Physiological characterisation of the 'meditative state' during intuitional practice (the Ananda Marga system of meditation) and its therapeutic value*

Dhanjoo N. Ghista **D. Nandagopal** **B. Ramamurthi** **Arjun Das**
Abhijit Mukherji **T. M. Srinivasan**

Biomedical Engineering Division, Indian Institute of Technology, Madras-6000 36, India

Institute of Neurology, Madras Medical College, Madras-600003, India

Abstract—*Intuitional practice (i.p.), the Ananda Marga system of meditation, is a scientific meditative technique in which the subject concentrates on a particular gland and mentally incantates a 2-syllable 'mantra' synchronous with his breathing, the glandular site of concentration as well as the mantra are specific for a subject. The physiological responses of subjects performing i.p. are characterised in order to qualify the efficacy and benefits of i.p. on 'normal' nonadept individuals. During i.p., the percentage of waves in the alpha and theta bands increases; also the signal amplitude in this band increases markedly. The transformation of the e.e.g. state, resulting in an energy predominance at a lower frequency band, is an index of the therapeutic value of i.p. Further, the blood levels of glucose, lactate and pyruvate are reduced considerably during i.p. from their normal premeditative values; the meditative state during i.p. can thus be characterised as a wakeful hypometabolic physiological state. Long-term follow-ups on some regular practitioners of i.p. indicate that (i) chronic hypertensive subjects have been able to bring down and maintain their blood pressure at a normal value (ii) cigarette and drug addicts voluntarily gave up their addictions.*

Keywords—*Intuitional practice, Meditation, E.E.G. changes, Metabolic rate, Therapy*

1 Introduction

1.1 *Lower-frequency e.e.g. states—symptomatic of relaxation*

STATES of rest, sleep and mental activity have been characterised by COOPER and MUNDY-CASTLE (1960) through the frequency analysis of electroencephalographic (e.e.g.) data. Characterisation of subjective states of feeling, by GREEN *et al.* (1973) and BROWN (1970) indicate that (i) lack of alpha activity is interpreted as indicating states of alertness, attention, orienting and anxiety (ii) the 'beta' state is associated with worry, anger, fear and frustration (iii) the alpha state has been noted to be associated with pleasant feeling, wellbeing, tranquility, relaxation (iv) an abundance of alpha-wave activity is considered to represent a state of rest (not sleep), relaxation and relief from concentration, (v) progressive lower-frequency states (from beta to alpha and more pronounced increased alpha-activity shift to lower-frequency alpha states) are associated with increased relaxation and tranquillity, culminating in a deep 'internalised' state (of warmth, love and contentment) in the theta state (GREEN *et al.*, 1973).

1.2 *The meditative state*

Usually, sleep produces a state of hypometabolism, wherein a slow decrease in metabolic activity is observed over several hours. There is yet another mental state; a dynamic state of rest known as the meditative state, also called 'a wakeful hypometabolic state' by WALLACE *et al.* (1971). In the light of these observations, concerning the beneficial effects of low-e.e.g.-frequency states, we deemed it fit to monitor the physiological responses of normal subjects during their performance of meditation so as to objectively (as opposed to subjectively) and physiologically 'qualify' the 'meditative' state. The meditative methods experimented with are intuitional practice (of the Ananda Marga system) and Pranayama.

In intuitional practice (i.p.), the practitioner concentrates at a particular 'chakra' or gland (such as the pineal, pituitary etc.) and mentally incantates a 2-syllable 'mantra', synchronous with his breathing. Both the chakra and mantra are specific for a subject and correspond to his rhythm and psychic state, which are assessed by the 'teacher' during initiation.† Pranayama is the classical form of breath control affecting various subtle centres of the body.

1.3 *Scope of the paper*

The physiological responses of subjects practising meditation are monitored and analysed, and com-

* *First received 31st January 1974 and in final form 3rd January 1975*

† *It is in this respect, of providing the specific 'chakra' and 'mantra' (i.e. the methodology of meditation) for a subject (as opposed to a prescription of the same chakra and mantra for everybody), that the Ananda Marga system is different from all other meditation systems (ANANDAMURTI, 1967)*

pared with those of nonpractitioners. The subjects are monitored prior to, during and after their meditation or concentration (for nonmeditators) periods, as the case may be. In this paper, for discussion purposes, we have selected four meditators and one nonmeditator, who acts as a control to help qualify 'meditation' as opposed to 'concentration'. The subjects whose responses are discussed here are listed in Table 1.

Table 1. List of subjects whose records are discussed in this paper

	Name	Process	Remarks
Subject 1	D.N	I.P	regular practitioner
Subject 2	A.C	I.P	regular practitioner
Subject 3	L.H	I.P	beginner
Subject 4	A.M	Pranayama	regular practitioner
Subject 5	B.N	concentration	

asked to 'meditate' or 'concentrate' (as the case may be) and his e.e.g. was recorded during this period, which normally lasted for 30 min. A recording of the postmeditative or postconcentration period was also taken for 15 min. These e.e.g. patterns were recorded on paper as well as on magnetic tape (on an HP type 3960 A tape recorder). The taped patterns were frequency-analysed as described below.

Fig. 1 shows the schematic for the analysis of taped e.e.g. data. The e.e.g. data were initially recorded on the tape at 15/16 in/s. During analysis, the tape was run at 16 times the recording speed, thus achieving a frequency multiplication of the recorded signals. The signals were passed through discrete, high-Q factor, active filters covering the frequency range of alpha waves (8×16 to 14×16 Hz). The number of waves passing through each filter was counted by means of an event counter. The percentages of waves corresponding to each frequency band were then presented as histograms.

For subject 1, a 15 ml sample of venous blood was taken just prior to and after meditation. Blood analysis was carried out, for these blood samples, to determine the levels of pyruvate, lactate, citrate and glucose.

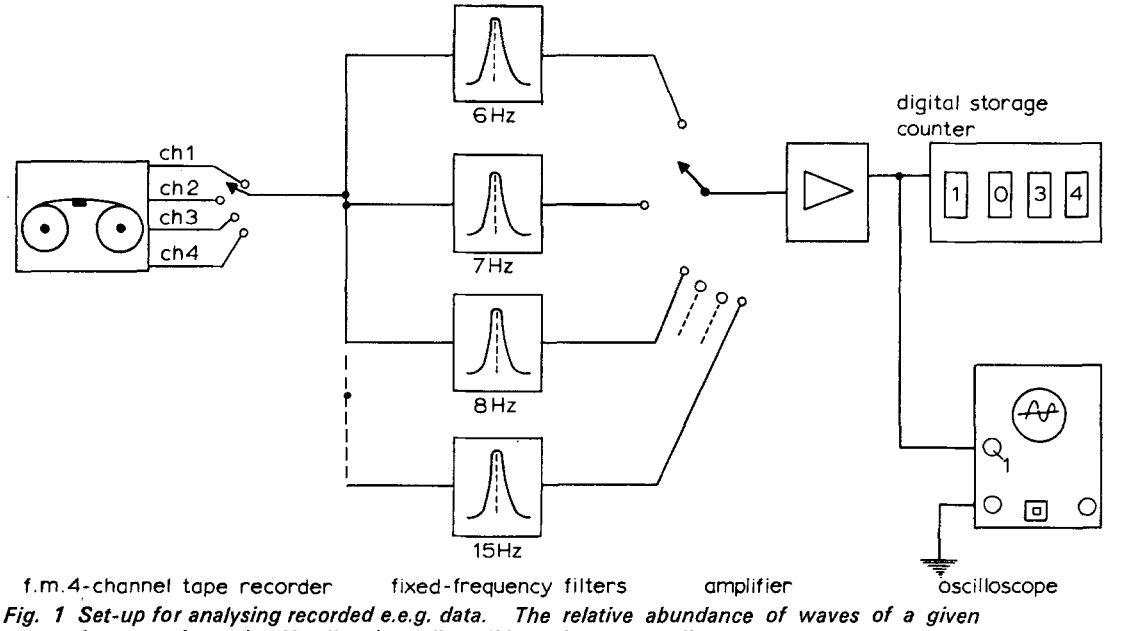

Fig. 1 Set-up for analysing recorded e.e.g. data. The relative abundance of waves of a given frequency is obtained by directly reading off from the counter display

2 Materials and method

During the experiments, the subjects sat quietly in an electrically shielded room. An 8-channel Grass e.e.g. machine was used for recording outputs from the scalp electrodes. The first six channels were used for recording bipolar signals in the order FP_2–C_4, C_4–O_2, T_4–O_2, F_1–C_3, C_3–O_1 and T_3–O_1. The seventh channel was used for recording the e.c.g. and the eighth for the oculogram.

For each subject, the e.e.g. was recorded for 15 min. with the subject in a relaxed but mentally active state, with the eyes closed. Then, the subject was

3 Results

The general pattern of the e.e.g. of the monitored subjects (Table 1) immediately indicates that the subject has not gone into drowsiness or sleep but is actually meditating. The sleep spindles characteristic of drowsiness are absent from the e.e.g. recordings, and the isoelectric oculogram recordings indicate no r.e.m. sleep. It was noted that the oculogram reaches

an isoelectric state during meditation; the non-meditators were not able to achieve this isoelectric electro-oculogram.

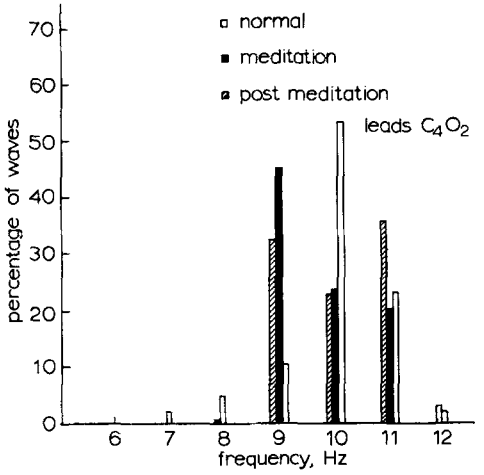

Fig. 2 The relative abundance of waves at various frequency bands of subject 1 (D.N.), who is a regular practitioner of i.p., before, during and after meditation
Note the shift in the frequency distribution to a low-frequency state during the post meditation

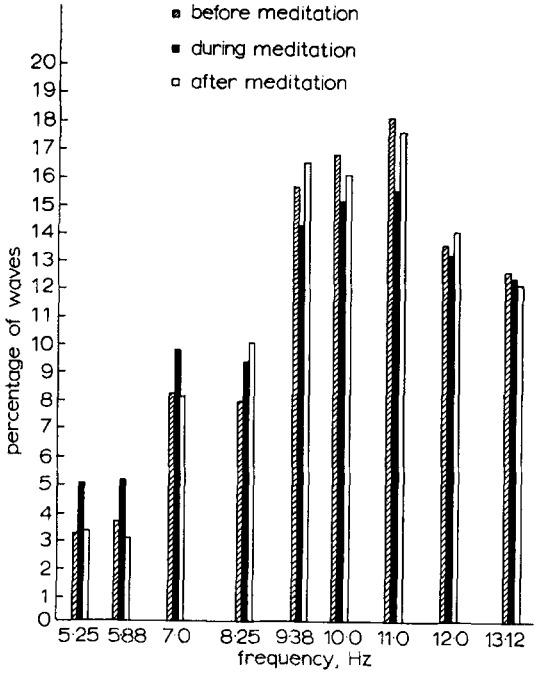

Fig. 3 The relative abundance of waves at the various bands for subject 2 (A.C.) before, during and after a session of i.p.
The subject is an adept and an instructor of i.p.
Note the abundance of waves in the theta band

The e.e.g. histograms are presented in Figs. 2–5 for the monitored subjects. Since, in general, the occipetal leads show the variations in alpha activity prominently, the frequency analysis was carried out for the C_4–O_2 leads only.

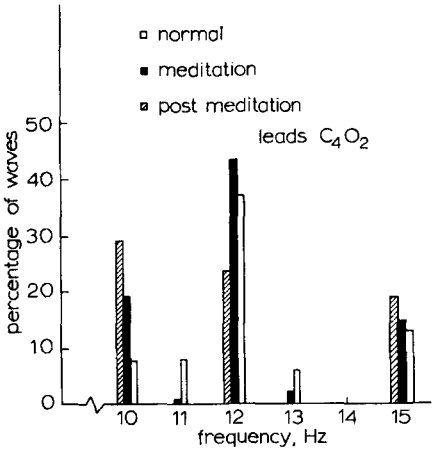

Fig. 4 The relative abundance of waves at various frequency bands for subject (A.M.), who is a regular practitioner of classical Yoga (Hatha Yoga) and Pranayama
Note the shift in the distribution to a low-frequency state during and after meditation

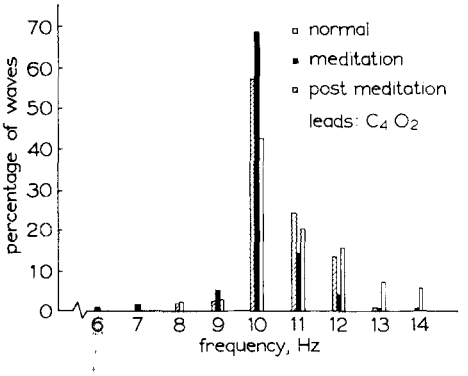

Fig. 5 The relative abundance of waves before, during and after meditation for subject 5 (B.N.)
Note that when this subject (a nonmeditator) concentrates there is no shift in the e.e.g. frequency distribution but a mere narrowing of the band about his intrinsic 10-cycle frequency

For the first four meditators (subjects 1–4), it was noted that a large percentage of the waves had shifted towards the lower frequencies during meditation. However, for the fifth subject, this shift was not observed; instead the distribution is seen to become clustered around the intrinsic frequency of 10 Hz.

We wish to make a particular case for the efficacy of i.p. by studying the records of subject 3. Prior to his learning i.p., his records showed a very small amplitude of alpha rhythm (see Fig. 6). Yet one week after he had been practising i.p. the amplitude of the alpha band had increased considerably, as seen in Fig. 6.

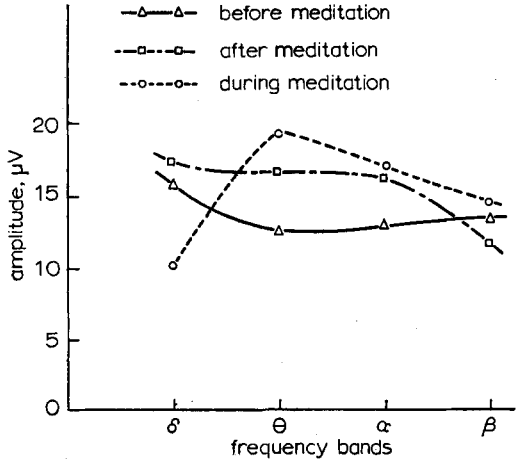

Fig. 6 The relative amplitude of waves over principal frequency bands for subject 3 (L.H.), before, during and after i.p.

For subject 1, the shift in alpha-wave activity towards the lower frequencies is more dramatically illustrated by the cumulative frequency plot shown in Fig. 7. This shift in frequency of alpha-wave activity is an indication of mental calmness and decreased metabolic activity termed 'dynamic rest'. The associated feeling described earlier, observed by other workers (WALLACE *et al.*, 1971; GREEN *et al.*, 1973), was felt subjectively by our meditating subjects.

Table 2 gives the results of a chi-squared analysis to obtain the confidence levels of the above frequency changes for correlating the different physiological states: a high level (99·9%) of confidence indicates that the changes in the frequency of the e.e.g. signals are highly significant.

Table 2. Statistical analysis to establish the confidence levels of e.e.g. frequency changes during meditation

Subject	χ^2 observed	χ^2 Table	Degrees of freedom	Level of significance
				%
D.N	49·91	29·58	10	99·99
A.M	47·59	45·56	24	99·95
B.N	45·0	42·31	18	99·99

* The changes observed in the frequencies are significant if the observed χ^2 is greater than the χ^2 given in the table

3.1 *Metabolic rate*

The levels of pyruvate, citrate, lactate and glucose in venous blood before and just after meditation were determined by routine chemical methods for subject 1, in three different experiments. The changes in these levels due to meditation are shown in Fig. 8. It is seen that the glucose, lactate and pyruvate levels are reduced considerably (up to 25%) during meditation from their normal, premeditative values. While glucose is an energy source in the blood, lactate is the metabolic end product of sugar used by the muscles. A decreased lactate level implies a reduced metabolic activity during meditation.

4 Discussion

4.1 *Concentration versus meditation*

The analyses enabled us to distinguish between 'concentration' and 'meditation'. In the former, neither the alpha-wave activity nor the metabolic activity of the subject undergoes any change; in the latter, these changes are quite marked.

4.2 *The meditative state: dynamic state of rest and, hence, of therapy*

Qualifying the e.e.g. response due to i.p., we find an increased percentage of waves in the lower-frequency (alpha) bands during this meditation process. Similar observations have been made by KASAMATSU and HIRARI (1963) in their investigations of 'adepts'. Our investigations were not aimed at qualifying the abilities of Yogis but rather to qualify the efficacy of 'meditation'—the i.p.—on a 'normal' (nonadept) individual.

We have also noted that the amplitude/frequency distribution peaks at a lower frequency band during an i.p. session compared with the distribution before the i.p. session. Now a shift of the e.e.g. energy state to a lower frequency band is, based on the investigations of GREEN *et al.* (1973) and BROWN (1970), associated with a decreased mental tension, increased tranquillity and increased restfulness. Further, the

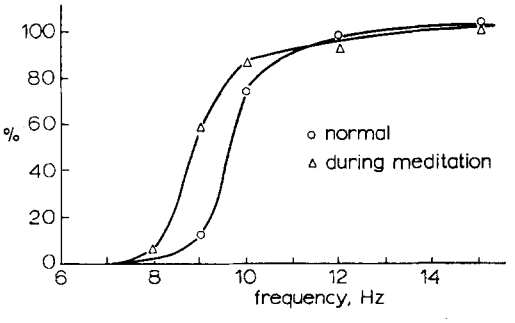

Fig. 7 The cumulative frequency plot, corresponding to Fig. 2, for subject 1, showing the overall shift towards the low frequency region during meditation

metabolic rate also decreases according to our data. We thus characterise i.p. as an effective therapeutic procedure. This is further validated by our long-term observations that chronic-hypertensive regular practitioners of i.p. are able to bring their blood pressure down.

I.P. has been found to influence both the physiological state (in reducing blood pressure) and the mental state in providing tranquillity; it can, hence, be characterised as a physico-cum-psycho-therapy. We have also observed that subjects, after being initiated into this type of meditation, have voluntarily discontinued their use of cigarettes and drugs.

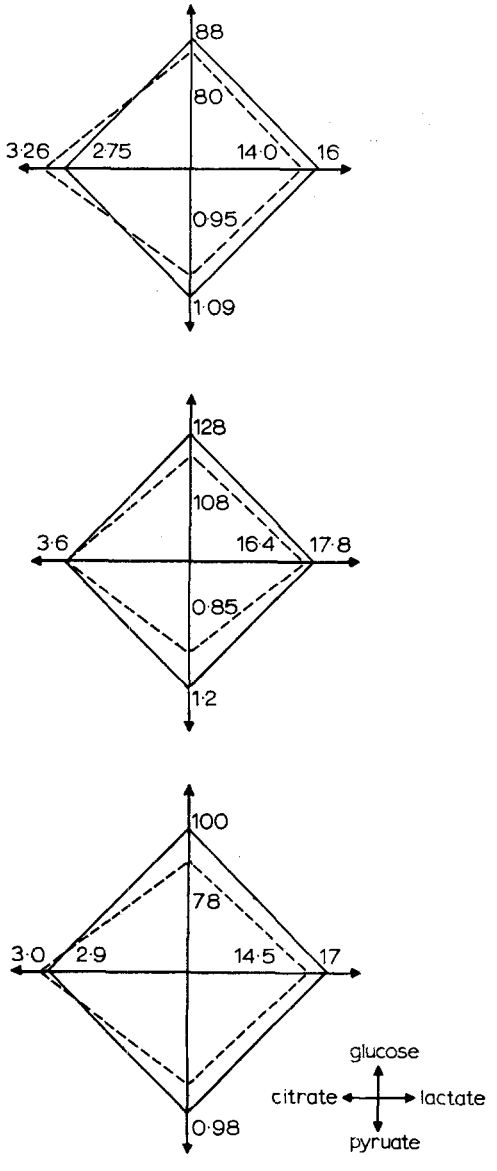

Fig. 8 The changes in blood chemistry for subject 1 before and during intuitional practice, indicating lowered metabolic activity
——— normal
– – – – meditation

4.3 *Intuitional practice versus transcendental meditation*

In a meditative technique called transcendental meditation (t.m.), studied by WALLACE and BENSON (1972) and BANQUET (1972), it has been observed that the e.e.g.-signal amplitudes are enhanced in a particular frequency band, intrinsic for a particular subject. In addition to an enhancement of the e.e.g.-signal amplitude at the intrinsic frequency, we have observed a shift and a predominance of the e.e.g. signal's energy distribution to a lower-frequency state during i.p. During t.m., the enhancement of the e.e.g. distribution at the intrinsic frequency may be taken as an indication of 'increased orderliness in the thinking process' (BANQUET, 1972); *on the other hand*, the transformation of the e.e.g. state resulting in an energy predominance at a lower frequency band is an index of *the therapeutic value of intuitional practice.*

References

ANANDAMURTI (1967), *Ananda Marga*, Ananda Marga Pracaraka Samgha, Anandanagar, Purulia, India, pp. 166–194.

BANQUET, J. P. (1972) 'E.E.G. and meditation', *Electroencephal. & Clin. Neurophysiol.* **33**, 449–458.

BROWN, B. B. (1970) 'Recognition of aspects of consciousness through association with e.e.g. alpha activity represented by a light signal', *J. Psychophysiol.* **6**

COOPER, R. and MUNDY-CASTLE, A. C. (1960) *Electroencephal. & Clin. Neurophysiol.*, **12**, 153.

GREEN, B. E., GREEN, A. M., WALTERS, E. D., SARGENT, J. D. and MEYER, R. (1973) 'Autogenic feedback training', 9th International Congress of Psychotherapy, Oslo, Norway.

KASAMATSU, A. and HIRAI, T. (1963) 'Science of Zazen'. *Psychologia* **6**, 86–91.

WALLACE, R. K. (1971) 'A wakeful hypometabolic physiological state', *Am. J. Physiol.* **221**, 795.

WALLACE, R. K. and BENSON, H. (1972) 'The physiology of meditation', *Scientific American* **226**, 84–90.

Caractérisation physiologique de 'l'état de méditation' au cours de la pratique intuitionnelle (le système de méditation Ananda Marga) et sa valeur thérapeutique

Sommaire—La pratique intuitionnelle (p.i.) du système Ananda Marga de méditation est une technique scientifique de méditation dans laquelle le sujet concentre son attention sur une glande déterminée et récite mentalement un 'mantra' de deux syllables, synchroniquement avec sa respiration, l'emplacement de concentration glandulaire ainsi que le mantra sont spécifiques à un sujet. Les résponses physiologiques des sujets pratiquant la p.i. sont caractérisées afin de qualifier son efficacité et ses bénéfices pour des individus 'normaux' non initiés. Au cours de la p.i. le pourcentage des ondes dans les bandes alpha et thêta augmente; l'amplitude du signal dans cette bande augmente aussi de façon nette. La transformation de l'état de l'e.e.g. ayant pour résultat une prédominance d'énergie dans la bande de basse fréquence, représente un indice de la valeur thérapeutique de la p.i.

Physiologische Beschreibung des 'meditativen Zustandes' während der intuitionellen Ausübung (das Meditationssystem nach Ananda Marga) und sein therapeutischer Wert

Zusammenfassung—Die intuitionelle Ausübung (i.p.) des Meditationssystems nach Ananda Marga ist eine wissenschaftliche meditative Technik, bei der sich die Versuchsperson auf eine bestimmte Drüse konzentriert und synchron mit der Atmung im Geiste das zweisilbige Wort 'Mantra' spricht. Die Drüse, auf die sich eine Person konzentriert und das 'Mantra' sind für jede Versuchsperson verschieden. Es werden die physiologischen Reaktionen der i.p. anwendenden Personen beschrieben, um die Wirksamkeit und Vorteile der i.p. auf 'normale' Nichteingeweihte zu veranschaulichen. Während der i.p. vermehren sich die Wellen der Alpha- und Thetabänder prozentual, ferner erhöht sich die Amplitude des Signals auf diesem Band auf bemerkenswerte Weise. Die Wandlung des e.e.g.-Zustandes, die sich aus einem Vorherrschen von Energie auf einem niedrigeren Frequenzband ergibt ist ein Anhaltspunkt für den therapeutischen Wert der i.p.