freeman, 1995) will give practical examples of how these techniques can be put into practice with several ECT machines.

The authors also correctly point out that there is a wide variation among ECT machines in the nature of the electrical stimulus produced and that these variations are not adequately described by a unit that measures only the amount of electrical charge passed (the Coulomb). This does complicate the comparison of research findings among treatment centres. The new guidelines will stress that each treatment centre develops its own treatment protocol based on their experience with a particular ECT machine, and modified by relevant audit and research findings.

FREEMAN, C. P. (1995) *The ECT Handbook. The Second Report of the Royal College of Psychiatrists' Special Committee on ECT (CR 39)*. London: Royal College of Psychiatrists.

ALLAN I. F. SCOTT and CHRIS FREEMAN
Special Committee on ECT, The Royal College of Psychiatrists, London

Sir: Byrne *et al* (*Psychiatric Bulletin*, 1995, **19**, 207–208) offered suggestions for an optimal ECT device and for treatment methods that might avoid the need for empirical titration of ECT stimulus dosage. We found the theoretical presentation to be flawed and their recommendations for practice to be clinically inadvisable.

The desirability of dosage titration is illustrated by the limitations of the optimal stimulus parameters offered by Byrne and colleagues. Their suggestion that the pulse

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frequency, width, and train duration be fixed for all patients, and the current of pulses be varied between 350 and 750 mA, as a function of patient age, translates into an approximate 2-fold range in total stimulus charge (210–450 mC), despite the 40-fold range among patients in actual seizure threshold (Sackeim *et al*, 1993; 1994). Both the efficacy and cognitive side effects of ECT are dosage sensitive, and related to the extent to which electrical dosage exceeds threshold (Sackeim *et al*, 1993). In general, age accounts for only about 10% of the variance in threshold, and many older patients will have 'adequate seizures' with a charge of only 24 mC. Following the suggestions of Byrne and colleagues, we would be subjecting the older patients, i.e. those most vulnerable to excessive cognitive side effects, to the greatest excess in electrical dosage. Alternatively, following these recommendations, other patients with high thresholds will have seizures of adequate duration, but fail to respond due to inadequately suprathreshold dosing.

Byrne *et al*'s main concern was to simplify methods of ECT administration by suggesting a fixed set of parameters and allowing dosage manipulation only with respect to the current of pulses. As we pointed out, the principle of dosage titration is independent of the specific parameters used to manipulate stimulus intensity (Sackeim *et al*, 1994). Furthermore, basic research has yet to determine the strength–duration functions necessary to finalise choice of optimal ECT parameters. At present, it is unknown whether manipulation of pulse frequency, train duration, and/or current provides the most efficient form of stimulation. The choice of pulse current made by Byrne and colleagues was without scientific foundation. At the practical level, because of the great variability in seizure threshold, it is unlikely that dosage adjustments offered by an optimal ECT device could ever be restricted to a single electrical parameter. Clearly, very low levels of pulse current would be inefficient in triggering depolarisation, while very high levels may not only be inefficient, but also dangerous.

We disagree with a number of other specific suggestions. We have described how knowledge of the dynamic impedance during the passage of the ECT stimulus can be fundamental in determining whether failure to provoke a seizure is due to an increase in threshold or to poor electrode contact (Sackeim *et al*, 1994). Byrne and colleagues also recommended that, when confronted by seizures of inadequate duration, the practitioner should automatically increase stimulus intensity. This is contradicted by recent studies that demonstrate that high intensity stimulation results in shorter seizure duration compared to lower intensity stimulation. Byrne *et al* also discouraged the incorporation of EEG monitoring facilities in ECT devices. The detection of nonconvulsive prolonged seizures, tardive seizures, and status epilepticus is not a trivial issue. While relatively rare, the documentation of such events in the ECT literature as leading to significant morbidity and, in some cases, death, should prompt more rather than less caution. Further, there is increasing interest in the use of ictal EEG parameters as measures of treatment adequacy, since it is now known that seizures of adequate duration can be reliably produced at every treatment session but fully lack antidepressant effects.

SACKEIM, H. A., PRUDIC, J., DEVANAND, D. P., *et al* (1993) Effects of stimulus intensity and electrode placement on the efficacy and cognitive effects of electroconvulsive therapy. *New England Journal of Medicine*, **328**, 839–846.

—, LONG, J., LUBER, B., *et al* (1994) Physical properties and quantification of the ECT stimulus: I. Basic principles. *Convulsive Therapy*, **10**, 93–123.

HAROLD A. SACKEIM
Chief, Department of Biological Psychiatry, New York State Psychiatric Institute and Professor, Department of Psychiatry, College of Physicians and Surgeons, Columbia University;

KEVIN MALONE
Research Psychiatrist, Department of Neuroscience, New York State Psychiatric Institute and Assistant Professor, Department of Psychiatry, College of Physicians and Surgeons, Columbia University

Sir: We are very pleased to have Professors Sackeim's and Malone's response to our article. We would like to make the following points:

1. The range of currents quoted and the doses these give, were designed to be illustrative rather than optimal. We apologise if we failed to make this sufficiently clear.

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